Smoking behaviour among Tuberculosis relapse cases attended at tertiary level hospitals in Dhaka city of Bangladesh

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Abstract:

This case-control study was conducted in two tertiary level hospitals in Dhaka City to determine the association between smoking habit and relapse tuberculosis (TB).

The study population was registered adult patients who got complete treatment within 2-5 years. Relapse and non-relapse TB cases are listed serially in hospital record books. The relapse cases were selected randomly as case group and age-matched ($\pm$ 2years) cured patients with the respondent of case group were included as control groups. A total of 170 respondents in each case and control groups were selected with 80% power and assuming 14% differences between cases and controls. The selected respondents who visited the respective hospitals on the scheduled day were interviewed face to face for data collection.

Mean age of the participants was 39.7$\pm$11.56 years. Significantly ($\chi2$=20.767; p=0.000) a lower proportion of the relapse cases were found to get complete TB treatment 3 years before in comparison to that of control group. Family size more than five, education of secondary level, two earning members in the family, past smoker, smoked more than 10 cigarettes per day and exposure to second hand smoking were found to be significantly associated with higher proportion of relapse cases. Regression analysis revealed that exposure to second-hand smoking and past smokers were 2.4 and 2.0 times more likely to develop relapse TB respectively.

Tuberculosis relapse case was more likely to develop within three years of the complete TB treatment. Past smoking habit and exposure to second-hand smoking had the strongest likelihood of developing more TB relapse cases.

Introduction

Tuberculosis (TB) is a major public health problem in the world. In 2014, among 100,000 people, 133 were estimated to be contracted TB [1]. Bangladesh ranks sixth among the high TB burden countries [2, 3, 4]. Annual incidence and prevalence of TB for all cases in Bangladesh was 225 and 411 per 100,000 populations respectively [5]. WHO categorized smoking as a high burden for tuberculosis and reported that the burden of smoking among patients with tuberculosis was poorly defined [1]. Study findings revealed that people who smoked had approximately twice the risk of both Mycobacterium tuberculosis infection and active tuberculosis [6]. A recent systematic review and meta-analysis of 24 published studies showed that individuals who smoked had a 73% increased risk of becoming infected with tuberculosis and were more than twice as likely to develop active tuberculosis than those who did not smoke. This review further revealed that smokers were 40 to 60 per cent more likely than non-smokers to develop tuberculosis after being infected with TB bacteria. Smoking could decrease immune response or damage the function of cilia in the airways and increase the risk for TB [7]. Smoking also increases the risk of relapses even after successful treatment of tuberculosis [8].

The Government of Bangladesh has prioritized to eliminate Tuberculosis [9]. Smoking is a modifiable exposure, therefore, in Bangladesh highlighting smoking as a risk factor for TB may have greater resonance. Very few published studies could address about how smoking behaviour or smoking cessation influenced the outcome of tuberculosis [10]. This study aimed to examine the extent of the risk of smoking behaviour among TB cases in selected tertiary level hospitals of Dhaka City in Bangladesh.

Methodology

This was a case-control study conducted among the TB-relapse and non-relapse (cured) cases who got complete TB treatment from the National Institute of Diseases of the Chest and Hospital (NIDCH) and TB Hospital in Dhaka, Bangladesh. These two hospitals have specialized facilities. A major proportion of the TB patients in the country are handled by them. These hospitals maintain patient's registration books and keep records of the relapse and cured TB cases serially. The study population was the registered adults (>18 years) TB patients who got complete treatment within 2 to 5 years from the respective hospitals. The registered

relapse case was selected as the participants of the case group and who were registered as cured (non-relapse) were selected as the participants of the control group.

The study sample size was calculated by using the formula: $n=z^2_{1-\infty/2}$ (P_1 $(1-P_1)$ +P_2 $(1-P_2)$)/d^2, where z = 1.96; d= acceptable level of error=10; P_1 and P_2 =anticipated population of adverse effect of smoking. By using Epi sample size calculator a sample of 170 cases and 170 controls were determined at 5% level of significance and 80% power of the test, where the anticipated prevalence of smoking with no recurrence or recurrence of relapse 23.2% and 37.2% respectively.

