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Sonja Smiljić †

The impact of smoking on clinical characteristics and treatment outcome of patients with pulmonary tuberculosis

Утицај пушења на клиничке карактеристике, радиолошке промене и исход лечења оболелих од туберкулозе плућа

Department of physiology, Faculty of Medicine, University of Priština, Kosovska Mitrovica, Serbia

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† **Correspondence to:**
Sonja SMILJIĆ
Medical Faculty, Anri Dinana bb Street, Kosovska Mitrovica, Serbia
E-mail: **sonja.smiljic@med.pr.ac.rs**

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Утицај пушења на клиничке карактеристике, радиолошке промене и исход лечења оболелих од туберкулозе плућа

SUMMARY

Introduction/Objective The objectives of our study was to determine the impact of smoking on clinical characteristics, the scope of radiological severity and treatment outcome of patients with pulmonary tuberculosis.

Method This prospective study included patients suffering from pulmonary tuberculosis (PTB) treated at the Pulmonology Department of the Clinical Hospital Center in Kosovska Mitrovica in the period between 2010-2016.

Results Among the smokers suffering from PTB there were significantly more males (p =0.05) between 30 and 49 years of age (p<0.001). There was significantly more alcohol consumption present in smokers (p<0.001) whose social factor for developing PTB (p=0.002) was more expressed. A more severe form of PTB with cavitation was more common in smokers (38.8%) while a milder, parenchymatous, unilateral pulmonary tuberculosis was present in non-smokers (31.8%). Extensive X-ray changes were more common in smokers (p=0.002). Relapse of the disease was more prevalent in smokers (p = 0.05). In multivariate logistic regression, the risks of being a smoker included years of age: 30-39 (OR = 18.11), 40-49 (OR = 19.66) and 50-59 (OR = 9:06) and alcohol consumption habits (OR = 9:32).

Conclusion Smokers were more often afflicted with sputum positive pulmonary tuberculosis, had extensive radiological changes and the relapse of the disease was more common. Smokers were mostly middle-aged with alcohol consumption habits and constructed a group of patients whose habits were a critical factor for the eradication of tuberculosis.

Keywords: pulmonary tuberculosis; smoking; alcohol; X ray abnormality

САЖЕТАК

Увод/Циљ Циљ нашег истраживања био је да утврдимо утицај пушења на клиничке карактеристике, обим радиолошких промене и исход лечења оболелих од туберкулозе плућа.

Метод Проспективном студијом обухватили смо све оболеле од туберкулозе плућа (ПТБ) лечене на одељењу Пулмологије Клиничко болничког центра у Косовској Митровици у периоду од 2010–2016. године.

Резултати Међу пушачима оболелим од ПТБ значајно више било је особа мушког пола (п=0.05), старости између 30 и 49 година (п<0.001). Пушачи су значајно више конзумирали алкохол (п<0.001) и имали су изражен социјални фактор за обољевање од ПТБ (п=0.002). Тежа клиничка форма ПТБ са кавернама била је чешћа код пушача (38.8%) а код непушача лакша, паренхиматозна, једностарана плућна туберкулоза (31.8%). Обимне радиолошке промене су биле израженије код пушача (п=0.002). Рецидив болести се чешће јављао код пушача (п=0.05). У мултиваријантној логистичкој регресији ризик да неко буде пушач јесу године живота 30-39 (ОР=11.18), 40-49 (ОР=19.66) и 50-59 (ОР=9.06) и навика конзумације алкохола (ОР=9.32).

Закључак Пушачи су чешће боловали од спутум позитивне туберкулозе плућа, имали су обимније радилошке промене и рецидив болести је био чешћи. Пушачи су у највећем броју били средњих година живота са навиком конзумирања алкохола и чинили су групу оболелих чије навике представљају критичан разлог за искорењивање туберкулозе .

Кључне речи: туберкулоза плућа; пушење; алкохол; РТГ абнормалности

INTRODUCTION

Smoking and tuberculosis are the two biggest public health problems in the world. Smoking is one of the leading causes of premature death, causing 6 million deaths annually. Today, about 33% of the world's population smokes, mainly in countries with a high prevalence of tuberculosis. In 2015, pulmonary tuberculosis affected 10.4 million people and one-fifth of tuberculosis cases can be blamed on tobacco smoking [1]. The 2014 U.S. Surgeon General's Report implicates smoking as a cause of TB disease among those latently infected with Mycobacterium tuberculosis (MT) [2].

