

Original Research Article

A comprehensive analysis on cigarettes smoking and its determinants in Bangladesh using logistic regression model

Afrin Sadia Rumana^{1*}, Asia Khatun¹, Sukanta Das²

¹Department of Business Administration in Accounting and Information Systems, Faculty of Business Studies, Bangladesh University of Professionals, Dhaka, Bangladesh

²Department of Statistics, Begum Rokeya University, Rangpur, Bangladesh

Received: 18 February 2020

Revised: 28 February 2020

Accepted: 20 March 2020

*Correspondence:

Dr. Afrin Sadia Rumana,

E-mail: rumana25sn@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: In Bangladesh, smoking is one of the leading preventable causes of death. Despite possessing knowledge about the consequences of smoking and the resultant non-communicable diseases, individuals have become considerably habituated to it. The study aims to identify the factors associated with smoking cigarettes and as well as to examine the existing situation of this issue among adult males in Bangladesh.

Methods: Total 480 adult males were surveyed from Bangladesh through personal interview and online questionnaire, (from June 2018 to June 2019). To measure the effect of the explanatory variables on cigarettes smoking, authors perform χ^2 test of independence as bivariate analysis. After performing bivariate analysis, a logistic regression analysis has been performed to assess the effect of the explanatory variables.

Results: Findings of the study revealed that educational level, household economic status, media exposure, division have significant contribution for smoking cigarettes among the adult male in Bangladesh. A comparison of religious affiliation showed smoking cigarettes to be higher among non-muslim counterparts. Respondents living in rural area are found to have smoking cigarettes comparing with urban area.

Conclusions: From the study it can be concluded that education and socio-economic status of male make a significant contribution in cigarettes smoking.

Keywords: χ^2 test, Logistic regression, Smoking behaviour

INTRODUCTION

Globally, smoking is one of the most prevalent causes of health problems such as cancer, respiratory and cardiovascular diseases. It is known for being habit forming after an individual tries the first cigarette of their lives. Substances in cigarettes pose health risks to non-smokers as well, through passive smoking. A cigarette contains around 600 chemicals, which increases to 7000 chemicals when burnt. These ingredients in the cigarettes have detrimental effects on almost all organs of the body of the smoker.

The nicotine present in the tobacco makes smoking cigarettes very addictive. Between 1990 and 2015, smoking was the cause of more than 5 million deaths per year.¹ This is because the habit causes the chemicals to intervene with the normal physiological processes of the body. During around 5000 BCE, smoking became a part of religious ceremonies of various culture. It was slowly adopted by the rest of the world and it has continued to be taken up as a habit till the present day. Today, several factors determine the cigarette use of individuals. This study aims to identify these determinants. Teenagers are more vulnerable to influence than other age groups.²

They tend to try out new things despite the risk involved, as the development of a rebellion attitude begins at this age. Peer pressure is another reason behind adolescents making smoking a regular practice. Traditionally

Several influences lie behind smoking, and more than 80% of smokers live in middle- and low-income countries.³ Bangladesh is a developing country and a major part of the population smokes cigarettes. Usually, males have a tendency of using tobacco products at a higher level than females.⁴ Moreover, males have a higher probability of taking up smoking during adolescence. These differences may be due behavioural factors as well as cultural factors.⁵

Physiological factors may also play a role. Since males smoke more than females, this research has been conducted on the smoking behaviour of men and the determinants affecting it. This study explores other factors such as age, parental smoking habits, personality traits, stress levels, occupation that affect levels of smoking in men. In many cases it is seen that individuals, out of curiosity, try smoking a cigarette for the first time at the onset of adolescence. The rationale of this study might be that, even if parents do not permit their children to smoke, their smoking practices may have inspired their offspring to take up the habit.⁶

In the Indian Subcontinent, chewing tobacco with betel quid, also known as paan, is a common practice. Chewing tobacco has major health risks associated with it, and a study amongst the Bangladeshi community living in east London was conducted. The respondents who smoked also had a habit of chewing betel quid.⁷