A total of 2664 TB patients (>18 years) were recorded in the registration books of both the hospitals within 2 to 5 years, of them 205 were relapse cases and other were non-relapse cases. From the list, 170 relapse cases were selected randomly as the respondents of case group while age-matched (± 2years) participants with the respondent of the case group from nearest serial were included in the control group. The selected participants who could not attend or did not give consent to participate in the study were replaced with the individual from the nearest serial of the registration books. Ultimately 340 respondents (170 case and 170 control) who visited the respective hospitals on the scheduled day were interviewed face to face for collection of data. Ethical issues of the study were reviewed and approved by the Research Ethics Committee of Daffodil International University, Bangladesh.

Results

The mean age of the respondents was 39.8 (±11.44) years and 47.1% of them belonged to 26-40 years age group. Age difference was not significant between case and control groups. Above 86% of the respondents were married. A higher proportion of them were from the case group (88.8%). About 57% and 25.3% of the respondents completed the secondary level of education and graduation respectively. Among the graduated 31.8% were from the control group and the difference was significant (χ^2=7.705; p=0.021). About forty four percent (43.8%) of both the groups were service holder and the rest were business (38.2%) and unemployed (8.5%) (Table-1).

<<Table 1 about here>>

Most of the respondents (68.5%) had family members up to 5 (Table-2). Significantly (χ^2=4.923; p=0.026) a higher proportion (37.1% Vs. 25.9%) of relapse cases were found among the families with more than 5 members. More than half (53.5 %) of the respondents had one earning member in their family. However, a higher proportion of the case group respondents had two or more than two earning members and the difference was statistically significant ($\chi2$=3.831; p=0.050). Majority (52.6%) of the respondents had monthly family income up to Taka 25000. Majority of the respondents (55.0%) lived in a house having up to two living rooms and significantly (χ^2=34.610; p=0.000) a higher proportion (61.8% vs. 28.2%) of the case group respondents lived in the house of more than two living rooms.

<<Table 2 about here>>

Almost two-thirds (65.3%) of the total respondents completed TB treatment 3 years before. Among them significantly ($\chi2$=53.979; p=0.000) higher proportion of respondents were from case group (46.5%) in comparison to that of control group (22.9%) (Table -3). A few household members (3.5%) of the total respondents had been suffering from tuberculosis and significantly ($\chi2$=5.529; p=0.019) a higher proportion of them were from case group (5.9% Vs. 1.2%).

<<Table 3 about here>>

Before diagnosis of TB 81.5% of the respondents had the habit of smoking and significantly ($\chi2$=10.307; p=0.001) higher proportion of them were found in case group (88.2% Vs. 74.7%). (Table 4). A majority (52.3%) of the respondents smoked more than ten cigarettes per day. This was significantly ($\chi2$=7.683; p=0.006) higher among the case groups (60.0%). The proportion of smoking for more than ten years was also found higher (44.7%) among the case group. Overall 9.1% of the respondents had the habit of smoking after treatment. Of the total respondents, 40.6% had a history of exposure to second-hand smoking in their home and the exposure was significantly higher (46.5%) ($\chi2$=4.879; p=0.027) among case group.

<<Table 4 about here>>

The impact of educational status, family size, earning member, living room, past smoker, exposure to second-hand smoking and years after complete TB treatment on the likelihood of developing relapse tuberculosis was assessed by binary logistic regression analysis (table-5). The combined effects of all these predictors can significantly ($\chi2=80.411$; p=0.000) explain the occurrence of relapse tuberculosis of the participants. The participants who had exposure to second-hand smoking significantly (p=0.003) 2.3 times more likely to develop relapse tuberculosis than those who had no history of exposure. Similarly, the participant who was a past smoker significantly (p=0.035) 2.0 times more likely to develop relapse tuberculosis than who was not a past smoker. On the other hand, a participant who had more than 2 living rooms significantly (p=0.000) 0.27 times less likely to develop relapse tuberculosis. The participants who got complete tuberculosis treatment more than 3 years before significantly (p=0.000) 0.25 times less likely to have relapse tuberculosis, inversely, a participant who got complete TB treatment within last 3 years, 4.0 times more likely to have relapse tuberculosis.

