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TUBERCULOSIS AND TOBACCO: ANALYZING THE CONSEQUENCES OF SMOKING ON TREATMENT OUTCOMES

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Abstract

Introduction: Tobacco use, in the form of smoking, has been a pervasive and long-standing global public health issue in its own right. What is less understood, though equally important, is the intricate interplay between tobacco use and TB. Understanding the consequences of smoking on TB treatment outcomes is imperative, as it has far-reaching implications for both individual patients and the broader efforts to control and eliminate TB worldwide.

Aims & Objectives: To determine the socio-demographic profile of newly diagnosed tuberculosis patients at a tertiary-level hospital and to determine the impact of smoking on treatment outcomes of newly diagnosed tuberculosis patients at the end of six months of standardized tuberculosis treatment.

Material & Methods: A prospective cohort study was carried out among newly diagnosed tuberculosis patients of tertiary care hospital of Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan. Data was collected through a structured interview schedule after taking institutional ethical committee approval, Data was analyzed using Epi Info software and treatment outcomes were defined as per recent RNTCP guidelines.

Results: A total of 64 patients were included in the study. While majority of the study participants (96.8%) showed favorable outcome at the end of treatment, only (3.2%) showed un-favorable outcome, one patient was having treatment failure and one patient was lost to follow up, no deaths were reported during the course of treatment.

Conclusions: In light of these findings, it is crucial to recognize that addressing tobacco use is not only an essential component of TB control but also an imperative in improving global public health.

Keywords: Tuberculosis, Tobacco, Smoking, Treatment outcome

Introduction

Tuberculosis (TB) is a global public health crisis, with millions of people affected by this infectious disease annually. Despite significant advancements in medical science and healthcare systems, TB remains a major health concern, particularly in low- and middle income countries. The effective treatment of TB is essential not only for the well being of individual patients but also for the

prevention of its transmission in the community. However, one critical factor that often complicates TB treatment outcomes is the use of tobacco.

Globally, TB is one of the top 10 causes of death and the leading cause of a single infectious agent (above HIV/AIDS). [1] The tobacco epidemic is one of the biggest public health threats of all times the world has ever faced, killing more than 7 million people a year. [2] According to the Global Adult Tobacco Survey-2 (2016-17) prevalence of use of any form of tobacco was 28.6% while the prevalence of smoking was found to be 10.7 % among the adult Indian population. [3,4]

Tobacco use, in the form of smoking, has been a pervasive and long-standing global public health issue in its own right. What is less understood, though equally important, is the intricate interplay between tobacco use and TB.

Understanding the consequences of smoking on TB treatment outcomes is imperative, as it has far-reaching implications for both individual patients and the broader efforts to control and eliminate TB worldwide.

World Health Organization in 2015 had adopted "End TB Strategy" aimed at ending the global TB epidemic by 2035. [5] As a signatory to this strategy, the Government of India has kept the target of TB elimination by 2025 and Rajasthan has set to achieve it before 2023 thereby making the first TB free state of the country. [6] To improve the treatment outcomes and subsequently reduce the morbidity and mortality due to TB, there is an urgent need to identify the predictors of poor treatment outcomes. Tobacco smoking has been reported to be associated with many aspects of TB disease, including increased vulnerability to being infected, recurrence with TB and related mortality. [7,8,9]

As the global community strives to reach the Sustainable Development Goals, which include targets for TB elimination and the reduction of non-communicable diseases, it is crucial to assess and address the impact of tobacco use on TB. By comprehensively analyzing the consequences of smoking on TB treatment outcomes, this research aims to contribute valuable insights that can inform public health policies and initiatives designed to combat both TB and the tobacco epidemic.

Keeping this in mind, the current study has been planned to determine an effect of smoking on treatment outcomes among newly diagnosed tuberculosis patients.

This research aims to delve into the multifaceted relationship between tobacco smoking and TB treatment outcomes with following objectives.

1. To determine the socio-demographic profile of newly diagnosed tuberculosis patients at a tertiary-level hospital, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan
2. To determine the impact of smoking on treatment outcomes of newly diagnosed tuberculosis patients at the end of six months of standardized tuberculosis treatment.