A similar research was conducted in India, and in addition to determine the pervasiveness of consuming tobacco by, chewing and smoking, this study aimed to define the demographic, social and economic links with consumption of tobacco. However, religious beliefs did not show significant impact on smoking behaviour, Sikhs being an exception, showing low consumption of tobacco.⁸

There is evidence that job-related pressure can also influence smoking behaviour. Other subjects smoke for pleasure and to escape the worries of poor financial condition and family crisis.⁹ Smoking behaviour drags the family down towards poverty, intervening with the ability to acquire daily supplies and necessities.¹⁰ The habits of the senior family members encouraged the subjects to follow their footsteps and adopt the smoking habit.¹¹

Taken together, the results of the prior literature suggest that smoking behaviour in men are affected by multiple factors. Age, level of education, parental smoking behaviour, family income, occupation, marital status and regional differences- all of these can put an impact on smoking tendency.

METHODS

This research aims to discover out the relationship between smoking cigarettes and some factors associated with it. Detail research design and methodology of this study is given below.

Selection of sample

For the quantitative analysis, data were acquired by a primary survey to examine the factors affecting smoking (mainly cigarettes) in Bangladesh. This survey was conducted from June 2018 to June 2019.

There are two parts of the questionnaire- demographic questionnaire and smoking behaviour associated questionnaire.¹²

In demographic questionnaire, basic demographic information on male - religion, occupation, highest level of education attained are collected. Demographic information on respondent - age, marital status and monthly expenditure are also collected. The questionnaire will comprise a combination of open-ended and multiple-choice questions, planned for gathering data on the males' socio demographic appearances.

Inclusion criteria

- Several studies have been done about the factors affecting cigarettes smoking. Using the literature review, authors selected seven independent variables: division, educational level, wealth index, age, religion, media exposure and place of residence. The study was a cross-sectional research design. Male including Muslim and non-Muslim of aged between 15 and 65, residing in rural or urban areas of Dhaka division, Bangladesh were included in this study. Here authors use division as an explanatory variable where the respondents came from and were living in the Dhaka division. For the purpose of this convenience, authors used Dhaka division as this study place.

Exclusion criteria

- By fitting logistic regression, authors find out whether there was any influence between dependent and independent variables. Authors can understand that all the variables were significant except age, religion and place of residence. Although generally it is seeming to have significant in cigarettes smoking but, in this analysis, based on the data, it was found as insignificant.

Authors have thought the main reasons of insignificant variables were large number of missing observations. For variable type of place of residence, authors think the main reason was that it contains more data from rural than urban area. Now taking decision about excluding the independent variables at first, authors must concern about

special criteria that is significantly important in statistical sense. Now out of 7 independent variables authors took 4 independent variables and fitting the logistic regression which were reduced form of the first stage of logistic regression model.

Data collection

In this study, data are composed from target respondents from direct personal interview at a time point (from June 2018 to June 2019). 480 adult males are the respondents from whom the data have been collected. The sample size is considered using the formula.¹³

$$n = \frac{Z^2 \times p(1 - p)}{\epsilon^2}$$

The sample consists of 480 randomly selected males of various professions at Bangladesh. Information was collected from the males from no education to highest level of education. In this study, education variable is divided by four categories that is no education, primary education, secondary education and higher education. Data was collected after taking permissions from the respondents following all ethical considerations. A self-structured questionnaire, approved by a medical officer of Dhaka Medical College, Dhaka, Bangladesh, was designed for the purpose of data collection, which involved all the details about age, sex, marital status, residence, job type, smoking habits, smokeless tobacco habits, recreational activity, sleeping hours, working mode, and family history. Data were collected randomly from male including students, day labourer, teachers, government employee, rickshaw puller etc.

Study variable

The linear logistic regression method is applied to determine the factors which effect the Cigarettes smoking among males in Bangladesh. Variables is used as dependent and independent in the analysis. Some of the variables are recorded according to their necessity for the study. The variables, which authors used in this study, are briefly described here.