<<Table 5 about here>>

To predict the occurrence of relapse tuberculosis and the number of sticks smoking daily, a second logistic regression (table-6) was performed among the past smoker participants, using the same predictors. The combined effect of the predictors was found to explain significantly ($\chi2=52.284$; p=0.000) the status of occurrence of relapse tuberculosis of the participants. This analysis also revealed that participants having a history of exposure to second-hand smoking 2.4 times more likely to develop relapse tuberculosis than those who had no history of exposure to second-hand smoking. The participant of past smokers who had more than two living room and got complete tuberculosis treatment more than three years before significantly (p=0.001 and p=0.000 respectively) less likely to have relapse tuberculosis. However, no significant ability to predict the likelihood of developing relapse cases was revealed with the increased number of sticks (>10) smoking per day.

<<Table 6 about here>>

Discussion

Recent WHO reports revealed the definitive evidence of increased risk of occurrence of TB, recurrent TB and negative response to the treatment of the TB by smoking [11]. Studies further revealed the increased risk of contracting TB by second-hand smoking, particularly among the children. Recurrent TB becoming an important public health challenge because of its increased MDR and high death rates [11, 12, 13, 14]. Bangladesh government has made good progress in reducing the occurrence of TB during last few decades. Yet TB is a major public health problem in the country. In 2016, about 223,921 cases of TB were reported. Of which 4.1% (9086) was reported to be the relapse cases. The overall TB case notification was 138/100.000 population and the TB mortality rate was 40/100,000 population. The incidence of MDR-TB was 5.3/100,000 population [15]. A study conducted in a tertiary level hospital in Bangladesh revealed that 56% of the MDR-TB cases were relapsed cases [14]. The current study was conducted among the TB relapse cases and non-relapse cases to assess the risk of smoking in developing relapse cases.

Majority of the respondents of this study were middle aged. The study identified the significant (p<0.05) inverse relationship between relapse cases and the higher educational level. It was also revealed that significantly ($\chi2=4.923$; p=0.026) a higher proportion of the relapse cases lived in a bigger family (>5), had significantly more earning members (≥ 2) in the family and had more than 2 living rooms than that of control group. A study carried out elsewhere reported the association between the lower level of education, unemployment, low household income with the occurrence of TB [16]. This study revealed that the TB patients within 3 years of complete TB treatment and had family member suffered from TB significantly ($\chi2=20.767$; p=0.000 and $\chi2=5.529$; p=0.019 respectively) a higher proportion of them suffered from relapse TB. Similarly, in a study, it was reported that most of the TB recurrences occurred within the first three years and patients at higher risk of recurrence who were living in neighbourhoods with high TB incidence or with a history of TB treatment[17].

Majority respondents of the current study were ex-smokers and significantly ($\chi2=10.307$; p=0.001) a higher proportion of them belonged to case group. Though not significant a higher proportion (11.2%) of the relapse cases continued smoking after the completion of their previous TB treatment. A case control study revealed the association of cigarette smoking with TB infection [18]. Other studies revealed the association of smoking with both relapse TB and mortality from TB [19, 20]. A study on hazard ratio analysis reported that the smoking relapse

case compared with that of higher education and previously treated patients were 3.48 time higher for less educated and 4.30 time higher for newly treated patients [21]. However, another study reported differently that the hazard ratio of occurrence of relapse TB was higher among the current smokers compared to the ex-smokers and never smokers [22]. In this study above 11% of the relapse cases were found to be a current smoker but not significantly different from control group participants. The current study further revealed that those who smoked more than 10 cigarettes per day they significantly suffered more from relapse TB, while the duration of the habit of smoking did not show any significant relationship with the relapse TB. Studies revealed that heavier smokers suffered more from increased risk of infection and increased mortality from TB [18, 19]. This study revealed a significant ($\chi2$=4.897; p=0.027) association between exposure to second-hand smoking and increased occurrence of relapse TB. Similar to the current study; studies from elsewhere reported that both passive and active exposure to smoking had a significant association with tuberculosis infection [22, 23].

