Addictive Behaviors 38 (2013) 2714–2717

Contents lists available at ScienceDirect

Addictive Behaviors

Health risk perception and betel chewing behavior — The evidence from Taiwan

Chiang-Ming Chen [a,*], Kuo-Liang Chang [b,1], Lin Lin [c,2], Jwo-Leun Lee [d]

[a] Department of Economics, National Chi-Nan University, 1 University Rd., Puli, Nantou Hsien 545, Taiwan, ROC
[b] Department of Economics, South Dakota State University, Box 504, Scobey Hall 109, Brookings, SD, USA
[c] Department of Banking and Finance, National Chi-Nan University, 1 University Rd., Puli, Nantou Hsien 545, Taiwan, ROC
[d] Department of Senior Citizen Service Management, National Taichung University of Science and Technology, Taichung, Taiwan, ROC

HIGHLIGHTS

- A study of the relationship between health risk perception and betel nut chewing.
- Apply a Bayesian two-stage approach for discrete models with endogenous variables.
- Better health knowledge reduces the possibility for people to become betel chewers.
- Betel chewers have relatively poorer health risk perception than non-chewers.

ARTICLE INFO

Keywords:
Betel chewing
Risk perception
Bayesian learning process

ABSTRACT

In this study, we provided an empirical examination of the interaction between people's health risk perception and betel chewing. We hypothesized that a better knowledge of possible health risks would reduce both the number of individuals who currently chew betel and the likelihood of those who do not yet chew betel to begin the habit. We constructed a simultaneous equation model with Bayesian two-stage approach to control the endogeneity between betel chewing and risk perception. Using a national survey of 26,684 observations in Taiwan, our study results indicated that better health knowledge reduced the possibility that people would become betel chewers. We also found that, in general, betel chewers have a poorer health risk perception than other population. Overall, the empirical evidence suggested that health authorities could reduce the odds of people becoming betel chewers by improving their knowledge of betel-chewing's harmful effects.

1. Introduction

Chewing betel contributes to a higher risk of oral cancer, oral leukoplakia, and submucosal fibrosis. Regular betel chewing also damage chewers' tooth enamel and gum tissue through cariostatic effects that create long-term dental problems (Howden, 1984). Furthermore, studies have found that women who consumed betel during pregnancy were more likely to have babies with birth defects and other health issues (Yang et al., 2008). However, despite of all the negative health effects, betel chewing is still a popular habit in southern Asian communities. For example, more than three million Taiwanese people were identified as regular betel chewers in the early 90s, and the number of chewers has increased steadily ever since (Chen & Shaw, 1996; Ko, Chiang, Chang, & Hsief, 1992). Consequentially, betel chewing has engendered enormous private and social costs, both of which have arisen from medical expenses associated with its detrimental health effects. Therefore, a better understanding of betel chewing behavior has important implication from the perspectives of public health and social welfare. In this study, we examined the connection between people's perception of health risk and their choice to consume betel products.

The main ingredient of betel products (known as arecoline) creates addictive behaviors, similar to what nicotine does to tobacco smokers. However, while previous studies have found a strong link between smoking and risk perception (Kenkel, 1991; Viscusi, 1990, 1991), few studies have examined the connection between betel chewing and risk perception. In this study, we hypothesized that a better knowledge on health risk would reduce the number of individuals who currently chew betel and reduce the likelihood for those who do not yet chew betel to start the habit. We also assumed that betel chewers had different levels of knowledge of health risk than non-chewers. Using the data from a national survey in Taiwan, we applied a simultaneous model to

* Corresponding author. Tel.: +886 49 22910960x4629; fax: +886 49 22914435.
E-mail addresses: ming@ncnu.edu.tw (C.-M. Chen), Kuo-Liang.Chang@sdstate.edu (K.-L. Chang), linlin@ncnu.edu.tw (L. Lin), jllee@nutc.edu.tw (J.-L. Lee).
[1] Tel.: +1 605 688 5322; fax: +1 605 688 6386.
[2] Tel.: +886 49 22910960x4965; fax: +886 49 22914511.

0306-4603/$ – see front matter
http://dx.doi.org/10.1016/j.addbeh.2013.07.001

explore the relationship between health risk perception and betel chewing behavior.

2. Theory and calculation

We faced potential endogeneity in estimating the relationship between health risk perception and betel chewing behavior for the following reasons. First, betel chewers may be biased in how they evaluate the impacts of betel chewing on their own health. Second, individuals with better health knowledge may be more likely to avoid betel chewing altogether. Empirical evidence also suggests that the decision to consume betel products is not random. Ko et al. (1992) found that elderly, blue-collar workers with little education as well as people who possessed both cigarette and alcohol addictions also tended to consume betel products. Wang, Tasi, Huang, and Hone (2003, 2004) found that adolescent children who possess one or more of the following characteristics are more likely to develop habits of betel chewing: male, low family social status, or a child of divorced parents. Because standard regression models may yield unreliable estimates in the presence of endogeneity, Kenkel (1991) and Viscusi (1990) developed standard empirical models to control this problem when they studied the effects of risk perception on addiction habits.

