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Smoking prevalence and effects on treatment outcomes in patients with tuberculosis

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SUMMARY

OBJECTIVE: More than 20% of tuberculosis (TB) cases worldwide are attributable to smoking, and it is associated with an increased risk of latent and active TB, recurrence, and mortality. The aim of this study is to assess the smoking prevalence and the effects on treatment outcomes in TB patients.

METHODS: A prospective cohort study was conducted in patients with a recent TB diagnosis. The smoking status was defined, in addition to the patients' knowledge and attitudes toward smoking. The patients were followed up until the end of the treatment, and the treatment result was recorded.

RESULTS: Ninety-two patients were included in this study. The prevalence of active smoking was 31.5%. Active smokers had less chance for cure (62.1% versus 82.5%; p=0.032) and more treatment dropout (31.0% versus 12.7%; p=0.035) than non-active smokers. Patients demonstrated positive attitudes and good knowledge about smoking.

CONCLUSIONS: Active smokers had less chance for cure and more abandonment than non-active smokers. These results can be useful for the proper planning of actions that impact TB control, especially in the treatment results, such as cognitive-behavioral approaches to smoking cessation.

KEYWORDS: Tuberculosis. Smoking. Knowledge. Prevalence. Smoking cessation.

INTRODUCTION

Tuberculosis (TB) is an important public health problem worldwide, particularly in low- and middle-income countries. Brazil is among the 30 countries with the highest TB burden, which is responsible for 87% of TB cases globally, with a cumulative incidence of 44 cases/100,000 inhabitants in 2018[1].

Among the various risk factors for TB, smoking was identified as a serious aggravating factor, especially in developing countries. Both active and passive smoking considerably increase the risk of falling ill and dying from TB. It is estimated that more than 20% of TB cases worldwide are attributable to smoking[1]. The influence of smoking on TB is explained by the dysfunction of ciliary mechanics, a decrease in the immune response of an individual, the number of macrophages, and a decrease in the levels of CD4 and CD8 cells, thus increasing susceptibility to infection by *Mycobacterium tuberculosis*[2].

Tobacco use is one of the most important public health issues worldwide. Currently, almost 6 million people consume

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tobacco each year, both for direct use of the product and for secondhand smoke. By 2020, the number of tobacco deaths will increase to 7.5 million, representing 10% of all deaths. In addition, smoking is associated with a significant increase in the risk of latent TB infection, active TB, TB recurrence, and TB mortality[3].

Therefore, considering that Porto Alegre is the Brazilian capital with the highest number of smokers (24.6% of males and 20.9% of females)[4], which is the fourth capital city with the highest number of TB cases in Brazil[5], the aim of this study is to assess the prevalence of smoking and the effects on treatment outcomes in TB patients.

METHODS

Study design and location

A prospective cohort study was conducted to assess the prevalence of smoking and its effects on treatment outcomes for patients diagnosed with TB treated at the Tuberculosis Reference Center of the District Management Glória-Cruzeiro-Cristal in the city of Porto Alegre, RS, Brazil. The study was approved by the Ethics Committee of the Municipality of Porto Alegre on January 30, 2018 (number: CAAE 81741418.7.0000.5338). All patients signed a written informed consent form before participating in this study.

Population and data collection

The study population consisted of patients with a recent diagnosis (i.e., maximum 30 days) of pulmonary TB, who were evaluated at the Tuberculosis Reference Center of the District Management Glória-Cruzeiro-Cristal. This study included patients aged 18 years or above, who were diagnosed as pulmonary TB cases according to consensus criteria[6]. Patients who refused to sign the written informed consent form were excluded.

A standardized form was filled out for each patient, with the demographic data, symptoms, smoking, alcohol and drug use, comorbidities, and TB diagnostic tests. The treatment outcome (e.g., cure, dropout, failure, and death) was also recorded.

Smoking status was determined according to the definitions of the Centers for Disease Control and Prevention (CDC)[7]. An active smoker was defined as one who smoked at least 100 cigarettes in his lifetime, and at the time of the survey he was smoking at least 1 day a week. An ex-smoker was defined as one who smoked at least 100 cigarettes in his lifetime, but who at the time of the study did not smoke anymore. That patient who smoked less than 100 cigarettes in his lifetime was considered a nonsmoker.

In addition to the smoking history, the phase in the cessation process in which the patient was found was identified, according to the stages of behavioral change described by Prochaska and Di Clemente (e.g., pre-contemplation, contemplation, preparation, action, maintenance, or relapse)[8].

