E C O N O M I C S B U L L E T I N

Tobacco Chewing, Smoking and Health Knowledge: Evidence from Bangladesh

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Abstract

Unlike the substance abuse studies in developed countries, tobacco consumption and its adverse effects in developing countries are poorly studied. The objective of this paper is to identify which factors influence individuals' decision to smoke cigarettes, chew tobacco and their knowledge about the health hazards of tobacco use. To allow for the potential correlation among smoking tobacco, chewing tobacco, and health knowledge, we estimate a trivariate probit regression model using household survey data from Bangladesh. For both chewing tobacco and smoking, the results show how the probabilities of uninformed tobacco user and uninformed nonuser vary across different demographic groups.

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1. Introduction

It is recognized that tobacco consumption is harmful to health, and is one of the main causes of death worldwide. According to Gajalakshmi *et al*. (2000), eight out of ten smokers now live in developing countries, and the prevalence of tobacco consumption has been rising in most low- and middle-income countries. Much of the existing literature on tobacco consumption and control has largely focused on developed countries (Baltagi and Levin 1986, Becker and Murphy 1988, Becker *et al*. 1994, Kenkel 1991, Jones 1989, Mullahy 1997, and Chaloupka and Warner 1999). Existing studies for developing countries have focused on smoking patterns and trends using aggregate data. By contrast, very little is known about the link between consumer characteristics, policy-based factors and tobacco use in developing countries; exceptions include Jones and Kirigia (1999) and Gurmu and Yunus (2004). While Jones and Kirigia (1999) used household survey data from South Africa to identify which factors influence individual women's choice to smoke cigarettes, Gurmu and Yunus (2004) used survey data from Bangladesh to assess the extent of the use of smoking- and chewing-tobacco using generalized bivariate negative binomial regression model. The absence of studies on individual smoking behavior in most other developing countries may largely be attributed to lack of household level data on tobacco consumption.

Unlike in developed countries where cigarette smoking is common, both smoking- and chewing-tobacco are prevalent among tobacco users in many developing countries in Africa and Asia. This paper analyzes individual tobacco consumption behavior using household survey data from Bangladesh. The objective is to identify which factors influence individuals' decision to smoke cigarettes, chew tobacco and their awareness about the health hazards of tobacco use. To allow for the potential correlation among smoking tobacco, chewing tobacco, and health knowledge, we estimate a trivariate probit regression model. Section 2 presents description of data and empirical methodology, followed by results and conclusion in sections 3 and 4.

2. Data and Methods

2.1 Data

We use data from the Tobacco Prevalence Survey (TPS) in Bangladesh sponsored by the World Health Organization in 2001; see Yunus, (2001) for details. The Survey was conducted in two administrative districts, Chittagong and Rangpur, of paramount interest for tobacco production and consumption in the country. While the former is the center for smuggling of foreign brands of cigarettes, the latter is a major tobacco-growing region. Data on daily consumption of smoking- and chewing-tobacco along with other socioeconomic and demographic characteristics and parental tobacco consumption habits were collected from respondents of 10 years of age and above. Our analysis is based on sample size of 15,000 individual respondents.

Table 1 shows definition of variables as well as their means and standard deviations. The dependent variables are dichotomous variables regarding daily use of smoking tobacco, chewing tobacco, and knowledge about health hazards of tobacco use. Most of the users of tobacco in TPS data are daily users; only about 4 percent of males

and 3 percent of females are occasional users of tobacco (Yunus 2001). The percent of daily users of tobacco products are 24.3% and 13.4% for smoking- and chewing-tobacco, even though 85.9% of the respondents are aware of the health hazards.[1] Regarding the health hazards of tobacco use, summary statistics reported in Yunus (2001) show that respondents are aware of respiratory diseases (30%), lung cancer (33%), heart diseases (17%), and stroke (5%).[2] The typical respondent is a Muslim, married, in his/her early thirties, lives in rural area, and has about 7 years of formal schooling. Although the country is mostly agrarian, only around 11% of the respondents were related to agricultural occupation in either doing agricultural operations on their own farms or working as agricultural wage laborers. More than one-half of the fathers and slightly less than two-thirds of the mothers of the respondents use or have used tobacco in some form or other.