To assess the impact of educational status, family size, earning member, number of living room, past smoker, second hand smoking and years of complete treatment of previous tuberculosis among case and control gropus, binary logistic analysis was carried out. The combined effects of all these predictors could significantly ($\chi2$=80.213; p=0.000) explain the occurrence of relapse cases. However, among these predictors, the participants who had two living rooms and TB treatment completed over 3 years independently had less (0.27 and 0.25 times) ability to predict likelihood developing of TB relapse cases. On the other hand, past smoker and exposure to second-hand smoking independently had the ability to predict the likelihood of developing more relapse cases. Among these predictors, the strongest predictor was the second-hand smoking followed by past smokers significantly (p=.003) 2.3 times and (p=.035) 2.0 times more likely to develop relapse tuberculosis respectively. Cigarette smoke increases the concentration of iron inside lung epithelial cell [24], has a harmful effect on lung function [25] and has significant association with TB infection [22, 23].

A second logistic regression was carried out using the same predictors to assess the ability of quantity of sticks smoking daily among the past smokers to predict the occurrence of relapse tuberculosis. The combined effect of the predictors to explain the occurrence of relapse tuberculosis among the past smokers was statistically significant ($\chi2$=52.284; p=0.000). However, the regression analysis revealed that the number of sticks smoking per day had no significant ability to predict the likelihood of developing relapse cases. But the exposure to

second-hand smoking had the same strongest (2.4 times) ability as found among the total participants to predict the likelihood of developing relapse tuberculosis. After adjustment of the confounders, the predictors having two living rooms and completed TB treatment over three years independently 0.34 and 0.29 times respectively less likely to develop relapse tuberculosis among the smokers. Past study also revealed independent association of smoking with the occurrence of TB [26]. Another study reported that the number of TB relapse cases decreased with increase of the time interval from the first diagnosis of TB and the relapse rate decreased yearly as well [27]. Most episodes of recurrence TB occured in the first three years of previous diagnosis [17]. However, the current study revealed that after removing the effect of possible confounders, the past smoker and second-hand smoking both had the strongest ability to develop relapse tuberculosis.

Conclusion

Tuberculosis relapse case was more likely to develop within three years than over three years of the complete TB treatment. Majority participants were the past smokers and one-tenth of them continued to smoking even after treatment of TB. Past smoking habit and exposure to second-hand smoking, independently had the strongest likelihood of developing more TB relapse cases.

References:

1. Global tuberculosis report 2014. Geneva: World Health Organization; 2014. Available from: http://www.who.int/tb/publications/global_report/en/ [Access in January. 2016).

2. Bulletin of the World Health Organization. 2007, 85 (10): 820-821. 10.2471/BLT.07.034797.]

3. WHO: Global Adult Tobacco Survey (GATS), Bangladesh 2017. https://ntcc.gov.bd/

(Access in July 2019).

4. WHO Framework Convention on Tobacco Control: an overview. http://www.searo.who.int/bangladesh/tobacco-control/en/ (Access 28th July 2019)

5. National TB Control Programme DGHS, Bangladesh. Tuberculosis control in Bangladesh. Annual Report. Dhaka, 2014

6. Global Tuberculosis Report 2015, Geneva. https://www.aidsdatahub.org/global-tuberculosis-report-2015-who-2015 (Access August 2019).

7. Stephen J., Jay MD. Smoking and Risk of Tuberculosis: JAMA, Arch Intern Med. 2007167(18):2008. doi:10.1001/archinte.167.18.2008-a

8. d'Arc Lyra Batista, J; de Ftima Pessoa Milito de Albuquerque, M; deAlencar Ximenes, RA; Rodrigues, LC (2008) Smoking increases the risk of relapse after successful tuberculosis treatment. International journal of epidemiology, 37 (4). pp. 841-51. ISSN 0300-5771. https://researchonline.lshtm.ac.uk/policies.html (Access January 2019)

9. Revised strategic plan for national tuberculosis control program: 2012-2016. DGHS, Government of Peoples Republic of Bangladesh.