Materials and Methods

Study Type: This study was a prospective cohort study.

Study Population: Newly diagnosed adult (≥ 18 years) tuberculosis patients were included in the study.

Study Area: A tertiary care hospital of Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan.

Sample Size and inclusion criteria: All consecutive patients were registered in the hospital during the study period from February to July, 2019 and based on inclusion and exclusion criteria, a total of 64 patients were included in the study.

Ethical Approval, Consent: Study was carried out after taking due permission from the Institutional Ethics Committee and after taking informed consent from participants.

Exclusion criteria: Multi/Extensive drug-resistant, previously treated, patients on immunosuppressive therapy and pregnant patients were excluded from the study.

Data collection: Data was collected through a structured interview schedule and smoking status was collected using the standard questionnaire which was used for collection of data regarding tobacco use in the Global Adult Tobacco Survey **(GATS)**. [10]

Interview schedules also contained self-reported information on alcohol use, socioeconomic indicators, human immunodeficiency virus (HIV) status, diabetic status, housing conditions, overcrowding and other relevant information related to study. The socioeconomic status of participants was determined according to the modified BG Prasad scale. Face-to-face interviews with eligible participants were conducted. All consecutive eligible patients were recruited and information collected from them according to the same procedure as described above. Details of the participant's final treatment outcomes after the end of the standardized treatment of 6 months were collected. Treatment outcome were classified either as favorable (cured or treatment completed) or unfavorable outcome (failure, loss to follow up or died).

Working definitions: -
Current smokers were defined as those who smoke daily or non-daily basis at the time of interview whereas **past smokers** as those who had ever smoked in their lifetime either daily or less than daily basis, but not smoking at the time of interview.
Ever smoker is defined as either current or past smoker.

Treatment outcomes were defined as per recent RNTCP guidelines.

1. Favorable Outcomes: -
a) Cured: Microbiological confirmed TB patient at the beginning of treatment who was smear or culture negative at the end of the complete treatment
b) Treatment completed: A TB patient who completed treatment without evidence of failure or clinical deterioration but with no record to show that smear or culture results of biological specimen in the last month of treatment was negative, either because test was not done or because result is unavailable.

2. Unfavorable outcomes: -
a) Failure: A TB patient whose biological specimen is positive by smear or culture at the end of treatment.
b) Lost to follow up: A TB patient whose treatment was interrupted for one consecutive month or more
c) Died: A patient who has died during anti TB treatment.

Data analysis:
Data was analyzed using Epi-Info software version 7.2.2. Frequencies and percentages were used for the description of variables. Pearson Chi-square and Fischer Exact test will be applied for univariate association analysis. P -value of < 0.05 was considered as statistically significant.

Results
A total of 278 patients were enrolled during the study period in Designated Microscopy Centre of Jaipur Institute of Medical Science and Research Centre, Jaipur, Rajasthan. Based on the inclusion and exclusion criteria, out of these, 64 patients were included in the study. (**Figure 1)**

Mean age of the study participants was found to be 32.8 years ranging from 18 to 66 years. Around 60% of the study participants were males and around 40% were females. Majority (89.1%) of the study participants were belonging to Hindu religion and rest were belonging to other religions (Muslim, Christian etc.) For the sake of convenience, all religions other than Hindu were clubbed under single category as others. Majority of the study participants were literate (93.8%), and

employed (81.3%). While majority of the study participants were belonging to upper and middle class of socio-economic status (71.9%) according to modified kuppuswamy scale and more than half of study participants (56.3%) were having normal body mass index. Around 14.1% of study participants were found to be having one or more co-morbid condition (eg. Hypertension, Diabetes Mellitus etc), 15.6% gave history of alcohol use and 25% of study participants were ever smokeless tobacco users **(Table 1)**

Of the total 64 study participants, 20(31.25%) were smokers. Among them, majority (18) were males while rest of them (2)were females.
Cigarette smoking was found to be most common form in which tobacco was used by study participants followed by bidi smoking which was found in 21% of participants.
While majority of the study participants (96.8%) showed favorable outcome at the end of treatment, only (3.2%) showed un-favorable outcome, one patient was having treatment failure and one patient was lost to follow up, no deaths were reported during the course of treatment

