

FACTORS ASSOCIATED WITH DEMAND FOR TOBACCO ACROSS MALAYSIA REGIONS: PARTICIPATION AND LEVEL OF CONSUMPTION

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ABSTRACT

Tobacco consumption is a serious public health concern. To design a better tobacco regulation, it is important for policy makers to understand which group of population consumes or does not consume tobacco. The objective of this study is to examine sociodemographic factors associated with consumption of tobacco among households in Malaysia. Data are obtained from the Malaysian Household Expenditure Survey (HES) 2014 (n = 10665). A double-hurdle model is utilised to analyse participation (extensive margin) and level (intensive margin) of consumption of tobacco. Age is negatively associated with the likelihood of consuming tobacco but positively associated with the amount consumed. Household size and households headed by males are positively correlated with participation and level decisions of tobacco consumption. Being married is associated with a reduced likelihood of tobacco consumption and the amount consumed. Households with less-educated heads are more likely to consume tobacco but consume less than households with well-educated heads. Being employed and alcohol consumption are positively associated with consumption likelihood and the amount consumed. In conclusion, sociodemographic factors play an important role in explaining participation and level decisions of tobacco. Intervention measures directed toward reducing tobacco consumption among households that have a high tendency to consume tobacco or consume more may hold promise.

Keywords: Cigarette; Education; Gender; Household; Tobacco

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1. INTRODUCTION

Over one billion people aged 15 years and above smoked tobacco in year 2016 (World Health Organization, 2018). Each year, tobacco smoking is responsible for over three million deaths across the globe. It is predicted that in year 2020, about 13.3% of total deaths will be attributable to tobacco smoking, and this amount will exceed eight million by 2030 (World Health Organization, 2008). Southeast Asian countries alone have about 600 million tobacco smokers, while Malaysia is no exception in this matter as it has around five million smokers (Al-Sadat, Misau, Zariyah, Maznah and Su, 2010). Smoking related illnesses, such as lung cancer, chronic obstructive pulmonary disease and coronary heart disease are among the common causes of death in Malaysia, accounting for about 1017 deaths per 100000 populations annually (Ezzati and Lopez, 2003).

In this respect, a number of initiatives have been taken by the Malaysian government to curb smoking. Among the initiatives are increasing the price of cigarette through tax, having text and pictorial warnings on cigarette packs, organising anti-smoking campaigns, banning the sale of kiddie packs, increasing the legal age of consuming tobacco and banning smoking in all the public areas. While analysing the effectiveness of these interventions is beyond the scope of this study, we aim to provide the government with better information about tobacco consumption behaviour, thus more effective policies can be generated.

It is important for policy makers to understand how people make a decision to consume tobacco if a better anti-smoking intervention measure is to be formulated. From the economic and public health viewpoint, Rampal, Sanjay, Azhar and Kamil (2006), Rampal, Rampal, Azhar, Sherina, Mohammad, Ramlee and Ahmad (2008), Cheah (2012), Cheah and Naidu (2012), Tan (2012), Lim, Ghazali, Kee, Lim, Chan, The, Mohd Yusoff, Kaur, Mohd Zain, Nik Mohamad and Salleh (2013), Mizanur Rahman, Arif, Abd Razak, Suhaili, Tambi, Akoi, Melissa and Hussein (2015), Lim, Jasvinder, Cheong, Ho, Lim, Teh, Lau, Suthahar and Ambigga (2016) and Ajan, Juni, Minhat and Aidalina (2016) are the researches to date who examine factors associated with tobacco consumption in Malaysia. They have all found that sociodemographic factors, such as age, income, education and marital status are significant in explaining the decisions of people to indulge in smoking. In particular, income and education are negatively associated with the likelihood of smoking (Rampal et al., 2008; Tan, 2012; Cheah, 2012; Cheah and Naidu, 2012; Lim et al., 2013; Lim et al., 2016). This is because higher income and well-educated people are more concerned about their health and have better health awareness than their lower income and less-educated counterparts. This study revisits these findings using a more recent nationally representative data.

In brief, three important contributions to the existing literature are made. Firstly, this study uses a better statistical model, i.e., double-hurdle model, to examine sociodemographic factors associated with participation and level of household consumption of tobacco. This model assumes that the explanatory variables do not have the same relationships with the probability of consuming tobacco and the amount consumed. Previous studies used logistic regression model and only focused on participation decisions of tobacco. This is questionable because the factors that are positively associated with the likelihood of participation may not necessarily be positively or significantly associated with the amount consumed. This is proven by Yen (2005), who found that well-educated and older individuals are less likely to smoke cigarette than less-educated and younger individuals, but smoke more.

