

# Correlation of Clinico-Bacterio Radiological Profile with Antitubercular Drug Treatment in Smokers and Nonsmokers Suffering From Pulmonary Tuberculosis

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| Received: 16.01.2019 | Accepted: 26.01.2019 | Published: 30.01.2019

DOI: [10.21276/sjmps.2019.5.1.3](https://doi.org/10.21276/sjmps.2019.5.1.3)

## Abstract

**Introduction:** Both tobacco smoking and tuberculosis are major global public health problems. Tobacco smoking has been linked as a risk factor for TB. This study was aimed to find the association between smoking and pulmonary TB. **Materials and methods:** Pulmonary TB patients aged between 17 and 85 years were enrolled over a period of 9 months. All patients had two consecutive sputum smears examined for the presence of acid-fast bacilli (AFB) using Fluorescence Microscopy technique at the initiation of treatment and repeated as per recommendations of the RNCTP. Response was determined in terms of sputum conversion at the end of intensive phase and final treatment outcomes. **Results:** Out of total of 124 current smokers, a very high number of patients 83(66.7%) were found to have a high load of TB bacilli(3+), these smokers with sputum 3+ grade showed less response to TB drug treatment. Out of 83 patients, only 15 patients (18.7%) showed smear conversion at the end of intensive treatment. 45 patients who had cavitary disease, 30 (66%) patients had cleared at the end of IP and 15 patients showed persistence of cavitation in smokers while 76% of non smokers showed clearance of cavity ( $P < 0.05$ ). Cure rate among smokers, ex smokers and non smokers were 52.5%, 78% and 84%, respectively. **Conclusion:** Smokers during initial presentation, as well as at end of the treatment indicate more radiological findings, cavitary disease, and worse sputum AFB smear grading. Smokers also had a poorer outcome in terms of treatment success rate as compared to non smokers. This was largely due to high percentage of default rate among smokers implying treatment adherence issues among smokers as a main confounder to treatment success. Focus needs to be made to reduce defaulters which are more common among smokers.

**Keywords:** Tuberculosis, Smear Conversion rate, Smear grade, Smoking.

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## INTRODUCTION

Both tobacco smoking and tuberculosis are major global public health problems. Globally, nearly 6 million people died from tobacco use in 2011 and tobacco use is estimated to be responsible for 16% of deaths among men and 7% of deaths among women in each year [1]. Tobacco smoke contains numerous harmful ingredients including nicotine, tar, and carbon monoxide. When inhaled, each of these ingredients can result in hazardous effects on our respiratory system, especially the lungs. When the smoke of a cigarette starts entering the respiratory system, it disturbs the cilia in the respiratory tract. As a part of the defense mechanism, mucus is released in the tract in order to avoid any harmful particles from entering the lungs. At the same time, nicotine constricts the blood vessels and restricts the flow of blood to the air sacs from where it is supposed to be taken to entire body. The cilia, which are in charge of the defense mechanism of the respiratory system, are rendered useless due to the

damage caused to them by nicotine. This compromises the person's immune system and makes him vulnerable to various other disorders [2]. Macrophages are the immune system's first line of defence against TB when it first enters the body. The immune cell engulfs the bacterial cell and tries to break it down. A majority of their alveolar macrophages exhibit lysosomal accumulations of tobacco smoke particulates & do not migrate to Mycobacterium tuberculosis. The incapacitation of highly microbicidal first-responding macrophages may contribute to smokers susceptibility to tuberculosis [3].

## MATERIALS AND METHODS

This study included 397 pulmonary smear positive new TB cases attending TB units of Government hospital, Ernakulam, district TB centre karuvelipady and government hospital paravur during the period Nov 2016 to July 2017. Pregnant women, TB with HIV patients were excluded. Study was approval

by Institute Ethics Committee. Informed consent was obtained from all study patients. All pulmonary new smear positive patients were included the study. All patients had two consecutive sputum smears examined for the presence of acid –fast bacilli (AFB) using Fluorescence Microscopy technique at the initiation of treatment and repeated as per recommendations of the RNCTP. Among TB patients; smokers and non smokers were separately evaluated. A standardized proforma was used to capture the clinical and radiological findings. Sputum AFB grading was done as per WHO guidelines [4]. The radiological severity of the disease was assessed based on the guidelines of National TB Association of USA at presentation and end of the treatment. Treatment outcomes were recorded as per RNTCP guidelines [4]. The radiological severity and sputum bacillary load were also assessed in terms of smoking index. Smoking index = No of packs of cigarettes smoked per day/No of years the person has

smoked 1 Pack year = Smoking 20 cigarettes (1 pack) per day for 1 year.