10. Kamal SM, Hossain A, Sultana S et al. Anti-tuberculosis drug resistance in Bangladesh: reflections from the first nationwide survey. Int J Tuberc Lung Dis 2015;19:151–6. 10.5588/ijtld.14.0200 [PubMed]

11. WHO. Smoking and tuberculosis: a dangerous combination, 2018. http://www.euro.who.int/en/health-topics/communicable--diseases/tuberculosis/news/news/2018/3/ Access September 2019

12. Yen YF, Yen MY, Lin YS, Lin YP, Shih HC, Li LH, et.al. Smoking increases risk of recurrence after successful antituberculosis treatment: a population-based study. Int J Tuberc Lung Dis 2014; 18(4): 492–498.

13. Liu Q, Zhu L, Shao Y, Song H, Li G, Zhou Y, et, al Rates and risk factors for drug resistance tuberculosis in Northeastern China. BMC Pub Health 2013; 13: 1171

http://www.biomedcentral.com/1471-2458/13/1171

14. Khatun UF, Amin R, Islam M, Rob A and Rahim A. Socio-demographic Profile and Drug Sensitivity Pattern of Suspected Drug Resistant Tuberculosis among Patients in Regional Tuberculosis Reference Laboratory (R.T.R.L) of a Tertiary Hospital. J Med 2017; 18: 62-67

15. DGHS. Tuberculosis Control in Bangladesh. Annual Report 2017, National Tuberculosis Control, Programme, Directorate General Health Services, Mohakhali, Dhaka-1212, Bangladesh

16. Pacifique Ndishimye, Bianca Domokos, Jonathan Stillo, Fouad Seghrouchni, Oulaya Mrabet, Daniela Homorodean, Carmen Monica Pop, Abderrahim Sadak. A case control study of risk factors associated with pulmonary tuberculosis in Romania: Experience at a clinical hospital of pneumology. Clujul Medical 2016

17. Juan-Pablo Millet, Evelyn Shaw, Àngels Orcau, Martí Casals, Jose M. Miró, Joan A. Caylà. Results Tuberculosis Recurrence after Completion Treatment in a European City: Reinfection or Relapse? PLoS One. 2013; 8(6): e64898. Published online 2013 Jun 11.

18. Jianming Wang and Hongbing Shen. Review of cigarette smoking and tuberculosis in China: intervention is needed for smoking cessation among tuberculosis patients. *BMC Public Health,* 2009 9:292. https://doi.org/10.1186/1471-2458-9-292

19. Bates MN, Khalakdina A, Pai M, Chang L, Lessa F, Smith KR Risk of tuberculosis from exposure to tobacco smoke: a systematic review and meta-analysis. Arch Intern Med. 2007 Feb 26;167(4):335-42.

20. A. S. Pradeepkumar, K. R. Thankappan, M. Nichter. Smoking among tuberculosis patients in Kerala, India: proactive cessation efforts are urgently needed. Int J Tuberc Lung Dis: 2008 12(10):1139–1145.

21. Dikran Raffi Balian, Karapet Davtyan, Andre Balian, Anna Grigoryan, Armen Hayrapetyan, Hayk Davtyan. Tuberculosis treatment and Smoking, Armenia, 2014–

2016. Journal of Clinical Tuberculosis and Other Mycobacterial Diseases. Volume 8, August 2017, Pages 1-5. https://doi.org/10.1016/j.jctube.2017.04.001Get_rights_and_content Access 17th August 2019

22. Pramil N Singh, Daravuth Yel, They Kheam, Glorietta Hurd, and Jayakaran S Job. Cigarette smoking and tuberculosis in Cambodia: findings from a national sample. Tob Induc Dis. 2013; 11(1): 8. Published online 2013 Mar 27. doi: 10.1186/1617-9625-11-8