Secondly, previous studies did not consider sociodemographic differences across regions in tobacco consumption, whereas this study segregates the sample by regions, i.e., Northern (Perlis, Kedah, Penang, Perak), East coast (Kelantan, Terengganu, Pahang), Central (Selangor, Kuala Lumpur, Putrajaya) and Southern (Negeri Sembilan, Melaka, Johor) regions. Hence, our results would serve as an important information for policy makers. We hypothesise that regional factor plays an important role in determining household consumption of tobacco given that sociodemographic characteristics of population vary across regions. Furthermore, there are also income and economic differences in these regions. In particular, Central region has the highest level of income and economic development, whereas East coast region has the lowest. Therefore, household expenditures on tobacco in these regions are expected to be varied.

Thirdly, analysis of a more recent nationwide dataset, i.e., Malaysian Household Expenditure Survey 2014, provides an opportunity to obtain a better understanding of the factors associated with the current smoking behaviour. This is important because the prevalence of smoking in Malaysia is still high (22.8%), despite the introduction of various anti-smoking policies (Institute for Public Health, 2015). Moreover, results of this study can facilitate a comparison between tobacco consumption behaviours evidenced from the recent data and those found in previous studies. There are several advantages of using household data. First, households offer a strategic place where all the people can be interviewed and surveyed. Second, members of households can allow for comprehensive population coverage. Third, a cross validation of survey results can be conducted, especially given that the survey comprises a large number of households. Fourth, household members are able to influence each other to smoke.

2. HEALTH BELIEF MODEL

The health belief model (HBM) is used in this study to explain household consumption of tobacco (Becker and Maiman, 1975). According to the HBM, people's beliefs about health and health behaviours depend on five components: perceived severity, perceived susceptibility, perceived benefits, perceived barriers and cues for action. These components are affected by modifying variables, i.e., the sociodemographic variables examined in this study. The HBM suggests that modifying variables affect health behaviours via these components.

Perceived severity refers to how people evaluate the seriousness of being suffered from diseases. If people perceive that tobacco induced diseases, such as cancers have very serious negative consequences, they are unlikely to consume tobacco. These negative consequences include painfulness and physical disability, as well as social costs, such as income lost caused by absence from works and increases in financial burden due to rises in medical care expenditure.

Perceived susceptibility refers to the evaluation of the risk of acquiring diseases. If people think that they have a high risk of developing diseases, they are unlikely to consume tobacco. On the other hand, if people are optimistic that they are unlikely to acquire diseases, they are likely to consume tobacco. Perceived threat is the combination of perceived severity and perceived susceptibility. Hence, in general, people who have higher perceived threat are less likely to consume tobacco than people who have lower perceived threat.

In addition, perceived benefit also plays an important role in determining participation in health behaviours. In particular, perceived benefits refers to the evaluation of the advantages of consuming tobacco. If people believe that tobacco has substantial benefits, such as stress reduction and improvement in moods, they are likely to consume it. Put differently, if people do not think that tobacco has any benefit, they are unlikely to consume it.

Another component of the HBM is perceived barriers. It refers to how people evaluate the constraint of participating in health behaviours. Although people think that tobacco has benefits, barriers may prevent them to consume it. Smoking ban, high tobacco tax rates and limited availability of tobacco products, for instance, are the barriers to consumption of tobacco. In general, people would weigh the benefits and barriers of health behaviour, preferring to engage only when the benefits outweigh the barriers.

The last component of the HBM is cues for action. According to the HBM, there must be something to trigger participation in health behaviour. Cues for action can be categorised into internal and external. Pain and symptoms, for instance, are the internal cues for action. Information provided by peers, media or health specialists are the external cues. For instance, if people feel the pain from tobacco induced diseases or are warned by medical doctors or friends of the disadvantages of consuming tobacco, they are unlikely to consume tobacco. In the opposite, if people do not feel the pain or are encouraged by their peers to indulge in smoking, they are likely to consume tobacco.

