Prevalence and Predictors of Heavy Smoking in Bangladesh: Ordinal Logistic Regression Approach

Sharif Chowdhury Joy[1], Md. Tahidur Rahman[1,2] and Papia Sultana[1*]

[1]Department of Statistics, University of Rajshahi, Rajshahi-6205, Bangladesh
[2]Department of Statistics, Islamic University, Kushtia-7003, Bangladesh
[*]Correspondence should be addressed to Papia Sultana
(Email: papia.stat@ru.ac.bd)

Abstract

Bangladesh is one of the top ten countries in the world with high smoking prevalence and the number of heavy smoker (≥ 20 cigarettes or other tobacco products per day) is increasing day by day that effect both in health and economic cost. This paper is aimed to estimate the prevalence of heavy smoking and to determine the significant predictors of heavy smoking using ordinal logistic regression model. Secondary data of sample size 9629 collected by the Global Adult Tobacco Survey (GATS) Bangladesh, 2009 has been used. Descriptive statistics has been used to assess the prevalence of heavy smoking, and the chi-square test and ordinal logistic regression have been used to identify the significant risk factors associated with heavy smoking. It has been observed that the prevalence of heavy smokers in Bangladesh is 5.22% with 11.03% male and 0.19% female. From ordinal logistic regression analysis, it has been observed that male respondents were 33 times more likely to be heavy smoker compare to the female respondents (OR=33.52, 95% CI= 22.85 - 49.17, P <0.001). Respondents from age group 45-54 years were three times more likely to be heavy smoker than respondents of age 15-24 years (OR=3.68, 95% CI= 2.93 - 4.62, P <0.001). Higher educated respondents were 77% less likely to be heavy smoker than respondents with no formal schooling (OR=0.23, 95% CI= 0.17 - 0.32, P <0.001). It has been also found that respondents from highest household wealth index were 0.53 time less likely to be heavy smoker than respondents from lowest household wealth index. In conclusion, the results of this study reveal that heavy tobacco smoking is strongly associated with social disadvantage, for example, low socio-economic status, less education. Giving it as public health priority, 'public awareness' provision of WHO framework convention on tobacco control should be implemented for those disadvantaged group in priority basis.

Keywords: Heavy smoking, ordinal logistic regression, Odds Ratio, GATS, Bangladesh.

AMS classification: 62M10.

1. Introduction

Tobacco smoking is a serious public health threat and is an established risk factor for non-communicable diseases including cardiovascular diseases, chronic respiratory diseases and cancer (Owolabi et al., 2017). Over the past three decades, tobacco smoking has accounted for more than 200 million preventable deaths worldwide, with the population of current tobacco smokers

exceeding 1 billion (WHO, 2015). With this high number of tobacco smokers worldwide, the WHO urged reducing tobacco use as it is quintessential to reducing the global burden of non-communicable diseases, which account for nearly 71% of global mortalities. Tobacco smoking is a huge concern in low-income and middle-income countries as 80% of tobacco smokers reside in these regions (Detels and Tan, 2015: WHO, 2015). Specifically, the South-East Asian region accounts for nearly 90% of the total tobacco smokers across the globe (Keller-Hamilton et. al., 2018).

Bangladesh is one of the top ten countries in the world with high current smoking prevalence. Approximately 48.28% of male and 1.47% of female have been reported to smoke some form of tobacco product on a daily or occasional basis in Bangladesh (Sultana et. al., 2016). Smoking and passive smoking are collectively the biggest preventable death in this country, with major public health burden of morbidity, disability, mortality and community costs (Nargis et. al., 2015). In Bangladesh cigarettes represent about half of all the tobacco smoked (Alam et. al., 2013) and the men living in the urban slums reported higher rates of smoking cigarettes and bidis as compared to men living in the urban non-slums (Khan et.al., 2009). Heavy smokers (≥20 cigarettes or other tobacco products per day) have greater risk for cardiovascular diseases, respiratory disorders, cancer, male impotent and infertility, blindness, hearing loss, bone matrix loss and hepatotoxicity (El-Zayadi, 2006). Heavy smokers are those smokers who smoker more than 19 cigarettes per day (Pierce et. al., 2011). Heavy smoking is associated with a persistence rise in blood pressure and also with an increase in blood pressure variability (Groppelli et. al., 1992) and also associated with increased carboxy-haemoglobin and decreased oxygen carrying capacity of red blood cell (RBCs) (El–Zayadi, 2006). Bangladesh is a low-income country and one of the largest tobacco consuming countries in the world (Ng et. al., 2014). According to a previous study of Bangladesh, smoking causes about 25% of all deaths in Bangladeshi men aged 25 to 69 years and an average loss of seven years of life per smoker (Alam et. al., 2013).