While the link between smoking and PTB was recognized almost a century ago, the impact of smoking on the development of tuberculosis has mostly been explained in the last few decades [3]. Active and passive exposure to tobacco smoke are independent risk factors for TB infection, the progression of TB infection to an active disease, severe clinical profile and an increased risk of relapse and mortality. Thus, smokers are at a higher risk of developing tuberculosis than non-smokers. In smokers, the latent form of tuberculosis often turns into an active one, and the determining factor in this is their general health status. Smoking affects the health and modifies the immune response, which favors the development of tuberculosis [4-6].

A recent study based on mathematical modeling estimated that, between 2010 and 2050, smoking can increase the number of TB patients in the world by 18 million, and cause a significant increase in mortality if the current trend in tobacco consumption continues unchecked [7]. Smoking prevalence among TB patients is higher than among the general population in many countries. However, the data are different, from 48% in Catalonia [8], 54.6% in China [9] to 81.5% in rural India [10]. Patients who are smokers often spread the disease to other family members [11]. World Health Organisation (WHO) estimates that about one-third of people in the world is infected with Mycobacterium tuberculosis and that 90% exhibit no symptoms, making it a latent TB infection [1]. Smoking, alcohol consumption and malnutrition can influence the transition from the latent to the active form of tuberculosis.

Possible mechanisms of the impact of smoking include reduced clearance of secretions on tracheobronchial mucosal surface, reduced phagocytic function of alveolar macrophages, reduced alveolar macrophage production of tumor necrosis factor and increased macrophage hemochromatosis [3,12]. Smoking reduces the effectiveness of the alveolar macrophages in developing effective immune response by altering the expression of cell proinflammatory cytokines [13]. In addition to nicotine, which modulates the activity of macrophages, about 5000 more substances present in tobacco smoke modulate the activity of inflammatory cells. The correlation of TB and smoking can be a result of the inhibitory effect of nicotine in the production of TNF-alpha and anti inflammatory cytokines CKSCL8 that make patients susceptible to the progression of the latent form of the infection into the active one. Smoking disrupts the phagocytic function of alveolar macrophages and induces apoptosis in macrophages. Chronic exposure to cigarette smoke reduces the expression of surface proteins related to antigen presentation by macrophages. Monocyte macrophage system in TB patients has a reduced phagocytic capacity which is further reduced in patients with TB who smoke [3,14).

Chronic alcohol use can reduce the response of macrophages and the immune system [15]. BMI value under 18.5 kg/m^2 is seen as a marker for malnutrition, and malnutrition can reduce immune response either through the interaction of monocyte-macrophages and T-lymphocytes and their cytokines or the secondary immune deficiency that increases the susceptibility of the host to infection [16]. Alcohol consumption significantly worsens the clinical manifestation of the disease and the outcome of the treatment, which may be the result of the adverse reactions to medication used in the

treatment of PTB. People that abuse alcohol are 1.32 times more likely to exhibit an adverse reaction to tuberculostatics [10,17]. The relation between the manifestation of adverse drug effects during treatment and unsuccessful treatment plays an important role in controlling the spread of tuberculosis (TB).

The social and clinical reasons for the failure of antituberculosis therapy can be seen as a result of smoking and alcoholism. Smoking and alcohol are related to other pathological conditions which can be one of the causes of treatment failure, and often of the premature discontinuation of therapy. This failure of treatment impacts the patients themselves but also the public health. Therefore, special attention should be paid to risk groups responsible for the spread of tuberculosis infection.

Unsuccessful treatment outcome is an adverse health condition both for the patients themselves and also for public health, because it increases the duration of infectiousness; thus individual and public health concerns should be considered together in planning effective control strategies. A large proportion of cases in which treatment will be unsuccessful could be predicted at entry through screening for age group, smoking and alcoholism, and specially targeted measures could be taken in such cases.

The aim of our study was to determine the impact of smoking on clinical characteristics, the scope of radiological severity and the treatment outcome of patients with pulmonary tuberculosis.

METHODS

The survey was conducted in accordance with the ethical principles and was approved by the Ethics Committee of the Medical Faculty in Pristina, with a temporary seat in Kosovska Mitrovica.

This prospective study was conducted at the Department of Pulmonology of the Clinical-health Center in Kosovska Mitrovica, the reference hospital for tuberculosis treatment. The study included patients suffering from tuberculosis, a total of 104 subjects treated during the period between 2010 and 1016.