Smokers were further divided as current smokers and Ex smokers. Patients were first asked if whether they are currently smoked or not at all. Those who reported that they currently smoked -were categorized as current smokers .Then remaining patients were then asked if they had smoked in the past on a daily ,those giving positive response were categorized as Ex smokers.

### Statistical Analysis

Statistical analysis was carried out using statistically available software (SPSS), Chi square online calculator, Medcalc online calculator. A 'P' value of < 0.05 was considered significant.

## RESULTS AND DISCUSSION

**Table-1: Characteristics of enrolled TB patients**

Characteristics	Number n (%)
Number of patients	397
Current smoker	124(31.23)
Ex smoker	98(24.68)
Non smoker	175(44.08)
Age(years)	
Mean	49.05(SD±15.06)
Range	17-85
Sex (percentage of patients)	
Male	313(78.25)
Female	84(21.15)
Smoking index	
<100	208(94.97)
100-200	14(6.30)
Smoking index	
Mean	44.57(SD±32.47)
Type of smoking (%)	
Beedi	156(70)
Cigarette	66(30)

A total of 397 patients, aged between 17 and 85 years were enrolled over a period of 9 months. The mean age 49.05years (SD±15.06). Majority (47.60%) of the enrolled patients were in the age group of 51-70 years. Among male patients (n=313), 31% were smokers, 24% ex smokers while females (n=84) .Of the enrolled,156 (70%) smoked beedi while 66(30%) smoked cigarette and rest were non smokers (Table 1).Among current and ex smokers,55.16% had a smoking index of <100 ( 94.97%), between 100 and 200 (6.30%) (Table-1).

### Assessment at Presentation

Assessment of bacillary load showed that out of total 213 patients who had 3+ grading, 67% were current smokers, 55.10% ex smokers and 42.69% non smokers. The data indicates a positive correlation of sputum bacillary load among pulmonary TB patients with higher smoking habit.

### Radiological Presentations in Pulmonary Tuberculosis Patients

When we compare radiological findings with smoking and non smoking TB patients cavitation, opacity, shadow and consolidation were found to be in more number of smokers than non smokers viz 22.97%:19.42%(p-0.3925); 8.5%:4% ; 2.3%:2.28%(p-0.0691);1.35%: 0.5%(0.44) (Table-2) .

### Bacterio Radiological Extent and Treatment Response With Respect To Smoking Index

In a total of 124 current smokers, a very high number of patients 83(66.7%)were found to have a high load of TB bacilli(3+) which could be because of impaired functioning of macrophages in lungs. These smokers with sputum 3+ grade showed less response to TB drug treatment also. Out of 83 patients, only 15 patients (18.7%) showed smear conversion at the end of intensive treatment (P-0.05) (Table-3) this clearly

indicates that smoking affects recovery, interferes with drug response and ultimately causes treatment failure and multi-drug resistant TB. Radiological findings show that many of smokers showed cavity formation in the lungs, which was persistent after the treatment also.

From the literature [5], it is evident that the function of pulmonary alveolar macrophages is impaired by smoking. Macrophages has an important role in early defense mechanisms against bacteria. Nicotine directly acts on nicotine receptors on macrophages to decrease intracellular TNF and thus impairs intracellular killing of MTB. When we look at the sputum conversion in smokers, it is found to be less when compared to non smokers TB patients, which is probably because of impaired macrophagal functions.

### Bacterio Radiological Profile and Treatment Response with Respect to Smoking

According to smoking index, there were 208 patients with <100 and 14 patients with 100-200 smoking index. At the end of intensive phase, 46.15% patients with smoking index < 100 converted to negative while only 9% of patients with SI of 100-200 could convert. Higher the smoking index lower is the sputum conversion (46.15% - <100; 9% in 100-200) (Table-4).

X ray findings show that 45 patients who had cavitary disease, 30 patients 66% had cleared at the end of IP and 15 patients showed persistence of cavitation in smokers while 76% of non smokers showed clearance of cavity (P-0.05). This data suggests that smokers and ex smokers demonstrate more persistence of cavitation on X ray at the end of treatment as compared to non smokers.