Response variable

Smoking cigarettes is used as the response variable. The response variable was dichotomous by dividing it into two categories: -those who are used to smoking cigarettes and those who are not used to smoking cigarettes. For analytical purposes, those who are not used to smoking cigarettes are considered as the ‘successes’. On the other hand, those who are used to smoking cigarettes are considered as the ‘failures’.

Explanatory variable

A variable which is independent of the target variable and which is used to envisage the values of the dependent

variable is known as the independent variable.¹⁴ Authors want to know whether these variables effect cigarettes smoking among adult male in Bangladesh. To know the division-wise variation in smoking cigarettes authors include this discrete categorical variable in the analysis. The divisions- Sylhet, Chittagong, Dhaka, Khulna, Rajshahi, and Barisal are coded 0, 1, 2, 3, 4, 5 respectively. Besides division authors include respondent’s education level, wealth index, place of residence, religion and age as explanatory variable. Exposure to media of the respondent is tried as an explanatory in the analysis. Religion is one of the most important characteristics of human being. Because, due to difference in religion, social behavior, norms, food habit etc. of human being vary widely.

So, authors include this categorical variable in this analysis: Division, Education Level, Wealth Index, Religion, Media Exposure, Place of Residence and age.

Statistical analysis

All the study is done by using two software: Statistical Package for Social Sciences (SPSS) and R. SPSS version 21 is used for data entry, cleaning and scrutinize the survey information. Whereas R have been used to do statistical analysis like test of association, fitting regression model and reduced it.

Binary logistic regression model

Suppose that there are individuals, some of them are called success and other are failure.

Let, Y_i denote the dependent variable for the i^{th} observation and let,

$Y_i = 1$, if the i^{th} individual is a success and

$Y_i = 0$, if the individually is a failure.

Suppose for each of the n individuals, p independent variables $X_{i1}, X_{i2}, \dots, X_{ip}$ are measured. Probability of success on independent variables is assumed to be

$$P_i = \Pr(Y_i = 1) = \frac{1}{1 + \exp(-\sum \beta_i X_{ij})}$$

$$1 - P_i = \Pr(Y_i = 0) = \frac{\exp(-\sum \beta_i X_{ij})}{1 + \exp(-\sum \beta_i X_{ij})}$$

Where x_{i0} and β_i are unknown coefficients

The logarithm of the ratio of P_i and $(1 - P_i)$ which are called logit of P_i and it turns to be a simple linear function of X_{ij} . Authors define,

$$\text{logit}(P_i) = \log \frac{P_i}{1 - P_i} = \beta_0 + \sum \beta_i X_{ij}$$

The logistic equation can term of odds as

$$odds = \frac{P_i}{1 - P_i}$$

Interpretation of the regression coefficients

Linear regression tells us amount of the change in the dependent variable for a one-unit change in the independent variable¹⁵. The coefficients of the logistic regression model are not that simple to interpret. To understand the interpretation of these coefficients, authors must consider rearrangement of the equation for the logistic regression. If authors take logarithm of the ratio P_i and $1 - P_i$, it will change to a simple linear function of x_{ij} .

Testing the significance of the estimated parameters

For testing the significance of the parameters of the logistic regression model Wald test are usually used,

Wald test

Null hypothesis,

$$H_0 = \beta_1 = 0$$

is rejected then to identify the significant coefficients individually Wald test is used. For testing the hypothesis,

$$H_0 = \beta_i = 0$$

$$H_1 = \beta_i \neq 0$$

The Wald statistic is known as

$$W_i = \frac{\beta_i}{S.E(\beta_i)}$$

Hypothesis

The hypothesis would be:

H₀: There is no association between smoking cigarettes and all the independent variables (Division, Educational Level, Wealth Index, Religion, Media Exposure, Place of Residence and Age).

H₁: There is association between smoking cigarettes and all the independent variables (Division, Educational Level, Wealth Index, Religion, Media Exposure, Place of Residence and Age).

RESULTS

Bivariate analysis

The result of the percentage of smokers in Bangladesh among adult males are shown in the table:

From Table 1 authors can see that 51.4% adult males are used to smoke cigarettes whereas 48.6% adult males are not used to smoking cigarette.

From Bivariate analysis, authors find smoking status by background characteristics.