While assessing the association between various Socio-demographic characteristics and risk of poor tuberculosis treatment outcomes, significant association (p value <0.05) was found between education status, occupational status, socio-economic status, co-morbid condition and alcohol use with unfavorable TB treatment outcome **(Table 2)**

Table 1: Socio-demographic and Clinical Characteristics of Study participants

Characteristics	No. of participants N (%)	Smokers (%)	Non Smokers (%)
Age (Years)			
< 60	59 (92.2)	16 (27.1)	43 (72.9)
≥ 60	5 (7.8)	4 (80.0)	1 (20.0)
Gender			
Male	38 (59.4)	18 (47.4)	20 (52.6)
Female	26 (40.6)	2 (7.7)	24 (92.3)
Religion			
Hindu	57 (89.1)	21 (36.8)	36 (63.2)
Others	7 (10.9)	6 (85.7)	1 (14.3)
Education Status			
Illiterate	4 (6.3)	4 (100)	0 (0)
Literate	60 (93.8)	16 (26.7)	44 (73.3)
Occupation			
Unemployed	12 (18.8)	7 (58.3)	5 (41.7)
Employed	52 (81.3)	14 (26.9)	38 (73.1)
Socio- economic status			
Upper & Middle Class	46 (71.9)	12 (26.1)	34 (73.9)
Lower Class	18 (28.1)	8 (44.4)	10 (55.6)
Body Mass Index			
Normal	36 (56.3)	12 (26.1)	24 (66.7)
Underweight & Obesity	28 (43.8)	8 (44.4)	20 (71.4)
Co- Morbid Condition			
Present	9 (14.1)	6 (66.7)	3 (33.3)
Absent	55 (85.9)	14 (25.5)	41 (74.5)
Alcohol Use			
Yes	10 (15.6)	9 (90.0)	1 (10.0)
No	54 (84.4)	11 (20.4)	43 (79.6)
Smokeless Tobacco use			
Ever User	16 (25.0)	14 (87.5)	2 (12.5)
Never User	48 (75.0)	6 (12.5)	42 (87.5)

Majority of the study participants were < 60 of age group, majority of them were males, belonging to Hindu religion with majority of them belonging to upper and middle class.

Table 2: Association between Socio-demographic characteristics and Risk of Poor Tuberculosis Treatment Outcomes

Characteristics	Favourable outcome (%)	Un-favourable outcome (%)	p value
Age (Years)			
< 60	57 (89.1)	2 (3.1)	0.675
≥ 60	5 (7.8)	0 (0)	
Gender			
Male	36 (56.3)	2 (3.1)	0.234
Female	26 (40.6)	0 (0)	
Religion			
Hindu	54 (87.1)	1 (1.6)	0.078
Others	6 (9.7)	1 (1.6)	
Education Status			
Illiterate	3 (4.7)	1 (1.6)	**0.009***
Literate	59 (92.2)	1 (1.6)	
Occupation			
Unemployed	10 (5.6)	2 (3.1)	**0.002***
Employed	52 (81.3)	0 (0)	
Socio- economic class			
Upper & Middle Class	46 (71.9)	0 (0)	**0.021***
Lower Class	16 (25.0)	2 (3.1)	
Body Mass Index			
Normal	35 (54.7)	1 (1.6)	0.856
Underweight & Obesity	27 (42.2)	1 (1.6)	
Co- Morbid Condition			
Present	7 (10.9)	2 (3.1)	**0.003***
Absent	55 (85.9)	0 (0)	
Alcohol Use			
Yes	8 (12.5)	2 (3.1)	**0.008***
No	54 (84.4)	0 (0)	
Smokeless Tobacco use			
Ever User	15 (23.4)	1 (1.6)	0.406
Never User	47 (73.4)	1 (1.6)	

* P -value of < 0.05 was considered as statistically significant.

A significant association was found between educational status, ccupation, socio-economic status, co-morbid condition and alcohol use with poor tuberculosis treatment outcome as p value was found to be < 0.05 in all these conditions.