3. METHODS

3.1. Data

The scope of this study is Peninsular Malaysia. It does not cover Sabah and Sarawak. Secondary analysis of the Malaysian Household Expenditure Survey (HES) 2014 was performed in this study (Department of Statistics Malaysia, 2014). HES 2014 was a nationally representative data that comprised a large sample size. The survey was carried out in all the regions of Malaysia: Northern, East coast, Central and Southern regions. The purpose of HES was to investigate the overall consumption pattern among Malaysian households.

A two-stage stratified sampling was used to collect the data. The selection in the first stage was based on Enumeration Blocks (EBs) designed for the Population and Housing Census, i.e., a nationally representative survey conducted by the Department of Statistics Malaysia. The EBs were categorised into two categories: urban (≥ 10000 population) and rural (< 10000 population) areas. In the second stage, households in the selected living quarters (LQs) were surveyed. In particular, each EB comprised 80 to 120 LQs. Exclusion criteria were households staying at residential institutions, such as hotels, hostels, hospitals, welfare homes and prisons. Only the head of each household was interviewed. The questionnaires were prepared in two languages (English and Malay) in order to facilitate a better understanding.

The data collected contained details of the sociodemographic characteristics of households and household heads. Monthly household expenditures on various items (e.g. food and beverages, clothing and footwear, housing, health and transport) were recorded. The sample size was

calculated based on three criteria: i) findings of previous HES; ii) level of sampling design; and iii) desired error. A total of 10665 households were interviewed and used for analyses.

3.2. Variables

The explained variable used in this study was the total monthly household expenditure on tobacco (including cigarette, cigar, cheroots, shisha and pipes) [in Ringgit Malaysia (RM)]. The explanatory variables were selected based on previous Malaysian studies related to tobacco consumption (Rampal et al., 2006; Rampal et al., 2008; Cheah, 2012; Cheah and Naidu, 2012; Tan, 2012; Lim et al., 2013; Mizanur Rahman et al., 2015; Lim et al., 2016; Ajan et al., 2016). In particular, the explanatory variables consisted of household heads' sociodemographic profile (gender, age, ethnicity, marital status, education, employment status), household income, household size, location of household and household expenditure on alcohol. Age of household heads (in years), monthly household income (in RM), household size and monthly household expenditure on alcohol (in RM) were formatted as continuous variables.

Ethnic variable was categorised into two categories: Bumiputera (i.e., Malaysians of indigenous Malay origin) and non-Bumiputera. Three categories of household heads' marital status were formed: single, married and widow/divorce. Household heads' level of education was grouped into four categories: no formal education, primary (<7 years of schooling), secondary (7-11 years) and tertiary (≥ 12 years). Employment status of household head consisted of employed and unemployed. Household location was grouped into urban and rural areas.

3.3. Statistical Analyses

Firstly, mean and percentage of all the explained and explanatory variables were calculated. Specifically, mean was calculated for continuous variables (expenditure on tobacco, age, income, household size and expenditure on alcohol), while percentage was calculated for categorical variables (gender, ethnicity, marital status, education, employment status and location of household). Secondly, Pearson χ^2 test was performed to analyse the differences in the proportion of households that consume tobacco with given household heads' sociodemographic profiles and household location. Because the data had a large sample size, Pearson χ^2 was used, instead of Fisher exact. Lastly, a double-hurdle model was used to estimate sociodemographic factors associated with participation and level of household consumption of tobacco. As pointed out by Madden (2008), double-hurdle model was the most appropriate model for tobacco consumption. The first part of double-hurdle model, i.e., participation decision, used a probit regression to estimate the probability of a particular household consuming tobacco, which was the extensive margin of tobacco consumption. The regression was estimated based on the entire sample. The second part, i.e., level decision, used an ordinary least square (OLS) to examine how much a particular household that consumed tobacco spent on tobacco, which was the intensive margin of tobacco consumption (conditional upon consumption). Additionally, the regressions were stratified by region (i.e., Northern, East coast, Central and Southern). The specification of the double-hurdle model can be expressed as (Wooldridge, 2010):

$$P(y = 0|\mathbf{x}) = 1 - \Phi(\mathbf{x}\boldsymbol{\gamma}) \quad (1)$$

$$(y|\mathbf{x}, y > 0) \sim \text{Normal}(\mathbf{x}\boldsymbol{\beta}, \sigma^2) \quad (2)$$

where P is the probability, y is the total monthly household expenditure on tobacco, \mathbf{x} is the independent variable (x_1 = age; x_2 = income; x_3 = household size; x_4 = male; x_5 = Bumiputera; x_6 = married; x_7 = widowed/divorced; x_8 = no formal education; x_9 = primary-level education; x_{10} = secondary-level education; x_{11} = employed; x_{12} = urban; x_{13} = total monthly household expenditure on alcohol), Φ is cumulative distribution function, $\boldsymbol{\gamma}$ is the parameter estimate in the consumption equation, $\boldsymbol{\beta}$ is the parameter estimates in the amount equation and σ is the standard deviation.