Table 1: Percentage of smokers in Bangladesh among adult males.

Smoking cigarettes	Frequency	Percent
Yes	247	51.4%
No	233	48.6%
Total	480	100%

Table 2: Smoking status by background characteristics.

Variable	Category	Smoking Cigarettes	
		No	Yes
Division	Sylhet	29.5%	70.5%
	Chittagong	47.1%	52.9%
	Dhaka	45.2%	54.8%
	Khulna	54.0%	46.0%
	Rajshahi	52.7%	47.3%
	Barisal	58.7%	41.3%
	Without education	40.7%	59.3%
Level of education	Education of primary level	39.8%	60.2%
	Education of secondary level	46.5%	53.5%
	Education of higher level	64.5%	35.5%
Wealth index	Poor	39.7%	60.3%
	Middle	43.6%	56.4%
	Rich	53.2%	46.8%
Religion	Non-muslim	41.9%	58.1%
	Muslim	49.6%	50.4%
Media exposure	Yes	47.6%	52.4%
	No	55.2%	44.8%
Place of residence	Rural	46.2%	53.8%
	Urban	51.6%	48.4%
Age	15-39	46.4%	53.6%
	40-65	50.2%	49.8%

By considering division wise smoking cigarettes, then it is uppermost in Sylhet and bottommost in Barisal. Authors see that, when the respondents have higher education, they are not used to smoking cigarettes rather than no education or primary education. Considering wealth index, it is observed that, smoking cigarettes are highest in poor people and lowest in rich people. (Table 2)

From Table 2 it is visualized that it is peak in non-Muslims rather than Muslims. It is obvious that the

percentage of smoking cigarettes is advanced in rural areas. With respect to age, it is stated that the respondents are used to smoking cigarettes highest in age interval (15-39) and lowest in (40-65).

Table 3: Pearson’s Chi-square test.

Independent variable	Chi-square	Df	Significance
Division	60.390	5	0.000
Education level	78.042	3	0.000
Wealth index	29.694	2	0.000
Religion	5.762	1	0.016
Media exposure	5.742	1	0.017
Place of residence	6.376	1	0.012
Age	3.03	1	0.082

The Table 3 contains the result of test of association. Taking 10% level of significance, from the p-value of chi-square test authors can select the variable which are significantly associated with the response variable (Table 3).

Initial logistic regression model fitting

The variable which are found significant in bivariate analysis to be considered for fitting logistic regression model. The results obtained from analysis are summarized as follows:

From the preceding table (Table 4) of regression analysis, authors can identify the significant variables considering 5% level of significance and p-value of Wald statistics.

Table 4: Logistic Regression Model with all selected independent variables.

Variables	β	Wald Statistics	Sig.	Odds Ratio	Lower	Upper
Division		52.106	0.000			
Sylhet	1.23	44.908	0.000	3.439	2.396	4.935
Chittagong	0.532	10.688	0.001	1.703	1.238	2.343
Dhaka	0.622	15.283	0.000	1.863	1.364	2.344
Khulna	0.296	3.346	0.067	1.345	0.979	1.848
Rajshahi	0.355	5.313	0.021	1.426	1.055	1.928
Barisal***						
Education Level		46.536	0.000			
No Education	0.773	6.633	0.010	2.166	1.203	3.907
Primary Education	0.861	43.608	0.000	2.366	1.832	3.055
Secondary Education	0.625	28.809	0.000	1.868	1.487	2.347
Higher Education***						
Wealth Index		11.574	0.003			
Poor	0.411	10.172	0.001	1.509	1.172	1.943
Middle	0.293	5.336	0.022	1.340	1.043	1.722
Rich***						
Religion						
Non-Muslims	0.242	3.159	0.076	1.273	0.975	1.662
Muslims***						
Media Exposure						
Yes	0.549	16.125	0.000	1.731	1.324	2.263
No***						
Place of Residence						
Rural	0.03	0.94	0.759	1.031	0.849	1.252
Urban***						
Age						
15-39	0.126	1.957	0.162	1.134	.951	1.353
40-65 ***						
Constant	-1.688	66.845	0.000	0.185		

Here, ***=Reference category

Analysis of the reduced logistic regression model

Consider the model with significant variables from initial logistic regression analysis:

From the Table 5, authors see that the variable division, educational level, wealth index, media exposure all has

significant effect on smoking cigarettes among adult males in Bangladesh.

