

Smoking as a risk factor for pulmonary tuberculosis in adults

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Tobacco use, particularly smoking, is widely recognized by the medical community as well as the general public as a major public health problem. The aim of this study was to determine tobacco smoking as a behavioral risk factor associated with pulmonary tuberculosis in adults. A case-control study design was used. The study subjects were 100 new pulmonary TB patients (cases) and age-sex matched 100 non-TB cases and healthy subjects (controls) attending Township TB Centre in Kyimyindine Township, Yangon from November 2006 to June 2007. Data were collected by face-to-face interview using questionnaires. Among the cases, proportion of non-smokers, current active smokers and ex-active smokers were 39%, 41% and 20%, respectively. Among the controls, they were 60%, 27% and 13%. It was found that current active smoking was associated with development of pulmonary TB (OR=2.15, 95% CI=1.05-4.38). Moreover, active smokers who started smoking at ≤ 20 years of age (OR= 4.12, 95% CI=1.7-9.99), or had a duration of >10 yrs (OR=4.18, 95% CI=1.63-10.73), or smoked more than 10 cigarettes/day (OR=3.13, 95% CI=1.47-6.66), were at a higher risk of pulmonary TB compared to non-smokers. Therefore, an effective anti-smoking campaign is needed to have a positive repercussion on TB incidence.

INTRODUCTION

Tobacco use, particularly smoking is widely recognized by the medical community as well as the general public as a major public health problem. The risk from tobacco smoke is not limited to the smoker alone but also affects those around the smoker [1]. Smoking is prevalent worldwide. The USA exports 194 billion cigarettes yearly, mainly to the developing world where the level of smoking habit is largely unrecorded. However, the annual rise in the number of smokers is estimated to be 2.1% [2]. Tuberculosis has re-emerged to become the world's leading cause of death from a single infectious agent, accounting for a quarter of the avoidable adult deaths in the developing world [3]. Nearly one third of world's population is infected with *Mycobacterium*

tuberculosis and 3 million people die due to TB every year [4]. Both smoking and TB primarily affect the lungs as they enter the lung through inhalation route. Long-term exposure to smoking has an adverse effect on the lung's defense mechanisms [5].

The prevalence of pulmonary tuberculosis among men aged 15 years and over is 2-4 times higher than in women of the same age. Interestingly, there is no difference in prevalence between two sexes below 15 years but the rates diverge above this age [6]. This sex difference may be due to either biological or behavioral (health related) changes occurring at about the age of 15 in one or both sexes. The tobacco smoking habit starts in men around the age of 15. So, it is possible that there is an association between tobacco smoking and higher rates of TB in men.

Although smoking is one of the literature-cited factors, the association between smoking and pulmonary tuberculosis has been assessed in very few studies and none in Myanmar. Using WHO guidelines, there are effective TB control programs and highly effective treatment is available, however, if people are not aware of its seriousness and prevention, especially behavioral risk factors, it will remain a public health problem. For these reasons, it is important to determine smoking as a risk factor associated with TB manifestation in adults. This knowledge can be utilized to develop a program for TB prevention and control and also for antismoking campaigns.

General objective

- To determine tobacco smoking as a behavioral risk factor associated with pulmonary tuberculosis in adults

Specific objectives

- To identify smoking status related to pulmonary tuberculosis
- To find out the association of smoking habits with pulmonary TB among active smokers

MATERIALS AND METHODS

Study design

A clinic-based case-control study was carried out.

Study area

Secondary health centre (Township TB Centre) in Kyimyindine Township, Yangon Division was selected.

Study population

A total of 200 subjects were recruited. Study subjects were 100 new pulmonary TB patients (cases) and age-sex matched 100 non-TB cases and healthy subjects (controls).

Exclusion criteria

- Known cases of diabetes mellitus
- Known cases of HIV-positive patients

- Patients who currently had an immunosuppressive drugs
- Those who had evidence of any other lung diseases

Working definitions

Case

A new pulmonary TB case, aged ≥ 15 years, diagnosed at Tuberculosis Center (Yangon Division) and referred to Township TB Centre for subsequent treatment and never had a treatment for TB (new patients who have taken anti-TB drugs for less than 4 weeks will be included). The TB criteria are at least two sputum specimens positive for acid fast bacilli (AFB) by microscopy, or with at least one sputum specimen positive for AFB and radiographic abnormalities relevant to pulmonary tuberculosis.

Control

Non-TB cases and healthy subjects, aged ≥ 15 years who came to the secondary health centre for various reasons (e.g. medical check-up). They did not have any history of TB. Controls were matched for sex and for age within 10 years interval (15-24 years, 25-34 years, 35-44 years, 45-54 years and ≥ 55 years).