23. Harvir S. Gambhir, Rajeev M. Kaushik, Reshma Kaushik, Girish Sindhwani. Tobacco smoking-associated risk for tuberculosis: a case-control study. International Health, Volume 2, Issue 3, September 2010, Pages 216–222. https://academic.oup.com/inthealth/article/2/3/216/859257 Access 17th August 2019

24. Ghio A.J., Hilborn, E.D., Stonehuerner, J.G. Dailey, L.A., Carter, J.D., J.H. Richards, J.H., Crissman, K.M., Foronjy, R.F., Uyeminami, D.L., Pinkerton, K.E. Particulate matter in cigarette smoke alters iron homeostasis to produce a biological effect. Am. J. Respir. Crit. Care Med., 178 (11) (2008), pp. 1130-1138

25. Feldman C., R. Anderson A. Cigarette smoking and mechanisms of susceptibility to infections of the respiratory tract and other organ systems. J. Infect., 67 (3) (2013), pp. 169-184

26. Hyungmin Lee, Jusang Kim. A Study on the Relapse Rate of Tuberculosis and Related Factors in Korea Using Nationwide Tuberculosis Notification Data. Osong Public Health Res Perspect. 2014 Dec; 5(Suppl): S8–S1

27. Leung CC, Lam TH, Ho KS, Yew WW, Tam CM, Chan WM, Law WS, Chan CK, Chang KC, Au KF. Passive smoking and tuberculosis. Arch Intern Med. 2010 Feb 8;170(3):287-92. doi: 10.1001/archinternmed.2009.506.

Table 1: Socio-demographic characteristics of respondents

Characteristics	Case n (%)	Control n (%)	Total n (%)	Test of Significance
Age group (years)				
≤ 25	16 (9.4)	19 (11.2)	35 (10.7)	χ^2=0.591; p=0.899
26 to 40	79 (46.5)	81 (47.6)	160 (47.1)	
41 to 55	57 (33.5)	55 (32.4)	111 (32.6)	
55+	18 (10.6)	15 (8.8)	33 (9.7)	
Mean ±SD	40.58±11.47	38.97±11.37	39.78±11.44	t=-1.347; p=0.179
Marital status				
Ever Married	151 (88.8)	144 (84.7)	295 (86.8)	χ^2=1.255; p=0.263
Never married	19 (11.2)	26 (15.3)	45 (13.2)	
Education				
Primary	34 (20.0)	26 (15.3)	60 (17.62)	χ^2=7.705; p=0.021
Secondary	104 (61.2)	90 (52.9)	194 (57.1)	
Graduate &above	32 (18.8)	54 (31.8)	86 (25.3)	
Occupation				
Service	68 (40.0)	81 (47.6)	149 (43.8)	χ2=7.129; p=0.068
Business	75 (44.1)	55 (32.4)	130 (38,2)	
Worker	15 (8.8)	17 (10.0)	32 (9.3)	
Unemployed	19 (11.2)	10 (5.9)	29 (8.5)	

Table 2: Family characteristics of respondents

Family Characteristics	Case n (%)	Control n (%)	Total n (%)	Test of Significance
Family size				
≤ 5	107 (62.9)	126 (74.1)	233 (68.5)	$\chi 2$=4.923;
>5	63 (37.1)	44 (25.9)	107 (31.5)	p=**0.026**
Earning members				
One	82 (48.2)	100 (58.8)	182 (53.5)	$\chi 2$=3.831;
Two or more	88 (51.8)	70 (41.2)	158 (46.5)	p=**0.050**
Monthly Family Income (BDT)				
≤ 25000	87 (51.2)	92 (54.1)	179 (52.6)	$\chi 2$=1.783;
25001 to 50000	69 (40.6)	70 (41.2)	139 (40.9)	p=0.410
> 50000	14 (8.2)	8 (4.7)	22 (6.5)	
Mean ± SD	29264±14095	28247±13084	28755±13588	t=-0.690; p=0.491
Living Room				
Up to 2	65 (38.2)	122 (71.8)	187 (55.0)	$\chi 2$=38.610;
> 2	105 (61.8)	48 (28.2)	153 (45.0)	p=**0.000**