Smoking has a great effect on both the social and economic sectors of Bangladesh. Tobacco-use results in both health and economic costs that is large and growing (Wu et. al., 2014). Due to its easy accessibility and social acceptability, there are now more young and teenagers having access to cigarettes and hence getting addicted. Some study have confirmed this (Hassan et. al., 2019; Ahammed, et. al., 2021; Islam et. al., 2016). Its losses are immeasurable or uncountable. Due to smoking, both the social and economic aspects of this country are being damaged. As a result, the social values of society are being degraded. Most of the heavy smokers have to go through family disputes and financial insufficiency. It has become a social disorder and significantly increasing direct and indirect economic losses due to diseases and disability related to smoking. Various organizations and NGOs are working in Bangladesh to reduce the level of smoking.

In Bangladesh, the number of heavy smoker is increasing day by day. But there has been no research worked about heavy smokers in Bangladesh. Therefore, the aim of the study is to estimate the prevalence of heavy smoking and to determine the significant predictors of heavy smoking using ordinal logistic regression model.

2. Materials and Methodology

In this paper, we have used secondary data collected by the Global Adult Tobacco Survey (GATS) in Bangladesh, 2009 (Jones et. al., 2017; Zhao et. al., 2021). The GATS 2009 Bangladesh survey report contains details about the data collection procedures, methodologies and questionnaire (GATS, 2009). The wealth index was constructed by the GATS collaborator team using principal component analysis that has been discussed in literature [Sultana et. al., 2016). From the data we will consider three categories of smoking status (heavy smokers, light smokers and non-smokers). Ex-smokers have been considered as non-smoker in the analysis of this paper.

Statistical Methods

We summarized the outcome variables by frequency distribution (number of observations with percentage). The association between outcome variable and independent variables was checked using Parson's chi-squared test. These tests have been performed at 5% level of significance. To analyze the socio-demographic and economic predictors to heavy smoker's ordinal logistic regression has been used and Odds Ratio (OR) with 95% confidence interval (CI) and p-value have been reported. Missing data on "age" and "occupation" has been adjusted using related information. Details can be found in literature (Sultana et. al., 2016). Data processing and all the analyses were done using STATA version 11 (StataCorp, College Station, Texas 77845, USA).

3. Result

Common socio-demographic and economic characteristics of the respondents have been described in details in (Sultana et. al., 2016). However, outcome variable (smoking level) has been summarized in Table 1.

Table 1: Distribution of smokers according to the level.

Smoking level	Sample size (N=9629) n (%)
Non-smoker	7591 (78.83)
Light smoker	1535 (15.94)
Heavy smoker*	503 (5.22)

*$\geq$ 20 cigarettes or other tobacco products per day.

It has been observed that the prevalence of heavy smokers in Bangladesh is 5.22% and the prevalence of light smokers is 15.94%.

From Table 2, it has been observed that among the heavy smokers in Bangladesh 11.03% are male and 0.19% are female, whereas among light smokers 33.10% are male and 1.09% are female. Age between 45 to 54 years (8.65%) and no formal schooling respondents (8.11%) are most prevalent to be heavy smoker.

Table 2: Comparing socio-demographic and economic factors among non-smoker, light smoker and heavy smoker.