### Treatment Outcome Based on Smoking Status

Smoking shows a definite or strong impact on TB treatment, our study results show that only 52.5% of

TB patients who are smokers recovered, whereas, TB patients who do not smoke 84% of them recovered from TB. Subsequently treatment failure rate was higher (6.4%) as compared to other categories such as non smokers. Death rate is also found to be high in TB patients with smoking followed by TB patients with smoking habit. Our result clearly show that smoking affects TB treatment and prognosis. Cure rate among smokers, non smokers and former smokers were 52.5%, 84% and 78%, respectively (P-0.05) (Table-5).

Chronic exposure to tobacco impairs normal clearance of secretion on the trachea-bronchial mucosal surface and may thus allow the causative organism mycobacterium tuberculosis, to escape the first level of host defences which prevent bacilli from reaching the alveoli. Smoking disturbs the function of pulmonary alveolar surfactants. Nicotine acts directly on nicotine acetylcholine receptors on macrophages to decrease production of intracellular tumour necrosis factor and thus impair killing of TB bacilli. Because of this effect there is an increased risk of acquiring TB or progression of TB [6]. The higher grades of sputum smear positivity could explain the cavitation in X-rays.

Sputum grading is much influenced in smokers. Out of 124 current smokers, 83 (66.93%) were having greater bacterial load with sputum 3+ and very few with sputum scanty grade. These results show the destructive effect of smoking on cellular immune function. 55% of ex smokers are in sputum 3+ and in non smokers it is only 42.6%. which confirms that smoking would increase the risk of TB, change latent TB into active infective TB. Many of smoker TB patients showed cavitation. Cavitation implies a high bacillary burden and high infectivity and is a risk for bacterial or fungal super infection. Lungs are usually filled with air. In chest x-ray, air in the lungs cause x ray appear to black. A white shadow appear from an infiltrate.

**Table-2: Radiological presentations in pulmonary tuberculosis patients**

Radiological findings	Smoker TB patients	Non smoker TB patients	P value
Cavitations	51(22.97%)	34(19.42%)	0.3925
Opacity	19(8.55%)	7(4%)	0.0691
Shadow	5(2.25%)	4(2.28%)	0.9841
Consolidation	3(1.35%)	1(0.57%)	0.44

**Table-3: Bacterio radiological extent and treatment response with respect to smoking index**

Sl no	Smoking habits	Sputum grade (3+) N=213 (53.65)	Initial X ray cavitation	Sputum negative at the end of IP	X ray cavitation at the end of IP	Chi square significance level
1	Current smoker	83(66.93)	27(21.77)	15(18.07)	23(85.18)	0.05
2	Ex smoker	54(55.10)	22(22.44)	38(70.37)	18(81.81)	
3	Non smoker	76(42.69)	33(18.53)	58(76.31)	25(75.75)	

**Table-4: Bacterio radiological profile and treatment response with respect to smoking**

Smoking index	Initial bacillary load	Initial X ray cavitation	Sputum conversion at the end of IP	Xray cavitation remaining at the end of IP	Chi square significance level
<100	208	45	96	15	0.05
100-200	14	2	1	1	

**Table-5: Treatment outcome based on smoking status**

Treatment outcome	Smoking history			
	Current smoker n (%)	Ex smoker n (%)	Non smoker n (%)	Total n(%)
TB Cured	65(52.5)	76(78)	150(84)	291(73)
TB defaulter	38(31)	16(16)	18(10)	72(18)
TB failure	8(6.45)	3(3)	5(2.8)	16(4)
Death	13(10.48)	3(3)	5(2.8)	21(5)
Total	124(31)	98(24)	178(44)	400(100)
Chi square significance level	0.05			

## CONCLUSION

Study shows male predominance (80.5%) in our TB patient population. Smoking habit is very common and 55.5% of study patients are smokers. Smoking has influenced to TB infection and also treatment. Smoking has increased the bacillary load (higher grades of sputum positivity). Smokers x-ray showed cavitation, indicating the severity of disease. At the end of treatment many smokers had persistent cavitation. Smokers also had a poorer outcome in terms of treatment success rate as compared to non smokers. This was largely due to high percentage of default rate among smokers implying treatment adherence issues among smokers as a main confounder to treatment success.

## Future Course of Action

There is an urgent need for default retrieval action among this subgroup of TB patients including motivation and counselling. TB control programs may also benefit from a focus on smoking cessation interventions. Study of psychosocial factors among these patients might help understand their behaviour and improve treatment outcome.

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