Our study applied Viscuit (1985, 1991) that allowed us to analyze the mutual influences between betel chewing and risk perception simultaneously. The Bayesian approach highlights the learning process by which individuals update their subsequent risk perception from three main information sources: prior risk assessments, direct and indirect personal experience, and publicly provided risk information (Viscusi, 1991). Accordingly, we treated the function of risk perception for individual i as a weighted sum of these three information sources:

$$\begin{aligned} &RP* = \alpha_0 + \alpha_2 x_{2i} + \alpha_{3i} + \alpha_{4i} Betel\_Chewing_i + U_{1i} \\ &RP = 1, RP^* > 0 (\text{betel chewing causes oral cancer}); \\ &RP = 0, \text{otherwise} \end{aligned} \quad (1)$$

where RP^*denotes a latent variable of health risk perception (subsequent to education). X_1 is prior belief for risk measured by a constant term; X_2 is personal risk experience and risk-related behavior measured by the following: 1) respondents' socioeconomic variables (i.e., *Age*, *Gender*, and *Children*); 2) risky behavior variables (*Betel_Chewing*) i.e., *Smoke* and *Betel*); and 3) exercise habits (*Exercise*); X_3 is public information about risk. We include respondents' level of education (X_3) as an index to measure the effectiveness of health information (including the risks of betel chewing) on *RP*.

The betel chewing decision is specified in latent regression Eq. (2). Assuming that individuals compare marginal benefit and marginal cost based on utilities gained and disutility resulting from betel chewing, Eq. (2) models the unobserved betel chewing participation decision:

$$\begin{aligned} &Betel\_Chewing_i^* = \beta_0 + \beta_1 RP_1 + \beta_2 X_{4i} + U_{2i} \\ &Betel\_Chewing_i = 1, Betel\_Chewing^* > 0 (\text{if individual } i \text{ is a betel chewer}) \\ &Betel\_Chewing_i = 0, (\text{if individual } i \text{ is not a betel chewer}) \end{aligned} \quad (2)$$

X_4 contains a set of exogenous variables that affect betel chewing decision — including age, gender, marital status, income and occupation. Together, Eqs. (1) and (2) formulate a simultaneous equation model that allows the mutual influence of betel chewing behavior and risk perception to be estimated simultaneously (Dubin & McFadden, 1984; Sasaki, 2002).

To estimate the effects of betel chewing on risk perception as in Eq. (1), we first constructed a logit model to estimate the likelihood of an individual's decision to begin chewing betel. We then used the resulting nonlinear probability as additional instruments in a linear probability equation to estimate the likelihood of an individual's decision to consume betel. Finally, we applied the resulting linear predicted probability as an instrument to measure betel chewing (*Betel_Chewing* in the Eq. (1). Concurrently, we applied a similar procedure to estimate the effect of health risk perception on betel chewing behavior as in Eq. (2), with two different instruments, namely, *Income* and *Profession*. We followed the method used by Kan (2007) to perform two likelihood ratio tests for the validity of instruments: the first test (i.e., weak instrument test) examines the explanatory power of instruments, and the second test (i.e., exclusion restrictions test) examines the existence of over-identification.

3. Material and results

This study utilized data from the 2002 National Survey on Knowledge, Attitude, and Practice of Health Promotion in Taiwan (HPKAP), a national survey conducted by Bureau of Health Promotion, the Department of Health Executive Yuan in Taiwan. HPKAP contains 26,696 responses from people over age 15 by systematic random sampling method during the period from October 2002 through March 2003. After deleting responses with missing values, we included responses from 2724 self-reported betel chewers and 23,895 non-chewers in the analysis. Table 1 provides descriptive statistics of the full sample and two sub-samples (current betel chewers and non-

Table 1
Variable definition and descriptive statistics.

Items	Definition	Full sample		Betel chewers		Non-Betel chewers	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
Endogenous variables							
RP	Does a respondent believe chewing betel can cause oral cancer; Yes = 1; No = 0.	0.8409	0.3657	0.7148	0.4516	0.8553	0.3518
Betel_Chewing	Did a respondent consume betel products in the past six months; Yes = 1; No = 0.	0.1023	0.3031				
Demographic variables							
Age	Respondent's age	42.8371	18.1636	45.0995	18.6907	42.5792	18.085
Female	Yes = 1; No = 0.	0.5125	0.4999	0.4402	0.4965	0.5207	0.4996
Child	Does a respondent have out-of-wedlock children or not; Yes = 1, No = 0.	0.3594	0.4798	0.3572	0.4793	0.3596	0.4799
Instrumental variables for risk							
Education	Respondent's years of education	9.7419	4.6249	9.2746	4.7261	9.7951	4.6103
Smoke	Whether a respondent has history of smoking or not; Yes = 1, No = 0.	0.3651	0.4815	0.3748	0.4842	0.364	0.4811
Exercise	Does a respondent exercise regularly; Yes = 1, No = 0.	0.5577	0.4967	0.5316	0.4991	0.5607	0.4963
Instrumental variables for betel nut							
Income	Average monthly income in the previous year dividend by 1000 (unit: NT dollars)	21.7188	23.6193	19.81	21.5762	21.9364	23.8318
Profession	Does a respondent work in agricultural and/or fishery industries; Yes = 1, No = 0.	0.0507	0.2193	0.0727	0.2597	0.0482	0.2141
Sample size	Number of observations	26,619		2,724		23,895	