The level of nicotine dependence was also assessed by using the Fagerström scale. This scale classifies the degree of dependence on smoking as follows: very low, low, medium, high, and very high. Patients' knowledge and attitudes toward smoking were also assessed. For this, a questionnaire was developed based on the earlier studies[9-11], in which the first part contains 10 questions (true/false) on knowledge about smoking and the tobacco–tuberculosis relationship and the second part contains 10 questions (e.g., the Likert scale) on attitudes toward smoking. The first part of the questionnaire was answered by all patients included in this study, and the second part was answered only by active smokers and ex-smokers. The questionnaire was pretested with 20 patients before the start of this study, and the results are described in Tables 1 and 2 (see also "Results" section).

Statistical analysis

The data analysis was performed using SPSS 18.0 (Statistical Package for the Social Sciences, Chicago, IL, USA). The data were presented as number of cases, mean ±standard deviation (SD), and median with interquartile range (IQR). Categorical comparisons were performed by the chi-squared test using Yates's correction if indicated or by the Fisher's exact test. Continuous variables were compared using the *t*-test or Wilcoxon test. A two-sided $p<0.05$ was considered significant for all the analyses.

Considering the prevalence of active smokers among TB patients in an earlier study of approximately 40%[9], with a 95% confidence interval (CI) and a CI amplitude of 0.20, it will be necessary to include 92 patients.

RESULTS

During this study period, 92 patients were included. The prevalence values of active smokers, ex-smokers, and nonsmokers were 31.5% (n=29), 22.8% (n=21), and 45.7% (n=42), respectively. Table 3 describes the characteristics of active smokers compared with those of non-active smokers (ex-smokers and never smokers). Active smoking patients were more often males (75.9% versus 49.2%; p=0.0016) and drug users (62.1% versus 11.1%; p<0.0001) compared with non-active smoking patients. The positive sputum smear microscopy was more frequent in active smoking

Table 1. Knowledge of patients regarding smoking.

Affirmative	True (%)	False (%)
Smoking is addictive	90 (97.8)	2 (2.2)
Smoking is a disease	78 (84.8)	14 (15.2)
Smoking has the greatest negative effect on the vascular system	86 (93.5)	6 (6.5)
"Smoker's cough," a type of chronic bronchitis, is caused by irritation of the lungs and bronchi and due to chemicals in the cigarette	92 (100.0)	0
Dangers from cigarette smoking increase with dose (number of cigarettes smoked, number of years a person smoked, and amount of smoke inhaled)	89 (96.7)	3 (3.3)
Smoking affected your health	85 (92.4)	7 (7.6)
Smokers are at increased risk of tuberculosis	85 (92.4)	7 (7.6)
Smokers are at higher risk of having tuberculosis more than once	84 (91.3)	8 (8.7)
Smokers with tuberculosis are more likely to spread the tuberculosis bacillus than nonsmokers with tuberculosis	86 (93.5)	6 (6.5)
Smokers with tuberculosis are at higher risk of death than nonsmokers	86 (93.5)	6 (6.5)

Table 2. Attitudes of patients toward smoking.

Affirmative	Totally agree	Agree	Not sure	Disagree	Totally disagree
Smoking is fun	0	22 (44.0)	2 (4.0)	26 (52.0)	0
People smoke just to show off	0	27 (54.0)	3 (6.0)	20 (40.0)	0
Smoking calms your nerves	1 (2.0)	43 (86.0)	0	6 (12.0)	0
Smoking makes you smelly	2 (4.0)	46 (92.0)	0	2 (4.0)	0
Smoking is a waste of money	2 (4.0)	45 (90.0)	0	3 (6.0)	0
Smoking makes you relieve all life stresses	1 (2.0)	30 (60.0)	0	19 (38.0)	0
Smoking keeps your weight down	0	36 (9.2)	0	14 (28.0)	0
Smoking gives you confidence	0	21 (42.0)	0	29 (58.0)	0
Smoking should be allowed at fewer places than it is now	1 (2.0)	42 (84.0)	2 (4.0)	5 (10.0)	0
Sales of cigarettes should be outlawed	2 (4.0)	39 (78.0)	0	9 (18.0)	0

patients (89.7 versus 66.7%; p=0.020). Regarding treatment outcomes, active smoking patients were less cured (62.1 versus 82.5%; p=0.032) and had more treatment dropout (31.0 versus 12.7%; p=0.035) than non-active smoking patients.

Among smokers, the degree of dependence measured by using the Fagerström scale was as follows: very low (n=2; 6.9%), low (n=6; 20.7%), medium (n=5; 17.2 %), high (n=11; 37.9%), and very high (n=5; 17.2%). With regard to the stages of behavioral change, smoking patients were distributed as follows: pre-contemplation (n=8; 27.6%), contemplation (n=16; 55.2%), and preparation (n=5; 17.2%). Table 1 shows the results for the patients' knowledge regarding smoking, and Table 2 shows the results for the patients' attitudes toward smoking.