Non-smoker

Any person who has never smoked (non-active smoker) or who has never or less than 3 times/week been exposed to tobacco smoked by others at home, work, or in public places (non-passive smoker).

Current active smoker

Any person who smoked a tobacco product at the time of the study or persons who used to smoke but had stopped smoking < 6 months before the interview.

Ex-active smoker

Any person who used to smoke and had stopped smoking ≥ 6 months before the interview.

Passive smoker

Any non-smoker who was exposed to tobacco smoke > 3 times/week, either at home, work, or in public places.

Sample size determination and sampling

Assuming that prevalence of smoking in control population 40%, OR=2.5, confidence level=95% and power 80%, desired sample size was 85 in each group, for case:control rate of 1:1. Taking non-responses into account, 100 each for cases and controls were recruited for the study.

Consecutive sampling method was used to recruit cases, followed by selection of controls matched for age and sex.

Data collection

Data collection was done from November 2006 to June 2007. All subjects enrolled in the study were interviewed by the trained personnel. Informed consent was taken prior to the interview. Following data were collected from cases and controls using a pretested semi-structured questionnaire;

- Background characteristics
- Smoking status (non-smoker/ current active smoker/ ex-active smoker/ passive smoker)
- Age at which smoking started
- Duration of smoking
- Type of tobacco smoked
- Quantity of item smoked per day
- Data on potential confounding factors
 - Alcohol drinking
 - History of TB in the family
 - House environment
 - Body mass index (BMI)

Statistical analysis

Background characteristics of case and control groups were compared using chi square test. Smoking status and habits were compared among the cases and controls. The univariate analysis and multiple logistic regression methods (adjusting for potential confounding factors) were used to find out the effect of smoking on TB. The crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated using stata 8 software. The level of significance was set at 0.05. Due to the small number of passive smokers, we merged this category

into category of non-smokers for the analysis.

Ethical consideration

This study was approved by the Institutional Ethical Review Committee of Department of Medical Research (Lower Myanmar).

RESULTS

In the case and control groups, the number of persons in each sex and age group were more or less similar. The majority of cases and controls were males between 15-34 yrs, married and had family members between 4-6. There was a significant difference between two groups regarding the education. The control group was found to have higher education status than the cases. Occupations were more or less similar between the two groups (Table 1).

Table 1. Background characteristics of case and control groups

Variable	Case (n=100)		Control (n=100)		p value*
	Number	Percent	Number	Percent	
Sex					
Male	89	89	89	89	1.00
Female	11	11	11	11	
Age (years)					
15- 34	53	53	49	49	0.62
35- 54	39	39	39	39	
≥ 55	8	8	12	12	
Education					
Primary school	35	35	13	13	<0.001
Middle school	40	40	30	30	
High school	18	18	25	25	
College	7	7	32	32	
Occupation					
Government employee	7	7	17	17	0.07
Employee at private business	7	7	7	7	
Own business	29	29	36	36	
Unskilled labour	35	35	28	28	
Dependent	22	22	12	12	
Marital status					
Single	19	19	24	24	0.64
Married	70	70	64	64	
Others	11	11	12	12	
Number of family members					
1-3	23	23	21	21	0.9
4-6	51	51	53	53	
≥7	26	26	26	26	

* Chi square test

Table 2 shows the association of other factors (confounding factors) with pulmonary TB in the study population. Body mass index (BMI) had a significant difference between case and control groups. Thus, education and BMI were found to be potential confounders in this study and controlled for in the final analysis.

Table 2. Association of other factors (confounding factors) with pulmonary TB in the study population

Variable	Case (n=100)		Control (n=100)		p value*
	Number	Percent	Number	Percent	
<i>Alcohol</i>					
No	51	51	45	45	0.24
Yes	49	49	55	55	
<i>Family history of TB</i>					
No	79	79	85	85	0.18
Yes	21	21	15	15	
<i>BMI (Body Mass Index)</i>					
Under weight	51	51	24	24	< 0.001
Normal	38	38	61	61	
Over weight	11	11	15	15	

* Chi square test

Table 3 shows the association of smoking status with adult pulmonary tuberculosis. It was found that among the cases, 41% were current active smokers and 20% ex-active smokers, whereas in control group 27% were current active smokers and 13% ex-active smokers. Current active smoking was associated with development of pulmonary TB.