The inclusion criteria for the selection of patients in this study were as follows: 1) older than 20 years of age; 2) typical symptoms of PTB (cough, sputum production, fever, night sweats and weight loss); 3) typical fibrocavitary pulmonary infiltrates on chest radiographs standard; 4) at least one smear positive sputum, with the subsequent positive culture of Mycobacterium tuberculosis and 5) all study patients could already have been on the antituberculosis treatment (processed with all necessary radiological, microbiological, and laboratory and spirometric examinations, before starting the antituberculosis treatment).

On admission, the patients' data regarding demographics, age, gender, residence, marital status, education, occupation and possible contact with people suffering from tuberculosis were gathered. Special attention was paid to risk factors for developing pulmonary tuberculosis: smoking, alcohol consumption, drug use and social status. In regards to comorbidities, we processed instances of dibetes mellitus.

All patients were divided into 2 groups, smokers and non-smokers. The subjects were considered smokers if they reported that they smoked ≥1 cigarettes a day, continuously during the year preceding the diagnosis of TB, or non-smokers if they consumed less than 100 cigarettes in their life [8,18]. Alcohol consumption was considered significant if the male subjects consumed more than 280g of alcohol per week, and female subjects over 168g per week. None of our subjects used drugs (intravenous heroin and / or cocaine, or other).

We processed the initial symptoms and signs in our patients: cough, sputum production, hemoptysis, chest pain, fever, night sweats, fatigue and weight loss. In regards to the laboratory parameters, we processed the parameters for anemia (hemoglobin, hematocrit, haematological indices) and the sedimentation rate. Sputum samples were taken from all the patients for a direct microscopy of the preparations stained according to Ziehl - Neelsen method. Also, a cultivation of bacillus on Lowenstein-Jansen medium was performed for all samples. Sputum was collected in the morning, before eating, after a spontaneous expectoration. Each sputum positive for direct microscopy was verified by the culture on Lowenstein-Jansen medium. Pulmonary tuberculosis was bacteriologically confirmed if the two sputum findings confirmed bacillus and/or in the case of positive sputum cultivation.

The chest X-ray results were categorized according to the scale of changes, their localization and their morphological structure. The interpretation of chest X-ray abnormalities was performed by a radiologist. Chest X-rays were focused on pulmonary parenchyma and caverns. The interpretation of abnormalities in the pulmonary parenchyma included unilateral or bilateral changes, the location of changes (in the lower, medium and upper fields) and the scale of changes (minimum/moderate and extensive).The final diagnosis of pulmonary tuberculosis was made based on the positive ARB in sputum and/or chest X-rays.

Statistical analysis

The data were analyzed by descriptive statistical methods and presented as frequencies andrelative numbers. For the analysis of frequency differences between the groups chi-square test was used. Binary logistic regression was the technique used to analyze the dependencies between activities. The multiple logistic regression model included all the predictors that had statistical significance at 0.05 in the single logistic regression model. The criterion for statistical significance was $p<0.05$.

For statistical data analysis we used a SPSS Statistics 22 software program SPSS Statistics 22. Inc., Chicago, IL, USA).

RESULTS

The study involved patients with pulmonary tuberculosis treated at the Department of Pulmonology in the period between 2010 and 2016. During these 6 years, we treated 104 patients with

tuberculosis, who were predominantly male (67%). Out of the total number of patients with pulmonary tuberculosis 60 were smokers (57.7%) and 44 non-smokers (42.3%). Among smokers suffering from tuberculosis there were significantly more males (p = 0.05), between 30 and 49 years of age (p<0.001). The majority of non-smokers who became ill (19) with tuberculosis are among women of the age between 20 and 29.

There was no significant difference in relation to the place of residence, family status and education level between smokers and non-smokers. However, smokers suffering from tuberculosis were more likely to be toilers (40%). Smokers consumed alcohol significantly more often than non-smokers (p = 0.001). The social determinant was significant in smokers with PTB (p = 0.002). A possible contact with the PTB affected people and diabetes mellitus were equally present in smokers and non-smokers (Table 1).

Table 1. Sociodemographic characteristics and risk factors for pulmonary tuberculosis in smokers and non-smokers (n= 104).