The main advantage of double-hurdle model is that it is flexible and can separate the mechanisms to determine participation and level decisions. In particular, the model allows the effects of independent variables on the likelihood of consuming tobacco and the amount spent on tobacco to have different signs. For instance, although males are more likely to consume tobacco than females, they may spend less on tobacco. However, this situation could not be captured by a binary regression that was employed by previous studies. The Stata statistical software was utilised to perform all the statistical analyses (StataCorp, 2015).

4. RESULTS

Each month, on average, households in Northern region, East coast region, Central region, Southern region and the entire Peninsular Malaysia spend around RM 45.13, RM 69.20, RM 71.01, RM 107.21 and RM 70.72 on tobacco, respectively. The average age of all household heads is between 43 and 49 years. Households in Central region have the highest monthly income (RM 6060.65), followed by those in Northern region (RM 6013.61), the entire Peninsular Malaysia (RM 5908.88), East coast region (RM 5852.29) and Southern region (RM 5644.04). Overall, each household has an average of four members. On average, households in Northern region, East coast region, Central region, Southern region and the entire Peninsular Malaysia spend around RM 11.80, RM 2.52, RM 21.85, RM 14.39 and RM 12.90 on alcohol per month, respectively (Table 1).

Table 1: Summary statistics of the explained and explanatory variables, by region

Variables	Region				
	Northern	East coast	Central	Southern	Peninsular
Continuous					
Expenditure on tobacco (in RM per month)	45.13	69.20	71.01	107.21	70.72
Age (in years)	48.20	48.57	43.41	46.94	46.78
Income (in RM per month)	6013.61	5852.29	6060.65	5644.04	5908.88
Household size (in person)	4.07	4.59	4.16	4.23	4.24
Expenditure on alcohol (in RM per month)	11.80	2.52	21.85	14.39	12.90
Categorical					
Gender					
Male	84.65	84.67	86.51	86.98	85.64
Female	15.35	15.32	13.49	13.02	14.36
Ethnicity					
Bumiputera	59.41	89.73	54.70	62.81	65.64
Non-Bumiputera	40.59	10.27	45.30	37.19	34.36

Variables	Region				
	Northern	East coast	Central	Southern	Peninsular
Marital status					
Married	77.91	81.66	78.43	79.76	79.28
Widowed/divorced	10.27	10.44	6.22	8.28	8.83
Single	11.82	7.89	15.36	11.96	11.89
Education					
No formal	2.47	4.67	1.10	2.22	2.55
Primary	18.22	21.60	6.98	16.27	15.66
Secondary	61.17	58.74	50.42	60.55	57.74
Tertiary	18.13	14.98	41.50	20.96	24.05
Employment status					
Employed	89.63	91.77	95.53	92.14	92.17
Unemployed	10.37	8.23	4.46	7.86	7.83
Location					
Urban	73.30	51.40	94.84	72.89	73.90
Rural	26.70	48.60	5.15	27.11	26.10
Observations	3232	2356	2735	2342	10665

Notes: RM refers to Ringgit Malaysia. For continuous variables, the values refer to mean. For categorical variables, the values refer to percentage.

Source: Malaysian Household Expenditure Survey 2014.

Most of the households are headed by males (84.65-86.98%). The majority of households in Northern region (59.41%), East coast region (89.73%), Central region (54.70%), Southern region (62.81%) and the entire Peninsular Malaysia (65.64%) are Bumiputera. Of the total sample, only a small proportion of households are headed by widowed/divorced (6.22-10.44%) and single (7.89-15.36%) individuals. The majority of household heads have secondary-level education (50.42-61.17%), followed by tertiary-level (18.13-41.50%), primary-level (6.98-21.60%) and no formal education (1.10-4.67%). In all the regions and the entire Peninsular Malaysia, a large proportion of households have employed heads (89.53-95.53%) and are located at urban areas (51.40-94.84%).

