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Prevalence and factors associated with smoking among patients with tuberculosis in Conakry (Guinea)

Gnoume Camara[1],Aboubacar Sidiki Magassouba[1,2], Almamay Amara Touré[1], Younoussa Sylla[3], Mabinty Conté[3], Adama Marie Bangoura[2], Souleymane camara[2], Mabinty Conté[1], Seydouba Bangoura[1], Mamadou Oury Garambe Diallo[3], Sidikiba Sidibé[1]

[1] Faculty of Science, Gamal Abdel Nasser University of Conakry, BP : 1147 Republic of Guinea
[2] National Tuberculosis Control Program, Conakry, Guinea
[3] Plan International, Conakry, Guinea

Corresponding Author: *G. Camara, Email: drgnoumecamara@gmail.com , Tel: +224 628 138 340*

Abstract:
Introduction: Smoking increases the risk of Mycobacterium tuberculosis infection and the risk of tuberculosis disease progression in infected individuals. The objective of this study was to estimate the prevalence and factors associated with tobacco use among tuberculosis patients. **Method** : We conducted a 3-month cross-sectional study with analytical aims in tuberculosis treatment centers in Conakry. 646 patients were included in this study, in whom smoking status and tobacco consumption in the last 12 months were assessed. We used the Fargerstrom test to measure nicotine dependence. The backward stepwise multivariate logistic regression model was used to identify potential factors associated with smoking in tuberculosis patients. The significance threshold was set at 5% **Results** : The prevalence of smoking was 37%, the mean age was 37.84±43.24, the male sex was predominant M/F=1.74; In 44.89%, these patients were illiterate; more than 14% were co-infected TB/HIV and 23.10% were alcoholics. Only 35.4% had knowledge of the health risks associated with smoking. The factors potentially associated with smoking were: age ($p<0.001$); male sex predominantly0.03 [0.01;0.06]; low level of education5.53 [2.62;12.6]. Low-income patients 2.06 [1.16;3.65]. Tuberculosis smokers were statistically associated with alcoholism 0.05 [0.03;0.08]. **Conclusion**:the prevalence of tobacco-dependent tuberculosis patients remains high and iThere appears to be sufficient evidence to conclude that factors such as alcohol consumption, gender, age, and standard of living were significantly associated with smoking.

Keywords: Prevalence, Tuberculosis, Tobacco, associated factors.

1 Introduction

Tuberculosis, a chronic infectious disease caused by Mycobacterium tuberculosis, remains one of the leading causes of death worldwide, despite the availability of effective drugs [1,2]. Smoking increases the risk of Mycobacterium tuberculosis infection and worsens tuberculosis outcomes in infected individuals [3]. Specifically, tobacco smokers are twice as likely to contract tuberculosis compared to non-smokers, and tuberculosis patients who smoke are twice as likely to die during treatment [4]. According to the World Health Organization (WHO), tobacco use claims more than 8 million lives annually [6]. Approximately 80% of tobacco users reside in low- and middle-income countries, where 95% of tuberculosis cases occur [5,7]. A study based on mathematical modeling estimated that, between 2010 and 2050, smoking could lead to an additional 18 million tuberculosis cases worldwide and significantly increase secondary mortality if current tobacco consumption trends persist [8]. The prevalence of smoking among tuberculosis patients may exceed that of the general population in many countries [9]. In Spain, between January 2006 and December 2013, among 5,846 TB patients, 39.3% were regular smokers at the time of diagnosis [9]. Factors associated with smoking in this group include male gender, social insecurity, alcoholism, and injecting drug use [9]. Similarly, a cross-sectional survey conducted in South Africa from October 2010 to March 2011 found that 26% of adults with tuberculosis were smokers [10].

In Guinea, the World Health Organization (WHO) estimated the prevalence of smoking in the general population at 12.8% in 2009 [11]. However, no published studies have reported the prevalence of smoking among tuberculosis patients in Guinea. A detailed understanding of smoking prevalence and its associated factors among tuberculosis patients could inform the development of effective tuberculosis control and surveillance strategies. Therefore, the objective of our study was to determine the prevalence of smoking among tuberculosis patients in Guinea and to identify factors associated with smoking in this population.