Characteristics	Smoking Level			p-value
	Non-smoker (n=7591)	Light smoker (n=1535)	Heavy smoker (n=503)	
	Percentage	Percentage	Percentage	
Residence				
Urban	80.15	15.69	4.16	<0.001
Rural	77.49	16.2	6.31	
Gender				
Male	55.86	33.1	11.03	<0.001
Female	98.72	1.09	0.19	
Age in years				
15-24	90.5	8.25	1.25	
25-34	80.6	15.38	4.02	
35-44	73.12	18.59	8.29	<0.001
45-54	70.81	20.54	8.65	
≥ 55	74.74	20	5.26	
Educational level				
No formal schooling	71.96	19.94	8.11	
Less than primary school	74.98	18.36	6.66	
Primary school completed	83.5	13.09	3.41	
Less than secondary school	83.74	13.01	3.25	<0.001
Secondary school completed	86.73	11.16	2.11	
High school completed	88.98	9.94	1.08	
College/University completed & higher	85.54	13.02	1.45	
Missing	0.66	-	-	
Occupation				
Employment (Gov./non-Gov.)	76.59	21.12	2.29	
Business (small/large)	55.69	33.33	10.98	
Farming (land owner & farmer)	50.24	34.14	15.62	
Agri/industrial worker/Daily labor/Other self-employed	54.33	33.38	12.3	<0.001
Homemaker/ Housework	98.96	0.94	0.1	
Retired and unemployed (able/unable to work)	80.74	15.31	3.94	
Student/ Others	84.14	11.99	3.88	
Wealth Index				
1(Lowest)	73.63	18.11	8.25	
2	75.05	18.57	6.38	
3	78.35	15.88	5.77	<0.001
4	80.78	15.49	3.73	
5(Highest)	86.32	11.54	2.13	

Note: P-values are obtained from Chi-square test (Pearson Chi-square or Likelihood Ratio whichever applicable). Total sample size=9629.

From ordinal logistic regression analysis [Table 3], it has been observed that male respondents are 33 times more likely to be heavy smoker compare with light and non-smoker than female respondents (OR=33.52, 95% CI= 22.85-49.17, P<0.001). Respondents from age group 45-54 years are 3 times more likely to be heavy smoker than respondents of age 15-24 years (OR=3.68, 95% CI= 2.93-4.62, P<0.001). Higher educated (college/University completed and higher) respondents are 77% less likely to be heavy smoker than respondents with no formal schooling

(OR=0.23, 95%CI= 0.17- 0.32, P<0.001). It has been also found that respondents from highest household wealth index are 47% less likely to be heavy smoker than respondents from lowest household wealth index (OR=0.53, 95% CI= 0.41- 0.68, P<0.001).

Table 3: Odds-ratio from ordinal logistic regression to heavy smoking compare with light and non-smoking (Sample size=9565).p

Characteristics	Heavy Smoking VS Light and Non-smoking	
	Odds-ratio(95% CI)	p-value
Residence		
Urban	1	-
Rural	0.92 (0.81, 1.06)	0.245
Gender		
Male	33.52 (22.85, 49.17)	<0.001
Female	1	-
Age		
15-24	1	-
25-34	2.19 (1.78, 2.69)	<0.001
35-44	2.95 (2.39, 3.63)	<0.001
45-54	3.68 (2.93, 4.62)	<0.001
55 and above	2.27 (1.79, 2.88)	<0.001
Educational level		
No formal schooling	1	-
Less than primary school	0.75 (0.64, 0.90)	0.001
Primary school completed	0.57 (0.46, 0.71)	<0.001
Less than secondary school	0.53 (0.44, 0.64)	<0.001
Secondary school completed	0.36 (0.27, 0.48)	<0.001
High school completed	0.26 (0.18, 0.37)	<0.001
College/University completed & higher	0.23 (0.17, 0.32)	<0.001
Occupation		
Employment (government/non-government)	1	-
Business (small/large)	1.38 (1.11, 1.71)	0.003
Farming (land owner & farmer)	1.19 (0.93, 1.51)	0.159
Agri/industrial worker/Daily labor/Other self-employed	1.26 (1.01, 1.57)	0.039
Homemaker/ Housework	0.37 (0.23, 0.61)	<0.001
Retired and unemployed (able/unable to work)	0.63 (0.45, 0.88)	0.006
Student/ Others	1.04 (0.79, 1.37)	0.755
Wealth Index		
1(Lowest)	1	-
2	0.77 (0.64, 0.92)	0.004
3	0.70 (0.58, 0.85)	<0.001
4	0.57 (0.47, 0.70)	<0.001
5(Highest)	0.53 (0.41, 0.68)	<0.001

Note: Odds Ratio, 95% CI and p-values are obtained from ordinary logistic regression analysis.