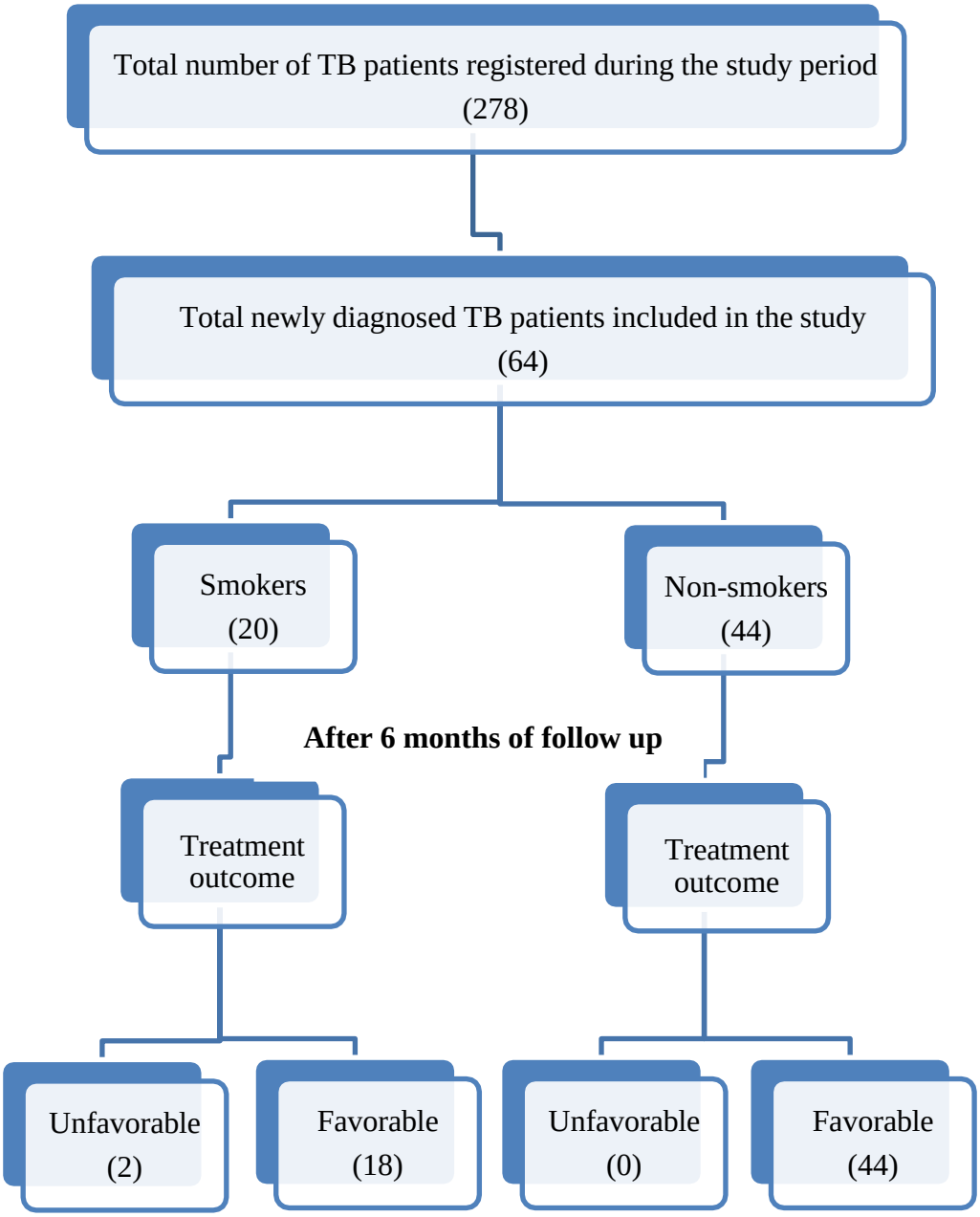

Figure 1: Flow chart of analyzing the Consequences of Smoking on Treatment Outcomes

Discussion

As we have mentioned in the results also that a total of 278 patients were enrolled during the study period and based on the inclusion and exclusion criteria, out of these 64 patients were included in the study. Of those 64 patients, 20 were found to be current smokers. Among them, 18 patients showed favorable treatment outcome but 2 patients showed unfavorable outcome, among them 1 patient had treatment failure and other one was lost to follow up which was included in unfavorable outcome as mentioned in working definition also.