Tobacco consumption seems to be more frequent among households with male heads [Northern (44.04%), East coast (51.18%), Central (46.53%), Southern (54.44%), the entire Peninsular Malaysia (48.57%)] than those with female heads [Northern (17.94%), East coast (25.76%), Central (24.39%), Southern (25.25%), the entire Peninsular Malaysia (22.80%)]. In East coast region, Central region, Southern region and the entire Peninsular Malaysia, 45.72-52.89% of Bumiputera households consume tobacco, compared with only 40.08-46.84% of non-Bumiputera households. In Northern and East coast regions, the highest proportion of tobacco consumers is evidenced in the households with single heads (44.24-51.08%), whereas in Central region, Southern region and the entire Peninsular Malaysia, the highest proportion of tobacco consumers is evidenced in the households with married heads (44.90-52.68%) (Table 2).

Table 2: Proportion of households that consume tobacco with given household heads' gender, ethnicity, marital status, education level, employment status and household location profiles

Variables	Region				
	Northern	East coast	Central	Southern	Peninsular
Gender					
Male	44.04	51.18	46.53	54.44	48.57
Female	17.94	25.76	24.39	25.25	22.80
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Ethnicity					
Bumiputera	40.99	48.11	45.72	52.89	46.65
Non-Bumiputera	38.64	40.08	40.92	46.84	41.46
<i>p</i> -value	0.181	0.018	0.012	0.005	<0.001
Marital status					
Married	41.62	49.12	44.90	52.68	46.60
Widowed/divorced	23.19	30.08	31.18	30.41	27.92
Single	44.24	51.08	41.67	51.07	45.90
<i>p</i> -value	<0.001	<0.001	0.002	<0.001	<0.001
Education					
No formal	28.75	46.36	53.33	36.54	40.07
Primary	44.14	50.88	49.74	49.87	48.14
Secondary	42.49	51.23	48.30	54.94	48.62
Tertiary	29.18	26.91	36.48	40.33	34.23
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Employment status					
Employed	42.42	49.49	44.51	52.97	46.85
Unemployed	19.40	22.68	22.95	23.37	21.56
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Location					
Urban	38.33	43.19	43.45	50.32	43.36
Rural	44.73	51.62	45.39	51.50	49.14
<i>p</i> -value	0.001	<0.001	0.650	0.613	<0.001
Observations	1294	1114	1191	1186	4785

Notes: *p*-value is based on Pearson χ^2 test.

Source: Malaysian Household Expenditure Survey 2014.

The proportion of households that consume tobacco with given household heads' education level vary across regions. In Northern region, tobacco consumption is the most common among households headed by individuals with primary-level education (44.14%), whereas in East coast region, Southern region and the entire Peninsular Malaysia, tobacco consumption is the most common among households with secondary-educated heads (51.23%, 54.94% & 48.62%). Surprisingly, in Central region, the proportion of tobacco consumers among households headed by individuals with no formal education is the highest (53.33%). A significant higher proportion of households with employed heads are tobacco consumers compared with household having unemployed heads in Northern region (42.42% vs 19.40%), East coast region (49.49% vs 22.68%), Central region (44.51% vs 22.95%), Southern region (52.97% vs 23.37%) and the entire Peninsular Malaysia (46.85% vs 21.56%). Finally, in Northern region, East coast region and the entire

Peninsular Malaysia, 38.33-43.36% of urban households compared with 44.73-51.62% of rural households consume tobacco.

In participation equation, the marginal effects of all the explanatory variables are estimated, whereas in level equation, the estimated coefficients are interpreted directly. If household heads' age increases by one year, the amount spent on tobacco increases by RM 0.89 and RM 0.56 among households in Central region and the entire Peninsular Malaysia, respectively. However, the likelihood of consuming tobacco reduces by 0.36-0.38% among households in Northern region, East coast region and the entire Peninsular Malaysia. An additional RM 100 of household income increases household expenditure on tobacco by RM 0.17 in Central region. However, the effect of income on tobacco consumption is not significant in other regions and the entire Peninsular Malaysia (Table 3). We suspect that this may be due to a high correlation between income and education. Hence, additional regressions that omit education variable were estimated (Table 4). Surprisingly, results of these regressions still show that income variable is not very significant, thus concluding that income and education are not highly correlated.