	Populatio examined		*p*
	Smoker n (%)	Non-smoker n (%)	
Baseline patient characteristics	60 (57.7)	44 (42.3)	
Age, years			
20-29	3 (5,0)	17 (38.6)	
30-39	11 (18.3)	3 (6.8)	
40-49	13 (21.7)	2 (4,5)	
50-59	21 (35,0)	10 (22.7)	
> 60	12 (20,0)	12 (27,3)	<0.001
Sex			
Male	45 (75)	25 (56.8)	0.050
Female	15 (25)	19 (43.2)	
Residence			
Rural	45 (75,0)	32 (72.7)	0.794
Urban	15 (25.0)	12 (27.3)	
Marital status			
Single	25 (41.7)	25 (56.8)	0.127
Married	35 (58.3)	19 (43.2)	
Education			
Primary	36 (60.0)	23 (52.3)	0.432
Secondary	22 (36.7)	21 (47.7)	
High	2 (3.3)	0 (0.0)	
Employment status			
Unemployed	13 (21.7)	11 (25.0)	
Toiler	24 (40.0)	9 (20.5)	
Office worker	9 (15.0)	8 (18.2)	
Pensioner	14 (23.3)	16 (36.4)	0.185
Alcohol use			
Yes	19 (31.7)	1 (2.3)	
No	41 (68.3)	43 (97.7)	<0.001
Social determinants			
Yes	30 (50.0)	9 (20.5)	
No	30 (50.0)	35 (79.5)	0.002
TB contact			
Yes	6 (10.0)	4 (9.1)	
No	54 (90.0)	40 (90.9)	0.877
Tb history			
Yes	9 (15.0)	7 (16.3)	
No	51 (85.0)	37 (83.7)	0.860
Diabetes mellitus			
Yes	9 (15.0)	5 (11.4)	
No	51 (85.0)	39 (88.6)	0.591

Respiratory symptoms were typical for both groups of patients, and did not differ significantly. Laboratory parameters for anemia and erythrocyte sedimentation rate did not differ significantly in smokers and non-smokers. A direct sputum bacilloscopy was more frequently positive in smokers than in non-smokers (Table 2).

There were some significant differences in radiographic severity. Smokers were often diagnosed with the tuberculosis with cavitation while in non-smokers the more common form was a unilateral parenchymal pulmonary tuberculosis. Upper lung fields were significantly more affected by the changes in smokers (68.3%). The extent of radiological changes was significantly higher in smokers (P = 0.002). The incidence of relapse in smokers was 23.3% and 9.1% in non-smokers. The relapse of the

Table 2. Symptoms and clinical signs between smokers and non-smokers with pulmonary tuberculosis (n=104).

	Populatio examined		*p*
	Smokers n (%)	Non-smokers n (%)	
Symptom	60 (57.7)	44 (42.3)	
Cough			
Yes	53 (88.3)	34 (77.3)	
No	13 (11.7)	11 (22.7)	0.132
Productive cough			
Yes	36 (60.0)	21 (47.7)	
No	24 (40)	23 (52.3)	0.214
Hemoptysis			
Yes	5 (8.3)	7 (15.9)	
No	55 (91.7)	37 (84.1)	0.232
Fever			
Yes	41 (68.3)	24 (54.5)	
No	19 (31.7)	20 (45.5)	0.151
Night sweats			
Yes	34 (58.6)	25 (56.8)	
No	26 (41.4)	19 (43.2)	0.935
Asthenia			
Yes	37 (61.7)	30 (68.2)	
No	23 (38.3)	14 (31.8)	0.493
Wight loss			
Yes	27 (45.0)	25 (56.8)	
No	33 (55.0)	19 (43.2)	0.234
Anemia			
Yes	19 (31.7)	11 (25.0)	
No	41 (68.3)	33 (75.0)	0.458
Sedimentation rate			
Yes	42 (70.0)	29 (65.9)	
No	18 (30.0)	15 (34.1)	0.658
Sputum			
Negative	17 (28.3)	20 (45.5)	
Positive	43 (71.7)	24 (54.5)	0.072

Table 3. Comparison of severity of pulmonary tuberculosis (PTB) and treatment outcome between smokers and non-smokers.