2.2 Model

A consumer is said to be addicted to a good, if it involves reinforcement, tolerance and withdrawal. However, a rational consumer also considers the future negative consequences of harmful behavior given the state of health knowledge. Consumers become aware of the consequences of the products they consume through print and electronic media. Following Mullahy and Portney (1990), Kenkel (1991) and Jones and Kirigia (1999), we employ a static utility maximization framework, where utility is assumed to be a function of smoking tobacco (S), chewing tobacco (C), the state of knowledge of negative health consequences of using tobacco (K), and a composite non-addictive good.[3] The state of the health knowledge depends on the level of consumption of goods (including smoking- and chewing-tobacco), a host of demographic factors, and unobserved individual characteristics. The solutions to the individual's utility maximization problem provide reduced forms for the choice variables.

Given the limitations of the survey data with no extraneous information on prices and lack of suitable instruments, we use the following reduced forms for smoking- and chewing-tobacco, and health knowledge:

$$S = S(X, \mu) \tag{1}$$

$$C = C(X, \mu), \tag{2}$$

$$K = K(X, \mu), \tag{3}$$

[1] The observed joint percentage frequencies for tobacco consumption and health knowledge, f(smoking, chewing, knowledge), are f(+, +, +) = 1.9, f(+, 0, +) = 18.7, f(0, +, +) = 8.6, f(0, 0, +) = 56.7, f(+, +, 0) = 0.7, f(+, 0, 0) = 3.0, f(0, +, 0) = 2.2, and f(0, 0, 0) = 8.3, where + denotes current users of tobacco products and/or awareness about health hazards associated with tobacco use and 0 represents nonusers.

[2] In this paper, we use a binary outcome measure of awareness of health risks of tobacco use because of lack of access to individual-level data disaggregated by type of risks. This dummy variable measures only the relative risks; it may or may not imply absolute risks since there are no details in the survey of the risks respondents face personally. For a related literature, see, for example, Schoenbaum (1996), who investigated whether smokers understand the mortality effects and magnitudes of smoking.

[3] Kenkel and Chen (2000) address the question of whether and how information about the risks of smoking can influence consumers' use of tobacco.

where X is a vector of observable factors and μ represents unobserved individual characteristics. The presence of unobserved heterogeneity, μ, implies that the error terms of empirical versions of the reduced forms 1 to 3 will share a common component and can be expected to be correlated with each other. This is exploited in our empirical model specification, where we use a trivariate probit model to allow for correlation between the unobserved determinants of smoking- and chewing-tobacco and health knowledge. Specifically, for observation *i* (*i =1, ..., n*), we assume that (S_i, C_i, K_i) has a trivariate normal$\left(x_{is}\beta_s, x_{ic}\beta_c, x_{ik}\beta_k; \rho_{sc}, \rho_{sk}, \rho_{ck}\right)$ distribution, where the β's and ρ's are unknown vectors or scalars of mean and correlation parameters, respectively.

3. Results

Table 2 presents sets of coefficient estimates and absolute *t*-ratios from the trivariate probit model, along with the value of the maximized log-likelihood function and the estimates of the correlation parameters, denoted by rho. The estimated negative and statistically significant correlation between tobacco consumption measures suggests that smoking and chewing tobacco are substitutes, as expected. The remaining correlations are insignificant.

Regarding factors affecting probability of using tobacco and health knowledge, Table 2 shows that male respondents are more likely to smoking tobacco while women are more likely to use chewing-tobacco. This is in line with the custom of the country, where adolescent female smokers are reprimanded, but females are encouraged to chew betel leaves with nuts as mouth fresheners. While the result for urban indicates no difference in smoking behavior, urban residents are less likely to use chewing-tobacco than their rural counterparts are. There is no evidence of significant family income effect on the likelihood of tobacco consumption in either form. On average, individuals that are more educated are less likely to use tobacco in either form, a finding that is consistent with that of Jones and Kirigia (1999). Respondents in urban areas and those with more education are more likely to be aware of health hazards of tobacco use. On average, parental use of tobacco seems to reduce the probability of consuming tobacco.