Table 3: Distribution of respondents by Tuberculosis

TB characteristics	Case n (%)	Control n (%)	Total n (%)	Test of Significance
Years of complete treatment				
3 years	91 (53.5)	131 (77.1)	222 (65.3)	$\chi2$=20.767; p=**0.000**
>3 years	79 (46.5)	39 (22.9)	118 (34.7)	
TB of Household				
No	160 (94.1)	168 (98.8)	328 (96.5)	$\chi2$=5.529; p=**0.019**
Yes	10 (5.9)	02 (1.2)	12 (3.5)	

Table 4: Distribution of respondents according to smoking habit

TB characteristics	Case n (%)	Control n (%)	Total n (%)	Significance test
Past Smoker				
No	20 (11.8)	43 (25.3)	63 (18.5)	$\chi2$=10.307;
Yes	150 (88.2)	127 (74.7)	277 (81.5)	p=0.001
Post Treatment				
Non-Smoker	151 (88.8)	158 (92.9)	309 (90.9)	$\chi2$=1.739;
Smoker	19 (11.2)	12 (7.1)	31 (9.1)	p=0.187
Smoking per day				
10 sticks	60 (40.0)	72 (56.7)	132 (47.7)	$\chi2$=7.682;
> 10 sticks	90 (60.0)	55 (43.3)	145 (52.3)	p=0.006
Total	150 (54.7)	127 (45.2)	277 (100.0)	
Smoking duration				
10 years	83 (55.3)	80 (63.0)	163 (58.8)	$\chi2$=1.666;
>10 years	67 (44.7)	47 (37.0)	114 (41.2)	p=0.197
Total	150 (100.0)	127 (100.0)	277(100.0)	
2nd hand Smoking				
No	91 (53.5)	111 (65.3)	202 (59.4)	$\chi2$=4.879;
Yes	79 (46.5)	59 (34.7)	138 (40.6)	p=0.027

Table-5: Logistic regression predicting likelihood of occurrence of Relapse Tuberculosis

Dependent Variables	Relapse Tuberculosis			95% Confidence Interval			
Independent Variables	B	S.E.	Wald	Sig	Exp (B)	Lower	Upper
Constant	.630	.514	1.504	.220	1.878		
Primary			8.036	**.018**			
Secondary	.219	.346	.402	.526	1.245	.632	2.453
Graduate and Above	-.625	.388	2.605	.107	.535	.250	1.143
Family Size (≥5)	.217	.319	.462	.497	1.242	.665	2.320
Earning member (≥2)	.115	.292	.155	.694	1.122	.633	1.988
Living room (>2)	-1.380	.278	24.574	**.000**	.252	.146	.434
Second hand Smoking	.835	.277	9.086	**.003**	2.305	1.339	3.968
Past Smoker	.711	.339	4.403	**.036**	2.035	1.048	3.953
TB Diagnosis(>3 Yrs)	-1.450	.293	24.447	**.000**	.235	.132	.417

$\chi2$=80.411; **p=0.000**

Table-6: Logistic regression predicting likelihood of occurrence of Relapse Tuberculosis among the smoker participants

Dependent Variables	Relapse Tuberculosis			95% Confidence Interval			
Independent Variables	B	S.E.	Wald	P	Exp (B)	Lower	Upper
Constant	1.199	.403	8.874	.003	3.317		
Primary			8.665	**.013**			
Secondary	.262	.364	.519	.471	1.300	.637	2.650
Graduate and Above	-.704	.407	2.989	.084	.495	.223	1.099
Earning member (≥2)	-.042	.323	.017	.896	.959	.509	1.805
Living room (>2)	-1.054	.303	12.102	**.001**	.348	.192	.631
Family Size (>4)	.300	.342	.771	.380	1.350	.691	2.641
Second hand Smoking	.886	.308	8.276	**.004**	2.426	1.326	4.436
Sticks per day (>10)	-.368	.288	1.635	.201	.692	.394	1.216
TB Diagnosis(>3 Yrs)	-1.217	.306	15.814	**.000**	.296	.163	.539

$\chi 2$=52.284; p=**0.000**