	Populatio examined		*p*
	Smokers n (%)	Non-smokers n (%)	
Clinical charactrstics	60 (57.7)	44 (42.3)	
Case type			
New	46 (76.7)	40 (90.0)	
Retreatment	14 (23.3)	4 (10.0)	0.050
Diagnosis			
PTB unilateral	14 (23.3)	14 (31.8)	
PTB bilateral	18 (30.0)	17 (38.6)	
PTB with multiple cavities	23 (38.3)	9 (20.5)	
Pleural effusion	5 (8.3)	4 (9.1)	0.273
Location CXR abnormality			
Upper field	41(68.3)	27 (61.4)	
Medium filed	11 (18.3)	7 (15.9)	
Lower filed	8 (13.4)	10 (22.7)	0.390
Radiological severity			
Initial	21 (48.1)	29 (65.9)	0.002
Advanced TB	39 (51.9)	15 (34.1)	
Outcomes			
Cure	46 (44.2)	39 (97.5)	
Relapse	11(10.6)	4(3.8)	0.475
Died	3(2.9)	1(1.0)	
Intra hospital therapy (days)			
< 30	11 (18.0)	9 (20.5)	0.786
> 30	49 (81.7)	35 (79.5)	

disease was significantly more common in smokers (p = 0.05) (Table 3). The multiple logistic regression of the variables related to socio-demographic characteristics and risk factors associated with smoking included age: 30-39 (OR = 11.18), 40-49 (OR = 19.66) and 50-59 (OR = 9.06) and the habit of alcohol consumption (OR = 9:32) (Table 4).

DISCUSSION

World Health Organisation estimates that, during 2015, 9.4 million people were affected by TB with a fatal outcome in 1.4 million of the treated patients. The main reasons for maintaining this high number of patients in the past two decades are the large number of HIV infected patients and multidrug-resistant tuberculosis [19]. Another very important risk factor whose effects on morbidity related to tuberculosis has been explained in the past few years is smoking [21]. In European countries 16% of fatalities among adults older than 30 years of age were caused by tobacco consumption [21]. Other risk factors for developing tuberculosis include alcohol, drugs and associated diseases, especially diabetes, a contact with the

Table 4. Multivariate logistic analysis of the association of demographic characteristics and risk factor with smoking.

Factors	OR (CI 95%)	*p*
Age, years		
20-29 Reference	-	-
30-39	11.18 (1.75-71.52)	0.011
40-49	19.66 (2.67-144.94)	0.003
50-59	9.06 (2.10-39.01)	0.003
> 60	5.29 (1.21-23.04)	0.027
Sex	0.80 (0.28-2.25)	0.615
Alcohol use	9.32 (1.12-77.67)	0.039
Social determinants	2.01 (0.72-5.66)	0.172

affected person, as well as poor living conditions such as overcrowding and poor ventilation. There are no detailed data on the global prevalence of risk factors, so it is assumed that the prevalence of risk factors is the same in all segments of the adult population.

Smokers suffering from tuberculosis had a more severe clinical and radiological presentation of the disease, a more common sputum positive tuberculosis in the beginning but also 2 months after the treatment, a lower therapy success rate and a higher risk of relapse [13]. Patients treated for tuberculosis who were included in our study were mostly smokers (57.7%). Compared with other studies, this is a higher percentage of smokers than in studies conducted in different parts of the world, including high PTB prevalence countries [9,10,15]. A similar number of smokers suffering from tuberculosis was recorded in Russia (49%) and Spain (48%). Also, the number of smokers among our patients suffering from PTB was higher than in the general population where it amounted to 41.2% in people between the ages of 18 and 64 [8,22].

Socio-demographic characteristics of smokers and non-smokers suffering from PTB included in our study did not notably differ. A significant difference was detected in relation to gender. Smokers suffering from tuberculosis were mostly middle aged men, between 30 and 49 years of age, who were toilers [23]. Among the non-smokers, ill with tuberculosis were mainly females between 20 and 29 years of age, from the rural environment . The traditional way of behavior among unemployed women from the countryside continues to be present in this region so that women are less likely smokers . Place of residence, family status and education level did not differ significantly, which is in contrast with the data from other regions where there were more affected smokers in the rural areas [24]. The results of the 2013 Health Survey in Serbia show that the percentage of smokers in the cities is statistically significantly higher compared to inhabitants of rural areas, as well as the fact that among smokers, there are less female smokers.

Risk factors considered important in the occurrence of PTB were a possible contact with the affected and a positive family history but they were equally present in non-smokers and smokers. We got the same results in regards to comorbidities. Our study was not able to confirm the existing evidence that the association of smoking and diabetes increases the risk of developing TB [23, 25], probably because among our patients, smokers suffering from TB were mostly middle-aged people who did not suffer from DM. Older patients suffering from TB who were treated for DM were rarely smokers.