DISCUSSION

In this cohort study, we found a prevalence of active smoking of 31.5% in TB patients. In addition, active smoking patients had less chance for cure and had more treatment dropout than non-active smoking patients.

There are several studies showing that smoking is strongly linked to TB, and a considerable proportion of the global TB burden can be attributed to smoking. A large proportion of TB patients can be active smokers or be exposed to other people's tobacco smoke[12-15]. In this study, we found that a prevalence of active smoking was 31.5% in TB patients. In a study conducted in Malaysia[9], the prevalence of active smoking was 40.27% among TB patients. Wang et al.[12] reported in a case–control study an even higher prevalence in China (54.6%). In a

Table 3. Characteristics of active smokers and non-active smokers.

Characteristics	Active smokers (n=29)	Non-active smokers (n=63)	p-value
Demographic data			
Age			
Male sex	22 (75.9)	31 (49.2)	0.016
White race	19 (65.5)	34 (54.0)	0.298
Symptoms			
Cough	28 (96.6)	54 (85.7)	0.162
Fever	15 (51.7)	31 (49.2)	0.822
Weight loss	25 (86.2)	52 (82.5)	0.768
Alcohol abuse	5 (17.2)	6 (9.5)	0.313
Drug use	18 (62.1)	7 (11.1)	<0.0001
HIV	14 (48.3)	20 (31.7)	0.127
Smear-positive sputum	26 (89.7)	42 (66.7)	0.020
Positive culture	20 (69.0)	44 (69.8)	0.932
Treatment outcomes			
Cure	18 (62.1)	52 (82.5)	0.032
Dropout	9 (31.0)	8 (12.7)	0.035
Death	2 (6.9)	3 (4.8)	0.649

study conducted in Iran[16], with patients with a recent diagnosis of TB, the authors demonstrated that 20.2% of the patients were daily smokers, 1.8% were occasional smokers, and 8.9% had quit smoking before TB diagnosis.

Increasing evidence suggests that smoking is significantly associated with treatment failure, dropout, and death[17-19]. In this study, smoking patients had less chance for cure and had more treatment dropout when compared to non-active smoking patients. A similar study that evaluated 183 smokers and 151 nonsmokers showed that the cure rates were higher in nonsmoking patients and in those who stopped smoking in the first 2 months of TB treatment, compared to smoking patients[20]. Dujaili et al.[21] performed a logistic regression analysis in a retrospective cohort study on the effects of tobacco on TB treatment outcomes and reported better results in nonsmokers than in smokers (odds ratio [OR] 0.312, 95%CI 0.17–0.57). El Sony et al.[22] also found a significant difference between treatment outcomes in the group who stopped smoking compared to the group of smokers.

In a cross-sectional study, more than 30% of smoking patients with TB revealed that they had never been asked about their smoking habits or were advised to stop smoking[23]. This approach to smoking in TB patients has been strongly recommended[24]. Likewise, understanding the knowledge and attitudes of TB patients about smoking is important to guide the development of effective educational interventions. In general, in this study, patients demonstrated good knowledge about smoking and positive attitudes against tobacco use. However, 88% of patients reported that "smoking calms your nerves" and more than 60% stated that "smoking relieves all life stresses." These findings alert to the need for cognitive-behavioral assessment and investigation of psychiatric comorbidities, such as anxiety and depression.

This study has some limitations. First, it was carried out in a single Health Unit. However, we believed that the results found in this study are applicable to places with similar characteristics. In addition, smoking status was self-reported and was not confirmed by biological measurements, such as the determination of carbon monoxide in exhaled air. Although the self-report of smoking status is strongly correlated with biochemical confirmation in the observational studies[25], underreporting of tobacco use may occur.

CONCLUSIONS

More than 30% of TB patients were active smokers in this study. In addition, active smoking patients were less cured and had more treatment dropout than non-active smoking patients. These results can be useful for the proper planning of actions that have an impact on TB control, especially on treatment outcomes, such as cognitive-behavioral approaches to smoking cessation.

AUTHORS' CONTRIBUTIONS

KRV: Conceptualization, Data curation, Investigation, Methodology, Project administration, Writing the original draft. **AAF:** Conceptualization, Investigation, Methodology, Writing – editing and review. **ACVA:** Conceptualization, Investigation, Methodology, Writing – editing and review. **DRS:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Supervision, Writing – original draft.

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