Table 5: Reduced logistic regression model.

Variables	β	Wald statistics	Sig.	Odds ratio	Lower	Upper
Division		54.329	0.000			
Sylhet	1.252	46.381	0.000	3.499	2.440	5.017
Chittagong	0.537	10.905	0.001	1.710	1.244	2.352
Dhaka	0.610	14.799	0.000	1.841	1.349	2.511
Khulna	0.281	3.022	0.082	1.324	.965	1.817
Rajshahi	0.345	5.056	0.02	1.412	1.045	1.907
Barisal***						
Education level		47.377	0.000			
No education	0.764	6.514	0.011	2.146	1.194	3.857
Primary education	0.864	44.089	0.000	2.373	1.839	3.063
Secondary education	0.638	30.233	0.000	1.893	1.508	2.376
Higher education***						
Wealth index		14.520	0.001			
Poor	0.428	12.304	0.000	1.535	1.208	1.950
Middle	0.307	6.287	0.012	1.359	1.069	1.728
Rich***						
Media exposure						
Yes	0.532	15.389	0.000	1.702	1.305	2.220
No***						
Constant	-1.582	65.171	0.000	0.206		

*** = reference category

According to the odds ratio, authors see that in division level smoking cigarettes occurs 3.499 times higher in Sylhet than the Barisal division as it is the reference category and corresponding it is 1.710 times in Chittagong, 1.841 times in Dhaka, 1.324 times in Khulna 1.412 times higher in Rajshahi. For considering education level with reference to higher education, it is seen that smoking occurs 1.893 times higher in secondary education, 2.373 times higher in primary education and 2.146 times higher in no education. According to media exposure, it is evident that smoking cigarettes occurs 1.702 times higher in exposed people than not exposed (Table 5).

According to the Table 5, a comparison of religious affiliation showed smoking cigarettes to be higher among Non-Muslim counterparts. Non-Muslim men showed 1.273 times more likely to get cigarettes than Muslim. Respondents living in rural area are found to have smoking cigarettes comparing with urban and it is 1.031 times more than urban men. A comparison of age group showed smoking cigarettes to be higher among 15- 39 age groups. This group showed 1.273 times more likely to get cigarettes than 40-65 groups. According to the odds ratio, authors perceive that in wealth index smoking cigarettes occurs 1.340 times higher in rich than the poor as it is the reference category and corresponding it is 1.509 times in higher in middle class which is highlighted in table 5.

DISCUSSION

The key objective of the study is to investigate and identify the factors, which are responsible for growing the cigarettes smoking habit among the men persons in Bangladesh. Investigating. A study investigated the factors affecting the smoking patterns of students in Uganda. Considering the worrying incidence of cigarettes and smoking hookah, particularly in dormitory environments, it may be helpful to determine the factors affecting this tendency.¹⁶ This study showed that male students with high education have a higher probability to be smokers than less educated people. Students studying in higher educational years tended to smoke less.

Investigating all the explanatory variables, background of education plays a vital role on cigarettes smoking. As educated person have knowledge about the adverse effect of smoking or tobacco consumption so educated men have lower risk of smoking cigarettes than less educated men do. For men who are not smoking, it is highest for higher education and lowest for men with primary education. In this study, the percentage of men, who are smoking, it is highest in poor and lowest in rich. Authors see that the percentage of men are currently smoking is more in rural than urban. From the previous study authors find that, it is necessary that the perception of people regarding smoking is studied, and the determinants driving the progression must be thoroughly understood.