The risk factors are more common in men than in women, which was concluded in the study that covered 14 countries with the highest rate of TB incidence. In addition to cigarette smoking, as

the most important predictors for developing PTB among our subjects were alcohol consumption and the social determinant. Men who drank alcohol and smoke cigarettes were more susceptible to TB. Among the general population 4.7% were daily alcohol consumers while among our patients with tuberculosis the percentage was several times higher (31.7%). There was a significant number of smokers who were also alcohol consumers [18]. Among the affected women there were less smokers and they rarely drank alcohol [19]. A lower number of smokers and alcohol consumers among our female patients treated for PTB can be explained by the fact that these habits are not socially acceptable in their social settings where men drink 6 times more than women.

Important symptoms in the diagnosis of TB are: a cough that is present for at least 2 weeks, sputum, fever, night sweats, weight loss, asthenia, and hemoptysis [18]. There could be only one symptom present or a combination of several TB sensitive symptoms. In patients involved in our study, the symptoms of the disease occurred earlier in smokers than in non-smokers but there was not a significant difference present in the manifestation of symptoms of the disease, which was not in line with other studies. We confirmed that the sputum positive pulmonary tuberculosis was more common in smokers. Smokers who suffer from TB are likely to have a greater ability to spread germs and a greater risk to infect their family members. It is possible to protect the family by changing their habits and quitting smoking. In patients with pulmonary tuberculosis we detected laboratory abnormalities such as anemia and accelerated erythrocyte sedimentation rate, which did not significantly differentiate between smokers and non-smokers. Chronic infections, including TB, cause anemia and this is explained by the suppression of erythropoiesis of inflammatory mediators. On the other hand, the disruption of iron homeostasis develops with an increased absorption and retention of iron in the reticulo-endothelial system during a chronic infection, such as TB [26].

Cigarette smoking is associated with an increased risk of advanced and more severe forms of the diseases such as cavitation, a positive sputum culture and subsequent conversion of sputum culture after starting the treatment. Smoking has adverse effects on the completion of the treatment and relapse [27,28]. In our study, smokers with pulmonary tuberculosis were more likely to experience bilateral changes on lung parenchyma or caverns. An Indian study showed that among non-smokers there were more people with minimal changes while extensive changes were more common among smokers. Cavitation is more common in smokers [29].

In our patients, in addition to severe clinical manifestations of the disease, poorer treatment outcomes and relapse were significantly more frequent. This is consistent with other studies where relapse of tuberculosis was recorded in 10.4% of patients [30]. For example, in a survey conducted in Gorgia smokers had a 70% poorer outcome than non-smokers [22].The patients experiencing extensive changes on the lung parenchyma often suffer from relapses [29,30] and are at increased risk of mortality. Among our patients there were more death outcomes in smokers suffering from tuberculosis. We could not statistically confirm this fact due to a relatively small sample and because the treatment of pulmonary tuberculosis in the Northern Kosovo region is mostly successful. The

effect of smoking on clinical parameters (lung cavitation and positive sputum culture) and a slower sputum conversion rate after the start of treatment has a serious impact on the prevention of disease transmission. Even in patients who are sensitive to the treatment with tuberculostatics, the success rate of the treatment is lower than the desired 85%, which is the objective set by the WHO.

Several lifestyle factors are associated with an increased risk of pulmonary tuberculosisincluding smoking and alcohol abuse [15, 16]. Smoking and excessive alcohol consumption aremajor health risks globally and are targets for interventions to reduce the global burden of disease. Ensuring that patients make appropriate lifestyle changes would help reduce the overallburden of PTB.

The impact on the social determinants that are significant predictors for developing PTB must take place through a number of actions at the social level in order to minimize poverty and promote better education on prevention measures. Integrated public health programs are needed which can help reduce the number of patients with DM, smoking and excessive alcohol use [31].

CONCLUSION

Smokers suffering from tuberculosis were more often middle aged males that consumed alcohol and lived in poor social conditions. They had more severe clinical manifestations of tuberculosis with extensive X-ray changes in the lungs, often with caverns. Smokers who suffered from tuberculosis had a higher risk of relapse. The risk of death was higher in smokers than non-smokers.

A detailed understanding of the diffusion of smoking in our environment, as well as the socio-demographic and clinical factors associated with smoking among patients with pulmonary tuberculosis is the first step towards the formation of effective strategies for early diagnosis, control and monitoring, in order to reduce the number of patients and improve treatment outcomes. Smoking is a risk factor for more frequent incidence of PTB with severe clinical forms and poorer treatment outcome. A part of the strategy eradicating TB needs to be directed towards the campaign against smoking.

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