2 Methods

2.1 Study Setting and Design

This study was conducted in ten diagnostic and treatment centers across the five communes of Conakry, the capital of Guinea. The research was designed as a cross-sectional study with an analytical approach, spanning a three-month period from November 4, 2019, to February 4, 2020. The primary objective was to assess the prevalence and determinants of smoking among tuberculosis patients using a standardized research methodology. The study setting was selected to ensure broad representation of patients undergoing tuberculosis diagnosis and treatment in Guinea.

2.2 Study Population

The study population consisted of tuberculosis patients aged 15 years and older who voluntarily agreed to participate. Participants were included regardless of their sex, ethnicity, or geographical origin, ensuring a diverse and representative sample.

To ensure the validity of the data collected, participants completed an anonymous structured questionnaire designed to gather comprehensive information on smoking behavior, socio-demographic factors, and health-related characteristics. This questionnaire was developed and pretested before implementation to ensure clarity, reliability, and cultural appropriateness.

2.3 Sample Size Calculation

The determination of the sample size was based on the SWARTZ formula, which ensures an accuracy level of 5

Using this estimate, the minimum required sample size was calculated at 592 tuberculosis patients. However, to enhance statistical power and ensure a robust analysis, a total of 646 tuberculosis patients were ultimately included in the study.

$$N = \frac{\mathbf{Z}(\mathbf{P} * \mathbf{Q})}{\mathbf{i}}$$

2.4 Smoking Status Assessment

To assess smoking behavior among the participants, each individual was asked the following key question during data collection: "Have you smoked cigarettes in the last 12 months?" This approach provided a standardized measure of smoking status among tuberculosis patients.

Based on responses, participants were classified into two primary categories. The first category, smoking status, referred to tuberculosis patients who had used tobacco at least once in their lifetime. The second category, active tobacco use, referred to those who had smoked within the 12 months preceding data collection.

2.5 Explanatory Variables

Several explanatory variables were examined to identify potential determinants of smoking behavior among tuberculosis patients. These variables were classified into socio-demographic characteristics and other relevant health-related factors.

The socio-demographic characteristics considered in the study included age, sex, marital status, education level, and occupational status. These variables were essential for understanding the social and economic determinants that could influence smoking behavior.

In addition to socio-demographic factors, other explanatory variables were analyzed, including alcohol consumption, presence of co-infections such as TB/HIV, awareness of health risks associated with tobacco use, prior exposure to tobacco-related health information, decisions related to smoking cessation, and successful attempts to quit smoking.

To further assess nicotine dependence, the FAGERSTRÖM test was administered. This test categorizes nicotine dependence into four distinct levels: - Very low dependence (0–2) - Low dependence (3–4) - Medium dependence (5–6) - High or very high dependence (7–10)

2.6 Data Collection and Analysis

Data collected during the study were systematically entered into EpiData 3.1 to ensure proper management and minimize entry errors. Statistical analyses were then performed using R version 4.0.3, which provided a robust analytical framework for processing the data.

The study employed different statistical approaches depending on the nature of the variables. Qualitative variables were analyzed using absolute frequencies and percentages, while quantitative variables were summarized using means and standard deviations.

To explore potential factors associated with smoking, a multivariate logistic regression analysis was conducted. The analytical process followed a two-step approach. First, univariate logistic regression was performed to examine individual associations between smoking behavior and explanatory variables. Variables that were found to be significantly associated with smoking in the univariate analysis were then included in a multivariate logistic regression model, allowing us to identify the independent predictors of smoking behavior.

Statistical significance was determined using a p-value threshold of less than 0.05, ensuring rigorous validation of the results and minimizing the risk of false associations.

2.7 Ethical Considerations

Before the commencement of the study, ethical approval was obtained from the relevant institutional review boards. This ensured compliance with national and international ethical guidelines for research involving human participants.

Additionally, informed consent was obtained from each participant prior to data collection. To uphold ethical standards, all collected data were processed with strict confidentiality measures, ensuring that participant identities remained anonymous. Throughout the study, ethical principles of voluntary participation, respect for privacy, and data protection were strictly observed, ensuring that participants' rights and dignity were safeguarded.