The results from the trivariate probit model can be used to identify groups of individuals that may be used in improving consumer information to reduce tobacco consumption. There are four groups, but the first two are of primary interest: (a) those individuals who may be more likely to be at risk of consuming tobacco (uninformed non-user), (b) those users of tobacco who may be more likely to respond to information shocks or health education (uninformed user), (c) informed tobacco-user, and (d) informed nonuser. Tables 3 and 4 present the sample means of the probabilities associated with (smoking, health knowledge) and (chewing tobacco, health knowledge), respectively.[4] The results are tabulated for the whole sample as well as selected determinants of choice probabilities, including benchmark groups for indicator variables. Observe that, in tables 3 and 4, the probability of uninformed tobacco user is lower than the probability of uninformed nonuser, except for male, agricultural wage labor and

[4] Estimated average probabilities for smoking and chewing tobacco as well as for tobacco use and health knowledge are available upon request from the authors. The latter are computed from the distribution of (smoking tobacco + chewing tobacco, health knowledge).

business occupation in Table 3. The proportion of uninformed user of tobacco relative to informed user is much greater among individuals who did not complete elementary school. Respondents in rural areas seem to be the most at risk of becoming a smoker. Those in agricultural-labor occupation are more likely to respond to health education.

Overall, the proportion of 'informed' seems pretty high, suggesting on the face of it little or no role for government intervention. The data preclude our providing a definite answer to the question of the effectiveness of intervention strategies such as health education and tobacco taxes. For example, our measure of risk of tobacco use places all risks into one category. Previous studies provide evidence suggesting that people have a tendency to overestimate the risks from smoking, and learn about the health risks of smoking through both experience and acquisition of information (Viscusi 1991; Viscusi and Hakes 2008). We also focus on smoking or tobacco chewing participation decision, not on the quantity of tobacco consumed.[5]

4. Conclusion

This paper has investigated the socio-economic determinants of the probability of tobacco chewing, smoking and knowledge of the health risks of tobacco use. There is strong evidence that the effects vary across different socio-economic groups and by types of tobacco use. The cross sectional nature of our data and lack of information on key explanatory variables (*e.g.*, prices) precludes detailed analysis of participation, consumption and quitting behavior, along with the effectiveness of tobacco control policies. Prior literature mostly using US data have explored the adequacy of risk beliefs, suggesting that people may have more information about some risks, may understand gradients in risk but not the absolute risks, and make decisions about whether to smoke based on their risk perceptions.[6] Future research directions might broaden the analysis for developing economy presented here to account for differential risks of tobacco use.

References

Baltagi, B H. and D. Levin (1986) "Estimating Dynamic Demand for Cigarettes using Panel Data: The Effects of Bootlegging, Taxation, and Advertising Reconsidered" *Review of Economics and Statistics* **68**, 148-155.

Becker, G.S. and M. Grossman, and K. M. Murphy (1994) "An Empirical Analysis of Cigarette Addiction" *American Economic Review* **84**, 396-418.

Becker, G. S. and K. M. Murphy (1988) "A Theory of Rational Addiction" *Journal of Political Economy* **96**, 675-700.

Chaloupka, F. J. (1991) "Rational Addictive Behavior and Cigarette Smoking" *Journal of Political Economy* **99**, 722-742.

[5] For example, Viscusi and Hakes (2008) provides evidence that cigarette taxes influence the amount of cigarette demanded, not the discrete smoking status decision.

[6] For example, see Viscusi and Hakes (2008) and references there in.

Chaloupka, F.J. and K. E. Warner (1999) "The Economics of Smoking" *National Bureau of Economics Research* working paper 7047.

Gajalaksmi, C.K., P. Jha, K. Ranson and S. Nguyen (2000) "Global Patterns of Smoking and Smoking –Attributable Mortality" in Jha P. and F.J. Chaloupka (eds.) *Tobacco Control in Developing Countries*, Oxford: Oxford University Press, 11-39.

Gurmu, S. and M. Yunus (2004) "An Empirical Analysis of Tobacco Consumption in a Developing Economy" In G.N. Muuka (ed.) *International Academy of African Business and Development Conference Proceedings,* Kentucky: IAABD, Volume 5, 358-364.

Jones, A. M. (1989) "A Double-Hurdle Model of Cigarette Consumption" *Journal of Applied Econometrics* **4**, 23-39.

Jones, A. M. and J.M. Kirigia (1999) "Health Knowledge and Smoking among South African Women" *Health Economics* **8**, 165-169.

Kenkel, D.S. (1991) "Health Behavior, Health Knowledge and Schooling" *Journal of Political Economy* **99**, 287-305.

Kenkel, D. and L. Chen (2000) "Consumer Information and Tobacco Use" in Jha P. and F.J. Chaloupka (eds.) *Tobacco Control in Developing Countries* Oxford, Oxford University Press, 177-214.

Mullahy, J. (1997) "Instrumental-Variable Estimation of Count Data Models: Applications to Models of Cigarette Smoking Behavior" *Review of Economics and Statistics* **79**, 586-593.