4. Discussions

From representative cross sectional study of Bangladesh we get the prevalence of heavy smoking is 5.22% with 11.03% male and 0.19% female and the prevalence of light smoking is 15.94% with 33.10% male and 1.09% female. Youngest respondents are less likely to be heavy smoker, whereas respondents with no formal education and those with lowest wealth-index are more likely to be heavy smokers than their counterpart. Farmers, businessman and workers/day labors are more likely to be heavy smokers, and employee, students and respondents with other jobs are less likely to be heavy smokers.

The prevalence of heavy smoking and light smoking is increasing with age but after 55 years it is decreasing. For those who have never been to school, the prevalence of heavy smoking is high and as the level of education increases, it decreases. Again in higher education, it rises slightly from its previous level.

Respondents belonging youngest age group have been found less likely to be heavy smoker. But the onset of earning age group is found more likely to be heavy smoker. The increase in prevalence among them might have indication about their job stress or family stress. Unless effective tobacco control measures are implemented soon, the future disease burden in Bangladesh will probably be influenced by the high level of smoking in young male adults.

Government and nongovernment employee, retired persons, homemaker/ housework, retired and unemployed, and students/ others are less likely to have heavy smoking. On the other hand, businessmen, farmers, and day labors are more likely to be heavy smoker. Peoples with stressed job are more likely to find themselves in condition predisposing them to initiation of heavy smoking. Similar pattern has been found with respect to wealth index. Respondents with lowest wealth index are most likely to be heavy smoker and with highest wealth index are least likely. This might be for their ignorance about adverse effect of smoking, or they might not be aware about their own health like many other diseases (Uddin and Choudhury, 2008; Rahman, 2009).

The major strengths of our study include large sample size, the coverage of men and women smokers, the coverage of both rural and urban areas, and the nationally representative population. However, there are several limitations that need to be addressed. The findings in this report are based on self- reports. Furthermore, education categories were combined into broad groupings, which could have contributed to biased estimates in terms of the gradients observed. Nonetheless, these groupings provided greater precision than those used in earlier tobacco use research in Bangladesh. The data used in constructing wealth index is based on limited number of asset variables, which might result in incomplete or underrepresenting socioeconomic status. Some other variables like psychological variables could provide more predicting accuracy, but no such variable is available.

5. Conclusion

The results of this study reveal that heavy tobacco smoking is strongly associated with social disadvantage, for example, low socio-economic status, less education. Giving it as public health priority, WHO Framework Convention on Tobacco Control should be implemented for those disadvantaged group in priority basis.

Competing interests

The authours declare that they have no competing interests.

References

[1] Ahammed, T., Ahmed, N. U. and Uddin, M. J. (2021). Changes in prevalence, and factors associated with tobacco use among Bangladeshi school students: evidence from two nationally representative surveys. BMC public health, 21(1), 1-13.

[2] Alam, D. S., Jha, P., Ramasundarahettige, C., Streatfield, P. K., Niessen, L. W., Chowdhury, M. A. H. and Evans, T. G. (2013). Mortalité attribuable au tabagisme au Bangladesh: une étude proportionnelle de la mortalité. Bulletin of the World Health Organization, 91(10), 757-764.

[3] Detels, R. and Tan, C. C. (2009). The scope and concerns of public health. Oxford Textb public Heal, 1, 392.

[4] El-Zayadi, A. R. (2006). Heavy smoking and liver. World journal of gastroenterology: WJG, 12(38), 6098.