3 Results

A total of 646 tuberculosis patients were included in the study. The prevalence of smoking among tuberculosis patients was estimated at 37

3.1 Socio-demographic Characteristics

Table 1 presents the socio-demographic characteristics of the study population. The majority of patients (38.70%) belonged to the 25–39 age group, while 33.59% were aged between 15 and 24 years. The proportion of patients aged 40–59 years was 21.83%, and those aged 60–80 years accounted for only 5.88%.

Regarding sex distribution, 63.47% of the study participants were male, while 36.53% were female. In terms of educational background, 44.89% of the patients had completed primary education, whereas 23.22% had secondary education. Only 14.71% had pursued higher education, and 17.18% were illiterate.

Employment status varied among participants. More than half of the patients (51.55%) were unemployed, while 22.91% worked as freelancers, 12.38% held official employment, and 13.16% were housewives.

In terms of marital status, 53.56% of the participants were married, while 46.44% were single. The study also found that 14.09% of the patients were co-infected with tuberculosis and HIV, and 23.10% reported alcohol consumption.

Despite 97.99% of the participants having received information about the health risks associated with tobacco use, only 35.45% demonstrated actual knowledge of these risks. Additionally, 36.7% of participants reported having smoked at least once in their lifetime.

Table 1: Distribution of patients according to socio-demographic characteristics

Variable	Workforce (n=646)	Percentage
Age		
15 – 24	217	33.59
25 – 39	250	38.70
40 – 59	141	21.83
60 – 80	38	5.88
Sex		
Male	410	63.47
Female	236	36.53
Level of education		
Illiterate	111	17.18
Primary	290	44.89
Secondary	150	23.22
Higher education	95	14.71
Occupation		
Unemployed	333	51.55
Freelance	148	22.91
Official employment	80	12.38
Housewife	85	13.16
Marital status		
Married	346	53.56
Single	300	46.44
Tobacco consumption		
No	409	63.31
Yes	237	36.69
TB/HIV co-infection		
No	555	85.91
Yes	91	14.09
Alcohol consumption (n=645)		
No	496	76.90
Yes	149	23.10
Knowledge of health risks associated with tobacco (N=646)		
No	417	64.55
Yes	229	35.45
Have you ever smoked in your life?		
No	409	64.30%
Yes	237	36.7%
Receiving information on the health risks associated with tobacco		
No	13	2.01
Yes	633	97.99

The average age of tuberculosis patients was 37.84 ± 43.24 years, with the majority belonging to the 25–40 age group (38.7%). The study population was predominantly male, with a male-to-female ratio of 1.74. Regarding educational background, 44.89% of the patients were illiterate.

Employment and marital status showed notable distributions. More than half of the patients (51.55%) were unemployed, while 53.6% were married. Among the participants, 14% were living with HIV, and 23.10% reported alcohol consumption, which may have implications for their overall health and disease progression.

Although almost all participants (98%) had received information about the health risks associated with tobacco use, only 35.4% demonstrated knowledge of these risks. Additionally, 36.7% reported having smoked at least once in their lifetime, highlighting the need for stronger awareness and prevention programs.

3.2 Factors Associated with Smoking Among Tuberculosis Patients

To identify the factors associated with smoking behavior among tuberculosis patients, a univariate logistic regres-

sion analysis was performed. The results are presented in Table 2.

Table 2: Univariate logistic regression of patients who have smoked in their lifetime

Variable	Yes	No	OR [CI]	p-value
Age				
15 – 25	43 (18.1%)	174 (42.5%)	Ref.	<0.001
25 – 40	105 (44.3%)	145 (35.5%)	0.34 [0.22;0.52]	
40 – 60	74 (31.2%)	67 (16.4%)	0.23 [0.14;0.36]	
60 – 80	15 (6.33%)	23 (5.62%)	0.38 [0.18;0.80]	
Sex				
Female	9 (3.80%)	227 (55.5%)	Ref.	<0.001
Male	228 (96.2%)	182 (44.5%)	0.03 [0.01;0.06]	
Level of Education				
University	34 (14.3%)	61 (14.9%)	Ref.	<0.001
No education	10 (4.22%)	101 (24.7%)	5.53 [2.62;12.6]	
Primary	134 (56.5%)	156 (38.1%)	0.65 [0.40;1.05]	
Secondary	59 (24.9%)	91 (22.2%)	0.86 [0.50;1.46]	
Occupation				
Official	36 (15.2%)	44 (10.8%)	Ref.	0.001
Unemployed	158 (66.7%)	175 (42.8%)	0.91 [0.55;1.48]	
Freelance	42 (17.7%)	106 (25.9%)	2.06 [1.16;3.65]	
Housewife	1 (0.42%)	84 (20.5%)	59.3 [12.3;1424]	