Table 3: Factors associated with participation and level of consumption of tobacco, by region

Variables	Region				
	Northern	East coast	Central	Southern	Peninsular
Constant	(39.75)	(148.58)*	(-3.41)	(143.81)*	(65.48)*
Age	-0.0036* (0.36)	-0.0038* (0.59)	-0.0014 (0.89)*	-0.0019 (0.27)	-0.0028* (0.56)*
Income/100	-0.0002 (-0.02)	-0.0001 (0.04)	-0.0002 (0.17)*	-0.0001 (0.08)	-0.0001 (0.07)
Household size	0.0072 (4.06)*	0.0126* (2.36)	0.0066 (7.65)*	0.0189* (7.83)*	0.0117* (5.73)*
Gender					
Male	0.2634* (15.83)	0.2342* (46.46)*	0.2269* (16.86)	0.2723* (27.58)	0.2512* (24.39)*
Female	–	–	–	–	–
Ethnicity					
Bumiputera	0.0267 (-17.65)*	0.1056* (-47.27)*	0.0692* (0.89)	0.0932* (-21.40)	0.0615* (-13.62)*
Non-Bumiputera	–	–	–	–	–
Marital status					
Married	-0.0797* (-25.78)*	-0.0452 (-62.90)*	-0.0481 (-40.51)*	-0.0767* (-33.80)*	-0.0642* (-36.62)*
Widowed/divorced	-0.0483 (-25.53)	-0.0413 (-40.90)	-0.0122 (-31.81)	-0.0785 (-16.22)	-0.0462 (-28.97)*
Single	–	–	–	–	–
Education					
No formal	0.1642* (0.25)	0.3283* (-82.16)*	0.2783* (-8.05)	0.1872* (43.85)	0.2154* (-19.91)
Primary	0.2557* (-7.27)	0.3157* (-50.35)*	0.1991* (-4.17)	0.1943* (-23.89)	0.2239* (-21.92)*

Variables	Region				
	Northern	East coast	Central	Southern	Peninsular
Secondary	0.1535*	0.2457*	0.1266*	0.1686*	0.1558*
Tertiary	–	–	–	–	–
Employment status					
Employed	0.1367*	0.1642*	0.1707*	0.2219*	0.1754*
Unemployed	–	–	–	–	–
Location					
Urban	-0.0293	-0.0521*	0.0403	0.0071	-0.0196
Rural	(17.23)*	(22.69)*	(37.23)*	(7.34)	(20.77)*
Expenditure on alcohol (in RM per month)	0.0007*	0.0012*	0.0005*	0.0005*	0.0006*
	(0.19)*	(0.15)	(0.01)	(0.14)*	(0.08)*

Notes: RM refers to Ringgit Malaysia. The values refer to marginal effects from probit regression (i.e. participation equation). The estimated coefficients of linear regressions are shown in parentheses (i.e. level equation). * $p < 0.05$.

Source: Malaysian Household Expenditure Survey 2014.

Table 4: Factors associated with participation and level of consumption of tobacco, by region (without education variable)

Variables	Region				
	Northern	East coast	Central	Southern	Peninsular
Constant	(39.62)	(106.54)*	(-8.71)	(133.08)*	(54.98)*
Age	-0.0015	-0.0009	-0.0001	-0.0004	-0.0008
	(0.29)	(0.40)	(0.90)*	(0.24)	(0.44)*
Income/100	-0.0002	-0.0001	-0.0002	-0.0001	-0.0001
	(-0.02)	(0.05)	(0.17)*	(0.08)	(0.07)
Household size	0.0088	0.0117*	0.0099	0.0212*	0.0133*
	(4.03)*	(2.25)	(7.48)*	(7.52)*	(5.54)*
Gender					
Male	0.2631*	0.2530*	0.2333*	0.2731*	0.2561*
Female	(15.63)	(41.31)*	(14.38)	(25.27)	(23.06)*
Ethnicity					
Bumiputera	0.0172	0.0883*	0.0630*	0.0778*	0.0537*
Non-Bumiputera	(-17.24)*	(-43.86)*	(-0.14)	(-21.89)	(-13.40)*
Marital status					
Married	-0.0798*	-0.0725	-0.0518	-0.0643	-0.0668*
Widowed/divorced	(-25.71)*	(-59.39)*	(-40.41)*	(-36.88)*	(-37.03)*
Single	-0.0311	-0.0269	0.0040	-0.0493	-0.0264
	(-25.85)	(-44.99)	(-35.19)	(-18.02)	(-31.22)*