That is when messages for prevention and awareness can be tailored according to their beliefs and knowledge about smoking.¹⁷

In this study, religion has also positive impact on smoking cigarettes. Dividing the data by two groups (Muslims and Non-Muslims), percentage of cigarette consumption is higher in Non-Muslims. Findings of the study revealed that smoking cigarettes is strongly influenced by education, wealth index, division.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Reitsma MB, Fullman N, Ng M, Salama JS, Abajobir A, Abate KH, et al. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the Global Burden of Disease Study 2015. *Lancet*. 2017 May 13;389(10082):1885-906.
2. Barman N, Rumana AS, Dhali MN. Impact of Smoking Cigarettes among University Students of Bangladesh: A Logistic Regression Analysis. *Int J Statis Applicat*. 2019;9(6):186-90.
3. Hosseinpoor AR, Parker LA, d'Espaignet ET, Chatterji S. Social determinants of smoking in low- and middle-income countries: results from the World Health Survey. *PLoS One*. 2011;6(5).
4. Higgins ST, Kurti AN, Redner R, White TJ, Gaalema DE, Roberts ME, et al. A literature review on prevalence of gender differences and intersections with other vulnerabilities to tobacco use in the United States, 2004-2014. *Prevent Med*. 2015 Nov 1;80:89-100.
5. Sieminska A, Jassem E. The many faces of tobacco use among women. *Medical science monitor: Int Medi J Exp Clini Res*. 2014;20:153.
6. Flora MS, Mascie-Taylor CG, Rahman M, Akter SF. Influence of parental smoking on smoking habit of Bangladeshi adult population in rural and urban areas. *Am Int J Contem Res*. 2012;2(6):221-7.
7. Ahmed S, Rahman A, Hull S. Use of betel quid and cigarettes among Bangladeshi patients in an inner-city practice: prevalence and knowledge of health effects. *Br J Gen Pract*. 1997 Jul 1;47(420):431-4.
8. Rani M, Bonu S, Jha P, Nguyen SN, Jamjoum L. Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross sectional household survey. *Tobac Contr*. 2003 Dec 1;12(4):e4.
9. Goon S, Bipasha MS. Prevalence and pattern of smoking among bus drivers of Dhaka, Bangladesh. *Tobac Use Insights*. 2014 Jan;7:TUI-S13966.
10. Khan MM, Khan A, Kraemer A, Mori M. Prevalence and correlates of smoking among urban adult men in Bangladesh: slum versus non-slum comparison. *BMC Publ Health*. 2009 Dec;9(1):149.
11. Mamun A, Karmaker H, Karim R, Islam N, Hossain G. Prevalence and Factors Associated of Cigarette Smoking Behavior among University Male Students in Bangladesh: Survey in Rajshahi University. *J Life Sci*. 2018;10(1):10-5.
12. Xu X, Liu L, Sharma M, Zhao Y. Smoking-related knowledge, attitudes, behaviors, smoking cessation idea and education level among young adult male smokers in Chongqing, China. *Int J Envir Res Publ Health*. 2015 Feb;12(2):2135-49.
13. Cochran WG. Sampling techniques, 2007. John Wiley & Sons. Available at: file:///C:/Users/HP/Downloads/SampTech.pdf. Accessed 21 November 2007.
14. Sekaran U, Bougie R. Theoretical framework in theoretical framework and hypothesis development. *Res Methods Business: Skill Build Appra*. 2010;80:13-25.
15. Dobson AJ, Barnett AG. An introduction to generalized linear models. CRC press; 2018. Available at: <https://doi.org/10.1201/9780367807849>. Accessed 17 April 2018.
16. Soltani E, Moosavi J, Ali S, Mehrzadi S, Mobaraki H, Javad Moosavi A, Raji H. An Investigation into the Factors Affecting Medical Students' Attitude Towards Smoking. *J Irani Medi Coun*. 2018 Dec 28;1(2):75-80.
17. Buller DB, Borland R, Woodall WG, Hall JR, Burris-Woodall P, Voeks JH. Understanding factors that influence smoking uptake. *Tobac Contr*. 2003 Dec 1;12(suppl 4):iv16-25.

Cite this article as: Rumana AS, Khatun A, Das S. A comprehensive analysis on cigarettes smoking and its determinants in Bangladesh using logistic regression model. *Int J Res Med Sci* 2020;8:1733-9.