Mullahy, J. and P.R. Portney (1990) "Air Pollution, Cigarette Smoking, and the Production of Respiratory Health" *Journal of Health Economics* **9**, 193 – 205.

Schoenbaum, M. (1996) "Do Smokers Understand the Mortality Effects of Smoking? Evidence from the Health and Retirement Survey" *American Journal of Public Health* **87**, 755-759.

Viscusi, W.K. (1991) "Age Variations in Risk Perceptions and Smoking Decisions" *Review of Economics and Statistics* **73**, 577-588.

Viscusi, W.K. and J.K Hakes (2008) "Risk Beliefs and Smoking Behavior" *Economic Inquiry* **46**, 45-59.

Yunus, M. (2001) *Craving for Nicotine: A Study on Tobacco Prevalence in Bangladesh,* World Health Organization, Regional Office South-East Asia, accessed at http://w3.whosea.org/EN/Section1174/ section1462/pdfs/surv/sentinelbangladesh.pdf

Table 1. Definition of Variables and Summary Statistics (Sample Size n = 15,000)

Variable	Description	Mean	Standard Deviation
Smoke	= 1 if smoking tobacco used daily	0.243	0.429
Chew	= 1 if chewing tobacco used daily	0.134	0.341
Knowledge	= 1 respondent is aware of health hazards of tobacco use	0.859	0.348
Region	=1 if Rangpur resident	0.500	0.500
Urban	=1 if urban resident	0.374	0.484
Age	Age in years	30.65	14.97
Education	Years of formal schooling	6.876	4.70
Muslim	= 1 if religion is Islam	0.789	0.408
Income	Monthly family income '000 Tk.	7.496	10.30
Male	=1 if male	0.549	0.498
Married	=1 if married	0.576	0.494
Agri-Labor	=1 if agriculture labor occupation	0.112	0.315
Service	=1 if service occupation	0.127	0.333
Business	=1 if business occupation	0.131	0.338
Self Employed	=1 if self employed or household chores	0.306	0.461
Student	=1 if student	0.263	0.440
Father use	=1 if father uses tobacco	0.537	0.499
Mother use	=1 if mother uses tobacco	0.646	0.478

Table 2. Coefficient Estimates from Trivariate Probit for Smoking-, Chewing-Tobacco and Health Knowledge (n = 15,000)

Variable	Smoking Tobacco	Chewing Tobacco	Knowledge
Constant	-3.849*** (30.57)	-2.943*** (21.24)	0.674*** (6.31)
Region	0.143*** (4.40)	0.496*** (14.49)	-0.388*** (13.16)
Urban	-0.009 (0.26)	-0.112*** (3.02)	0.280*** (8.41)
Age	1.129*** (18.67)	0.884*** (15.36)	0.065 (1.23)
Age-squared	-0.113*** (17.45)	-0.064*** (10.28)	-0.010 (1.63)
Education	-0.882*** (9.02)	-0.070 (0.71	0.539*** (5.60)
Education-squared	0.331*** (4.81)	-0.314*** (3.82)	0.208*** (2.66)
Muslim	-0.107*** (3.09)	-0.077** (2.10)	0.104*** (3.12)
Income	0.079 (0.54)	-0.012 (0.06)	-0.614*** (3.86)
Male	1.979*** (36.29)	-0.554*** (10.84)	0.007 (0.20)
Married	0.078* (1.87)	-0.077 (1.60	0.203*** (4.78)
Agri-Labor	0.080 (1.23	0.329*** (3.64	0.063 (0.91)
Service	-0.092 (1.42)	0.236** (2.50)	0.047 (0.63)
Business	0.144** (2.31)	0.236*** (2.59)	-0.012 (0.17)
Self Employed	-0.166** (2.40)	0.295*** (3.47)	-0.069 (1.04)
Student	-0.566*** (7.73)	-0.586*** (4.49)	0.132** (2.02)
Father Use	-0.111*** (3.20	-0.035 (0.94)	-0.136*** (4.30)
Mother Use	-0.084*** (2.61)	-0.260*** (7.27)	-0.137*** (4.45)
Rho (Smoking, Chewing)		-0.248*** (10.97)	
Rho (Smoking, Knowledge)		-0.006 (0.27)	
Rho (Chewing, Knowledge)		0.002 (0.08)	
Log Likelihood Function		-14750.9	

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. Figures within parentheses are absolute values of *t*-ratios. The excluded occupational category is wage labor.