Variables	Region				
	Northern	East coast	Central	Southern	Peninsular
Employment status					
Employed	0.1547* (48.29)*	0.1916* (52.48)*	0.1668* (77.67)*	0.2191* (45.83)	0.1840* (57.95)*
Unemployed	–	–	–	–	–
Location					
Urban	-0.0604* (18.08)*	-0.0823* (25.37)*	-0.0058 (38.40)*	-0.0110 (6.50)	-0.0534* (23.44)*
Rural	–	–	–	–	–
Expenditure on alcohol (in RM per month)	0.0007* (0.19)*	0.0012* (0.16)	0.0005* (0.01)	0.0005* (0.14)*	0.0005* (0.09)*

Notes: RM refers to Ringgit Malaysia. The values refer to marginal effects from probit regression (i.e. participation equation). The estimated coefficients of linear regressions are shown in parentheses (i.e. level equation). * $p < 0.05$.

Source: Malaysian Household Expenditure Survey 2014.

One more member in a household raises the probability of consuming tobacco by 1.26-1.89% in East coast region, Southern region and the entire Peninsular Malaysia. Also, it increases the level of consumption by RM 4.06-7.83 among households in Northern region, Central region, Southern region and the entire Peninsular Malaysia. Households with male heads are 22.69-27.23% more likely to consume tobacco than households with female heads and also spend RM 46.46 and RM 24.39 more if they are in East coast region and the entire Peninsular Malaysia, respectively. Being Bumiputera households increases the likelihood of consuming tobacco by 6.92-10.56% in East coast region, Central region, Southern region and the entire Peninsular Malaysia. However, it reduces the level of consumption in Northern region (RM 17.65), East coast region (RM 47.27) and the entire Peninsular Malaysia (RM 13.62). In all the regions and the entire Peninsular Malaysia, households with married heads spend RM 25.78-62.90 less on tobacco than households with single heads. Also, they are about 6-8% (Northern region, Southern region and the entire Peninsular Malaysia) less likely to consume tobacco.

If households are headed by individuals with no formal, primary-level and secondary-level education instead of tertiary-level education, the predicted probability of consuming tobacco increases by 15.35-25.57%, 24.57-32.83%, 12.66-27.83%, 16.86-19.43% and 15.58-22.39% in Northern region, East coast region, Central region, Southern region and the entire Peninsular Malaysia, respectively. However, in East coast region, households with uneducated, primary-educated and secondary-educated heads spend around RM 82.16, RM 50.35 and RM 58.07 less on tobacco, respectively, compared with their counterparts headed by tertiary-educated individuals. In Central and Southern regions, having secondary-educated heads reduces the level of consumption of tobacco by RM 19.12-27.88. The negative relationship between education and expenditure on tobacco is also evidenced in the entire Peninsular Malaysia [primary (-RM 21.92) and secondary (-RM 22.29)].

If household heads are employed, the likelihood and level of tobacco consumption increase by 13.67-22.19% and RM 48.84-81.30, respectively. In East coast region, urban households are 5.21% less likely to consume tobacco than rural households, but spend RM 22.69 more. In Northern region, Central region and the entire Peninsular Malaysia, urban households spend around RM

17.23-37.23 more on tobacco compared with rural households. Another RM 1 of monthly alcohol expenditure increases the likelihood of consuming tobacco by 0.05-0.12% among households in all the regions and the entire Peninsular Malaysia. It also raises tobacco expenditure by RM 0.08-0.19 among households in Northern region, Southern region and the entire Peninsular Malaysia.

5. DISCUSSION

This study uses a nationally representative data to throw new light of the factors associated with tobacco consumption in various regions of Malaysia. Using the Pearson χ^2 test, this study finds that the proportion of households that consume tobacco varies across sociodemographic profiles and regions. Likewise, findings based on the double-hurdle model suggest that age, income, household size, gender, ethnicity, marital status, education, employment status, household location and alcohol consumption are independently associated with participation and level decisions of tobacco. Past studies examining the relationships between sociodemographic factors and smoking only focused on consumption likelihood and did not make any comparison between regions (Rampal et al., 2006; Rampal et al., 2008; Cheah, 2012; Cheah and Naidu, 2012; Tan, 2012; Lim et al., 2013; Mizanur Rahman et al., 2015; Lim et al., 2016; Ajan et al., 2016). Hence, it is interesting to compare and contrast the findings obtained from this study and those evidenced in previous studies.