Overall, age was significantly associated with tobacco use among tuberculosis patients, with a mean age of 43.57 ± 42.87 years (p<0.001). Tobacco use was notably more common among men than women, with an odds ratio (OR) of 0.03 [0.01;0.06].

Patients with no formal education had a significantly higher likelihood of smoking compared to those with a university education (OR = 5.53 [2.62;12.6]). Similarly, tobacco consumption was more prevalent among tuberculosis patients engaged in freelance or informal occupations compared to those employed in the public sector (OR = 2.06 [1.16;3.65]).

No statistically significant association was found between TB/HIV co-infection and tobacco consumption among tuberculosis patients (OR = 1.14 [0.72;1.84]). However, alcohol consumption was frequently observed among tuberculosis smokers (OR = 0.05 [0.03;0.08]). Furthermore, tuberculosis patients who were aware of the health risks associated with tobacco use were less likely to smoke compared to those who were unaware (OR = 0.16 [0.11;0.23]). The vast majority of tuberculosis patients had received information on the health risks of tobacco (OR = 0.16 [0.01;0.82]).

3.3 Patients Who Smoked in the Last 12 Months

A univariate logistic regression analysis was conducted to assess factors associated with recent tobacco use among tuberculosis patients. The results are presented in Table 3.

Overall, age was statistically significantly related to tobacco use in these patients (p<0.001). Unlike other smokers, tobacco use was not related to gender.0.61 [0.08;2.70]. There was a decrease in tobacco consumption as the level of education increased.1.39 [0.29;6.15].On the other hand, alcohol consumption was not linked to tobacco consumption in these patients.1.62 [0.94;2.82]No relationship was established between smoking and nicotine dependence (p= 0.822), nor was knowledge of the health risks associated with tobacco in these patients (p=0.556) 4.

Table 3: Univariate logistic regression of patients who smoked in the last 12 months

Variable	No	Yes	OR [CI]	p-value
Age				
60 – 80	11 (14.3%)	4 (2.50%)	Ref.	<0.001
15 – 25	9 (11.7%)	34 (21.2%)	9.67 [2.61;43.6]	<0.001
25 – 40	26 (33.8%)	79 (49.4%)	8.00 [2.46;32.0]	<0.001
40 – 60	31 (40.3%)	43 (26.9%)	3.68 [1.12;14.8]	0.031
Sex				
Female	2 (2.60%)	7 (4.38%)	Ref.	0.722
Male	75 (97.4%)	153 (95.6%)	0.61 [0.08;2.70]	0.545
Level of Education				
No education level	4 (5.19%)	6 (3.75%)	Ref.	0.931
Primary	42 (54.5%)	92 (57.5%)	1.47 [0.35;5.60]	0.579
Secondary	20 (26.0%)	39 (24.4%)	1.31 [0.29;5.28]	0.711
University	11 (14.3%)	23 (14.4%)	1.39 [0.29;6.15]	0.666
Occupation				
Unemployed	52 (67.5%)	106 (66.2%)	Ref.	0.546
Freelance	14 (18.2%)	28 (17.5%)	-	-
Official	10 (13.0%)	26 (16.2%)	-	-
Housewife	1 (1.30%)	0 (0.00%)	-	-

Table 4: Multivariate logistic regression of tuberculosis patients who have smoked in their life