Table 3. Association of smoking status with adult pulmonary TB

Smoking status	Case (n=100) (%)	Control (n=100) (%)	Crude OR (95% CI)	Adjusted OR ^a (95% CI)	p value
Non-smoker (Ref)	39	60	1	1	
Current active smoker	41	27	2.34 (1.24-4.39)	2.15 (1.05-4.38)	0.03
Ex-active smoker	20	13	2.37 (1.06-5.3)	2.03 (0.79-5.2)	0.14

^a Adjusted for education and BMI

Ref = Reference category

Moreover, active smokers who started smoking at ≤ 20 years of age, or had a duration of >10 years, or smoked more than 10 cigarettes/day were at a higher risk of

pulmonary TB compared to non-smokers (Table 4).

Table 4. Association of smoking habits with pulmonary TB among active smokers

Smoking status	Case (n=100) No. (%)	Control (n=100) No. (%)	Crude OR (95%CI)	Adjusted OR ^a (95%CI)	P value
Non-smoker (Ref)	39	60	1	1	
Active smokers n=61 n=40					
<i>Age of start smoking</i>					
<20 yrs	34	11	4.75 (2.16-10.48)	4.12 (1.7-9.99)	0.002
>20 yrs	27	29	1.43 (0.74-2.77)	1.33 (0.62-2.82)	0.46
<i>Duration of smoking</i>					
<10 yrs	33	31	1.64 (0.87-3.09)	1.45 (0.69-3.03)	0.32
>10 yrs	28	9	4.79 (2.04-11.22)	4.18 (1.63-10.73)	0.003
<i>Number of cigarette smoked per day</i>					
1-10	16	19	1.29 (0.59-2.82)	1.11 (0.47-2.67)	0.33
>10	45	16	3.30 (1.71-6.36)	3.13 (1.47-6.66)	0.02

^a Adjusted for education and BMI

Ref = Reference category

DISCUSSION

This study showed that current active smoking was associated with an increased risk for developing active pulmonary TB in adults with relative odds increased to 2.15 times. This result corresponded with other studies, but the risk estimated for TB was different. Alcidine *et al*, in a case-control study, showed the risk estimated for TB was higher (OR=3.8, 95% CI=1.5-9.8) for active smokers among young adults between 15 to 24 years) [7]. In Niorn *et al*'s report of a case-control study, multiple logistic regression analysis showed OR of 2.7 (95% CI= 1.04-6.97) for current active smokers [8]. The adjusted OR of both studies was higher compared to the present study because of the difference in study design, study population and sample size.

This study found the number of cigarettes/ cheroots smoked per day and duration of smoking were strongly associated with active pulmonary TB in active smokers. The results corresponded with other studies.

Peng *et al.* found that persons who smoke >20 cigarettes a day had 2.5 times (95% CI=1.11-5.6) more risk of pulmonary TB compared to non-smokers [9]. Yu *et al.* also found that relative risk of heavy smokers (≥ 400 cigarettes a year) compared with non-smokers was 2.17 (95% CI=1.29-3.63) [10]. Regarding the duration of smoking, Baskin *et al.* reported that persons smoking for ≥ 20 years had 2-3 times higher risk than never smokers [11].

These findings were consistent with the understanding that long-term exposure to cigarettes smoke had an adverse effect on the lung's defense mechanism, namely clearance of potential pathogens, such as *M. tuberculosis* [5]. Cilia are tiny hair-like projections which help to sweep dirt and waste products out of the lungs. When impaired by exposure to cigarette smoke, the cilia can not perform this cleansing process [12]. The acute inhalation of cigarette smoke results in ciliostasis and reduced mucociliary clearance by converting ciliated epithelium to non-ciliated epithelium, by altering the amount and character of the mucus products, and by inflammatory and emphysematous narrowing of the airways [13, 14].

Smoking affects the normal function of alveolar macrophages which eliminate microorganisms, including *M. tuberculosis*, from the distal airway and keep the alveoli sterile. *M. tuberculosis* can survive within the macrophage, particularly if the immune system is not operating adequately [15]. The occurrence of tuberculosis is thought to be linked to altered immune response, multiple defects in macrophage/monocyte immune responses and CD4 lymphopenia [16]. Tobacco smoke could alter native and acquired resistance to *M. tuberculosis*. Exposure to tobacco smoke also results in morphological and functional changes in the alveolar macrophages [17]. All of these factors, in combination, may contribute to increased susceptibility of an individual to tuberculosis infection and occurrence of the disease.

Conclusion

The findings of the study highlighted effects of smoking on pulmonary tuberculosis in adults. Therefore, an effective anti-smoking campaign is needed to have a positive repercussion on TB incidence in the country.

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