[5] Groppelli, A., Giorgi, D. M., Omboni, S., Parati, G. and Mancia, G. (1992). Persistent blood pressure increase induced by heavy smoking. J hypertens, 10(5), 495-499.

[6] Hassan, M. S., Hossain, M. K., and Khan H. T. A. (2019). Prevalence and predictors of tobacco smoking among university students in Sylhet Division, Bangladesh. Int Health, 11(4):306-313. doi: 10.1093/inthealth/ihy091.

[7] Islam, S. M., Mainuddin, A. K., Bhuiyan, F. A., and Chowdhury, K. N. (2016). Prevalence of tobacco use and its contributing factors among adolescents in Bangladesh: Results from a population-based study. South Asian J Cancer, 5(4):186-188. doi: 10.4103/2278-330X.195339.

[8] Jones, D. M., Majeed, B. A., Weaver, S. R., Sterling, K., Pechacek, T. F. and Eriksen, M. P. (2017). Prevalence and factors associated with smokeless tobacco use, 2014-2016. American journal of health behavior, 41(5), 608-617.

[9] Keller-Hamilton, B., Muff, J., Blue, T., Lu, B., Slater, M. D., Roberts, M. E. and Ferketich, A. K. (2018). Peer Reviewed: Tobacco and Alcohol on Television: A Content Analysis of Male Adolescents' Favorite Shows. Preventing chronic disease, 15.

[10] Khan, M. M. H., Khan, A., Kraemer, A. and Mori, M. (2009). Prevalence and correlates of smoking among urban adult men in Bangladesh: slum versus non-slum comparison. BMC Public Health, 9(1), 1-12.

[11] Nargis, N., Thompson, M. E., Fong, G. T., Driezen, P., Hussain, A. G., Ruthbah, U. H. and Abdullah, A. S. (2015). Prevalence and patterns of tobacco use in Bangladesh from 2009 to 2012: evidence from International Tobacco Control (ITC) Study. PloS one, 10(11), e0141135.

[12] Ng, M., Freeman, M. K., Fleming, T. D., Robinson, M., Dwyer-Lindgren, L., Thomson, B. and Gakidou, E. (2014). Smoking prevalence and cigarette consumption in 187 countries, 1980-2012. Jama, 311(2), 183-192.

[13] Owolabi, E. O., Goon, D. T., Adeniyi, O. V., Seekoe, E. and Adedokun, A. O. (2017). Prevalence and factors associated with tobacco use among adults attending selected

healthcare facilities in Buffalo City Metropolitan Municipality, South Africa. South African Family Practice, 59(6), 201-207.

[14] Pierce, J. P., Messer, K., White, M. M., Cowling, D. W. and Thomas, D. P. (2011). Prevalence of heavy smoking in California and the United States, 1965-2007. Jama, 305(11), 1106-1112.

[15] Rahman, M. (2009). Determinants of knowledge and awareness about AIDS: Urban-rural differentials in Bangladesh. Journal of Public Health and Epidemiology, 1(1), 014-021.

[16] Sultana, P., Akter, S., Rahman, M. M. and Alam, M. S. (2015). Prevalence and predictors of current tobacco smoking in Bangladesh. J Biostat Biometric App, 1(1), 102.

[17] Uddin, M. J. and Choudhury, A. M. (2008). Reproductive health awareness among adolescent girls in rural Bangladesh. Asia Pacific Journal of Public Health, 20(2), 117-128.

[18] WHO (2009). Global adult tobacco survey: Bangladesh Report 2009.

[19] WHO (2015). WHO report on the global tobacco epidemic 2015: raising taxes on tobacco. World Health Organization.

[20] Wu, F., Chen, Y., Parvez, F., Segers, S., Argos, M., Islam, T. and Ahsan, H. (2013). A prospective study of tobacco smoking and mortality in Bangladesh. PloS one, 8(3), e58516.

[21] Zhao, L., Mbulo, L., Twentyman, E., Palipudi, K. and King, B. A. (2021). Disparities in smokeless tobacco use in Bangladesh, India, and Pakistan: findings from the global adult tobacco survey, 2014-2017. Plos one, 16(4), e0250144.