Variables	OR added	Confidence interval (95%)	p-value
Age			
15 – 25	-	-	-
25 – 40	0.33	0.17 – 0.61	>0.001
40 – 60	0.21	0.10 – 0.42	<0.001
60 – 80	0.23	0.08 – 0.69	0.009
Sex			
Female	-	-	-
Male	0.07	0.03 – 0.16	<0.001
Level of study			
University	-	-	-
No education level	0.31	0.08 – 1.25	0.10
Primary	0.23	0.10 – 0.53	<0.001
Secondary	0.32	0.14 – 0.70	0.005
Occupation			
Official	-	-	-
Unemployed	0.34	0.14 – 0.81	0.016
Freelance	0.63	0.23 – 1.71	0.4
Housewife	1.25	0.12 – 30.2	0.9
Alcohol consumption			
No	-	-	-
Yes	0.15	0.09 – 0.26	<0.001
Have you managed to quit smoking for good?			
No	-	-	-
Yes	0.08	0.01 – 0.27	<0.001
Decide to quit smoking for good			
No	-	-	-
Yes	0.00	-	>0.9

Age was statistically associated with smoking among tuberculosis patients ($p<0.001$). Male tuberculosis patients were significantly more likely to smoke compared to females, with an odds ratio (OR) of 0.07 [0.03;0.16].

Patients with lower levels of education had a higher likelihood of tobacco use compared to those with a university education (OR = 0.31 [0.08;1.25]). Additionally, unemployed tuberculosis patients exhibited higher smoking rates compared to those employed as civil servants (OR = 0.34 [0.14;0.81]).

No significant association was found between TB/HIV co-infection and tobacco consumption (OR = 1.14 [0.72;1.84]). However, alcohol consumption was significantly more prevalent among tuberculosis patients who smoked compared to those who did not (OR = 0.07 [0.04;0.13]).

Furthermore, tuberculosis patients who were aware of the health risks associated with tobacco use were less likely to smoke compared to those who lacked awareness 5.

Table 5: Multivariate logistic regression of patients who used tobacco in the last 12 months

Variables	**Adjusted OR**	**Confidence Interval (95%)**	**p-value**
Age	0.96	[0.93 – 0.98]	<0.001
Alcohol Consumption			
No	—	—	-
Yes	1.74	[0.95 – 3.21]	0.073
Successfully Quit Smoking			
No	—	—	-
Yes	0.08	[0.01 – 0.27]	<0.001
Decision to Quit Smoking Permanently			
No	—	—	-
Yes	0.00	-	>0.9

Among tobacco-smoking tuberculosis patients, only age and age were associated at all levels with smoking among tuberculosis patients ($p<0.001$); we did not find a relationship between standard of living and smoking ($p>0.05$); no link was found between alcohol consumption and smoking1.75[0.94;3.35].

4 Discussion

This study provides valuable insights into the factors associated with smoking among tuberculosis patients. However, its findings can only be generalized to the city of Conakry. Several limitations should be considered when interpreting these results. Firstly, the study did not assess the level of motivation to quit smoking using the Q-MAT test. Secondly, its cross-sectional design does not allow for causal inferences between covariates and study variables. Thirdly, we did not quantify daily tobacco consumption, making it difficult to evaluate a possible dose-response relationship. Additionally, only smoking status at the time of the survey was recorded, which limits our ability to assess the impact of smoking cessation on disease progression.

A total of 646 tuberculosis patients were included in the study, divided into two groups: 409 non-smokers and 237 smokers. The prevalence of smoking among tuberculosis patients was estimated at 37%, significantly higher than the 12.8% reported in the general population by the World Health Organization (WHO) [12]. This prevalence is comparable to the findings of Kombila UD et al., who reported a smoking rate of 35.8% among tuberculosis patients [13]. According to existing literature, the prevalence of smoking among tuberculosis patients varies from 33.3% to 62.5% [14]. The relatively lower prevalence observed in our study compared to others may be attributed to the short data collection period (three months) and the sociopolitical crisis in Guinea, which was marked by demonstrations and city lockdowns.

The average age of smoking tuberculosis patients was 43.57±42.87 years, with a predominance of the 25–40 age group. This result is not surprising, as this age group is the most exposed and engaged in socio-professional activities. Compared to non-smokers, smoking tuberculosis patients were older at the time of diagnosis, with an average age of 43.8±12.7 years. These findings are consistent with those of Mahishale et al. [15], who reported an average age of 43±8.2 years among smoking tuberculosis patients. However, our results indicate a higher average age compared to those reported by Janah et al. [16] and Fekih et al. [17] in Morocco and Tunisia, where the mean ages were 41±12 years and 37±14.5 years, respectively. This highlights that tuberculosis and smoking predominantly affect young individuals at the peak of their economic productivity, potentially leading to substantial direct and indirect economic losses. The average age of smoking initiation in our study aligns with literature from Senegal, which indicates initiation ages ranging from 13 to 20.5 years [18].