Table 3: Average Probabilities for Smoking Tobacco and Health Knowledge[a]

Variable (#Observations)	Informed Smoker (P_{s11})	Informed Non-smoker (P_{s01})	Uninformed Smoker (P_{s10})	Uninformed Non-smoker (P_{s00})
Full Sample (15000)	0.169	0.689	0.035	0.106
Region (7500)	0.172	0.646	0.048	0.134
Urban (5604)	0.144	0.776	0.014	0.067
Rural (9396)	0.185	0.637	0.048	0.300
ESC (8466)[b]	0.129	0.794	0.010	0.066
Less than ESC (6534)[b]	0.222	0.553	0.067	0.158
Muslim (11830)	0.168	0.696	0.033	0.103
Male (8241)	0.296	0.574	0.059	0.007
Female (6759)	0.015	0.829	0.005	0.150
Married (8636)	0.239	0.612	0.049	0.100
Unmarried (6364)	0.076	0.794	0.016	0.115
Agri-Labor (1677)	0.458	0.321	0.140	0.081
Service (1900)	0.247	0.688	0.021	0.044
Business (1972)	0.412	0.474	0.063	0.052
Self-employed (4593)	0.055	0.761	0.018	0.166
Student (3942)	0.020	0.790	0.002	0.099
Father Use (8053)	0.196	0.645	0.044	0.115
Mother Use (9688)	0.165	0.682	0.038	0.116
Sample size (n)	3091	9793	550	1566

[a] The underlying probabilities are computed for each individual using estimates from the trivariate probit model for smoking tobacco, chewing tobacco and health knowledge. Since smoking tobacco and health knowledge follow a bivariate normal distribution, the probabilities are computed for each respondent using the univariate and bivariate normal cumulative distribution functions as follows:

$P_{s11} = \Phi\left(x_{si}\beta_s, x_{ki}\beta_k, \rho_{sk}\right)$, $P_{s01} = \Phi\left(x_{ki}\beta_k\right) - P_{s11}$, $P_{s10} = \Phi\left(x_{si}\beta_s\right) - P_{s11}$, and

$P_{s00} = 1 - P_{s01} - P_{s10} - P_{s11}$.

[b] ESC denotes elementary school complete or higher.

Table 4: Average probabilities for Chewing Tobacco and Health Knowledge[a]

Variable (#Observations)	Informed Chewer (P_{c11})	Informed Non-chewer (P_{c01})	Uninformed Chewer (P_{c10})	Uninformed Non-chewer (P_{c00})
Full Sample (15000)	0.105	0.754	0.029	0.112
Region (7500)	0.129	0.690	0.043	0.138
Urban (5604)	0.084	0.837	0.012	0.067
Rural (9396)	0.118	0.704	0.039	0.139
ESC (8466)[b]	0.064	0.860	0.007	0.070
Less than ESC (6534)[b]	0.158	0.616	0.058	0.167
Muslim (11830)	0.101	0.763	0.026	0.110
Male (8241)	0.074	0.796	0.018	0.111
Female (6759)	0.142	0.702	0.042	0.113
Married (8636)	0.156	0.695	0.040	0.109
Unmarried (6364)	0.036	0.834	0.014	0.116
Agri-Labor (1677)	0.160	0.619	0.054	0.167
Service (1900)	0.068	0.867	0.006	0.058
Business (1972)	0.093	0.792	0.016	0.098
Self-employed (4593)	0.197	0.619	0.059	0.125
Student (3942)	0.003	0.896	0.004	0.100
Father Use (8053)	0.133	0.708	0.041	0.117
Mother Use (9688)	0.101	0.745	0.032	0.121
Sample size (n)	1677	11308	439	1576

[a] The underlying probabilities are computed for each individual using estimates from the trivariate probit model for smoking tobacco, chewing tobacco and health knowledge. Since chewing tobacco and health knowledge follow a bivariate normal distribution, the probabilities are computed for each respondent using the univariate and bivariate normal cumulative distribution functions as follows:

$P_{c11} = \Phi\left(x_{ci}\beta_c, x_{ki}\beta_k, \rho_{ck}\right)$, $P_{c01} = \Phi\left(x_{ki}\beta_k\right) - P_{c11}$, $P_{c10} = \Phi\left(x_{ci}\beta_c\right) - P_{c11}$, and

$P_{c00} = 1 - P_{c01} - P_{c10} - P_{c11}$.

[b] ESC denotes elementary school complete or higher.