Study done by Reddy DS et al [11] in 2009 in Khammam Tuberculosis Unit showed that of the total 413 patients enrolled in the study, cure rate was found to be 85.47% which is in line with our findings. Study done by Chandrasekaran V et al [12] in Tiruvallur district of Tamil Nadu found that 14.6% were defaulters among smokers in comparison to 5.9% among non smokers and 17.1% were defaulters among alcoholics in comparison to 6% among non-alcoholics. Similar findings were reported from our study also where association of acohol intake with poor TB outcome was found to be statistically significant.

A retrospective analysis [13] of 9822 new pulmonary TB cases registered between 1998 and 2000 in twenty four public tuberculosis dispensaries in Istanbul showed that the treatment success and the default rates were 82% and 9% respectively.
Study done by Kumar Mahesh et al [14] also reported that non compliance was more among smokers (11.5%) in comparison to non-smokers (6.1%) and non-compliance was more among alcoholics (23.9%) in comparison to non alcoholics (6.2%). The findings of the study showed similar pattern as the results were seen in our study.
Study done by Jakubowiak WM et al [15] in six Russian regions regarding the course of the disease, there is sufficient evidence indicating that heavy alcohol consumption disrupts medication intake regimens and negatively affects help seeking and treatment processes, leading to worse treatment outcomes compared to abstinence, similar to our findings.
In our study tobacco smoking was found to be significantly associated with unfavorable treatment outcomes. Study done by Gupta PC et al [16] in Mumbai in 2005 also shown that smoking is associated with increased risk of tuberculosis mortality and tuberculosis treatment failure.
Smoking induces coughing and other symptoms consistent with tuberculosis, there may be longer delays in the diagnosis of tuberculosis among smokers than among non-smokers and they are presenting with more advanced disease at the time of diagnosis. Biological mechanisms related to smoking that impair host defenses and increase the risk of M. tuberculosis infection probably contribute to the relatively poor results of tuberculosis treatment among smokers. [17]

Conclusion

In light of these findings, it is crucial to recognize that addressing tobacco use is not only an essential component of TB control but also an imperative in improving global public health. Public health campaigns should prioritize educating both healthcare providers and individuals about the harmful effects of smoking in the context of TB, and offer comprehensive tobacco cessation support alongside TB treatment.

Recommendations

- **Integrate Smoking Cessation Programs into TB Care:** Health systems should incorporate smoking cessation programs as a routine part of TB care. By addressing tobacco addiction alongside TB treatment, we can improve treatment outcomes and long-term health prospects.
- **Raise Awareness:** Public health campaigns should be initiated to raise awareness about the risks of smoking and its association with TB.
- **Training for Healthcare Providers:** Equipping healthcare providers with the skills and knowledge to address tobacco addiction will enhance their ability to support patients in their journey towards cessation.
- **Research and Data Collection:** Invest in further research to better understand the relationship between smoking and TB, especially in diverse populations and different contexts.
- **Target High-Risk Populations:** Identify high-risk populations that are particularly vulnerable to both TB and smoking and focus on interventions to address the unique challenges they face.

Limitations of the study

- **Small Sample Size:** One of the primary limitations of this study is the relatively small sample size. This limited sample may not fully represent the diversity of TB cases and tobacco use patterns, potentially introducing a selection bias that can affect the generalizability of the findings.
- **Single-Center Study:** The study was conducted in a single healthcare facility, which may not be representative of the broader population.
- **Lack of Control Group:** The absence of a control group of non-smoking TB patients hinders the ability to compare treatment outcomes effectively. Without a control group, it is challenging to attribute the observed differences solely to smoking.

- **Self-Reported Data:** The study relied on self-reported smoking status. Some patients might have concealed or downplayed their smoking habits and intensity, which can be subject to underreporting or social desirability bias.
- **Generalizability:** Due to the limitations mentioned above, the findings of this study may not be broadly generalizable to different populations, healthcare settings, or regions.

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