As observed in other studies [19], our findings indi-

cate a significantly higher prevalence of smoking among men compared to women. In our study, 96.2% of smokers were men, whereas only 3.8% were women. Globally, tuberculosis is more prevalent in men than in women, although recent trends suggest a narrowing gap. A study conducted in 22 high-burden tuberculosis countries found that smoking was a predictive factor in the increasing tuberculosis burden among men [20], implying that gender disparities in tuberculosis prevalence could be partly attributed to the higher smoking rates among men [21,22]. Additionally, the lower prevalence of smoking among women in our study reflects societal norms in Guinea and other African societies, where smoking is often perceived as a moral failing for women. In contrast, men are often judged less harshly for engaging in behaviors such as smoking, which exposes them to social vices.

Our study also identified a significant association between educational level and tobacco use among tuberculosis patients. The likelihood of smoking increased with lower levels of education. Similar findings were reported by Balkissou et al. in Cameroon [23], who found that a lower level of education was associated with poor knowledge of tuberculosis and reduced awareness efforts. In another study, smoking was directly linked to the level of education, with lower educational attainment being a predictor of higher tobacco use [24].

More than half of the smoking tuberculosis patients in our study also reported alcohol consumption (53.6%). In our regression model, alcohol consumption emerged as a key factor associated with smoking. Previous studies have established a strong link between alcohol abuse and smoking, with prevalence rates ranging from 10.4% to 99% among smokers [25,26,27,28]. This association is likely due to the immunosuppressive effects of alcohol on cellular immunity, T lymphocyte function, and defense mechanisms against pulmonary infections [29]. Additionally, alcohol consumption facilitates the passage of carcinogens present in tobacco smoke, further increasing the risk of developing smoking-related diseases.

Regarding awareness of the risks of tobacco use, our study revealed that 61.6% of tuberculosis patients had significant knowledge of tobacco risks, while nearly all participants (99.6%) had received information about the health hazards of smoking. Bruce J et al. [13] reported similar findings, indicating that tuberculosis patients generally possess substantial knowledge about the risks associated with tobacco consumption. However, this awareness does not always translate into behavior change. According to Jiménez-Fuentes et al. [21], improving knowledge levels alone is not sufficient; individuals must internalize this information to develop a personal understanding of the risks. Strengthening information dissemination strategies, ensuring message consistency, and aligning public health interventions could enhance the effectiveness of tobacco control efforts.

5 Conclusion

The prevalence of smoking among tuberculosis patients remains high in Conakry. Our findings provide strong evidence that factors such as alcohol consumption, gender, access to information, and knowledge of the health risks associated with smoking are significantly linked to tuberculosis. Given the detrimental impact of smoking on tuberculosis progression and treatment outcomes, it is imperative that tuberculosis patients receive comprehensive counseling and support to quit smoking.

Healthcare professionals involved in tuberculosis management should incorporate smoking cessation counseling as part of their routine care. A more detailed understanding of smoking prevalence in the local context will aid in designing targeted interventions to improve patient outcomes. Future research should explore the long-term impact of smoking cessation on tuberculosis prognosis and investigate effective strategies to integrate tobacco control measures within tuberculosis treatment programs.

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Author Contributions

Each author played a crucial role in this study. - **Study conception and design**: Gnoume Camara, Aboubacar Sidiki Magassouba. - **Data collection and field supervision**: Almamay Amara Touré, Younoussa Sylla, Mabinty Conté , Adama Marie Bangoura, Souleymane Camara. - **Data analysis and statistical modeling**: Aboubacar Sidiki Magassouba, Seydouba Bangoura. - **Manuscript drafting and revision**: Mamadou Oury Garambe Diallo, Sidikiba Sidibé, Aboubacar Sidiki Magassouba. - **Final approval of the manuscript**: All authors read and approved the final version.

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Conflict of Interest

The authors declare no conflicts of interest related to this study.

Data Availability

The dataset used and analyzed during this study is available from the corresponding author upon reasonable request.

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