Households with older heads are less likely to consume tobacco than households with younger heads. This is in line with the findings of previous studies that age is associated with a decreased likelihood of smoking (Cheah and Naidu, 2012; Tan, 2012; Lim et al., 2013). The reason for this finding is that older individuals tend to have poorer health conditions than younger individuals and consequently are more aware of their health (Cheah and Naidu, 2012; Lim et al., 2013). Furthermore, older individuals have learned more about the adverse effects of smoking on health compared with their younger counterparts (Lim et al., 2013). A more relax lifestyle that older individuals engage in may also be an explanation because stress may lead to smoking (Cheah and Naidu, 2012). However, our findings show that households with older heads spend more on tobacco than households with younger heads. This is due to the fact that younger household heads are more motivated by perceived barriers to consume tobacco and cues for not smoking than older household heads (Carmel, Shani and Rosenberg, 1994). Hence, if households are headed by a young adult instead of an old adult, their consumption of tobacco tends to be lower. However, owing to data limitation, the exact types of barriers and cues that affect tobacco consumption are not well-understood, and this can be a direction of future qualitative research. Considering these findings, smoking prevention programmes should focus primarily on households headed by young adults in Northern and East coast regions, while smoking cessation programmes have to concentrate on households headed by old adults in Central region.

The past findings on income were inconclusive. Cheah and Naidu (2012) found that income was negatively associated with the likelihood of smoking. They claimed that higher income individuals were more productive than lower income individuals and thus were more concerned about their health. Ajan et al. (2016) found otherwise that income was correlated with an increased tendency to smoke. Their results remained significant after all the demographic factors were held constant. In this study, household income is positively associated with the amount spent on tobacco, which

is consistent with the findings of Ajan et al. (2016). However, this association is only significant in Central region. The positive relationship between income and tobacco consumption may reflect the effects of tax on cigarette. Since cigarette is heavily taxed in Malaysia, higher income households may find it more affordable than lower income households. In Malaysia, the tax on cigarette is about 49%, which is higher than the average taxes on other goods (Mohamed Nor, Raja Abdullah, Rampal and Mohd Noor, 2013). Of note, there are no income differences in tobacco consumption in Northern, East coast and Southern regions, implying that taxation approach may not be a very equitable move in those regions. Given that tax is not analysed in this study, we avoid extrapolations to possible tax-related anti-smoking policies.

The positive relationships between household size and the likelihood of consuming tobacco, and the amount spent imply that a policy directed towards reducing tobacco consumption among households with many family members can be effective in lowering the prevalence of smoking in Malaysia. All the regions should be given equal attention by the policy makers because significant relationships are evidenced in all the regions. The Theory of Planned Behavior (TPB) developed by Ajzen (1991) can be used to explain these positive relationships. According to the TPB, if the majority of members in a household smoke, it would be appropriate for the members in that household to indulge in smoking. Therefore, members in a larger household have a higher chance to be influenced by family to consume tobacco than members in a smaller household. Surprisingly, however, our findings contradict those of Tan, Yen and Nayga (2009) that household size was negatively related to alcohol consumption. The authors claimed that alcohol was a non-necessity good, thus consumption of it reduced as household size increased. It can, thus, be concluded that the effects of household size on alcohol and tobacco are dissimilar, even though both of them are heavily-taxed.

Rampal et al. (2006) found that the prevalence of smoking was higher among males than females. In another study, Rampal et al. (2008) also found that males were more likely to smoke than females. Similar effect of gender was evidenced after adjustment for all the demographic variables. Cheah (2012) identified likewise that being male was positively associated with the odds of smoking. Other researchers provided consistent results (Cheah and Naidu, 2012; Tan, 2012). The findings of this study that households headed by males are more likely to consume tobacco and consume more than households headed by females seem to lend support to the evidences of previous studies (Rampal et al., 2006; Rampal et al., 2008; Cheah, 2012; Cheah and Naidu, 2012; Tan, 2012). Several reasons that explain these findings. First, men have a greater tendency to take risks compared with women (Byrnes, Miller and Schafer, 1999). Since smoking is a risk-taking behaviour, men are more likely to engage in it than women. Second, male-smoking is more acceptable to the society than female-smoking (Lim et al., 2013). Third, women have better health awareness than men because of their natural family caretaking characteristics (Cheah and Naidu, 2012). In addition, the TPB can be used to explain this gender-tobacco relationship. As the theory suggests, if household heads are smokers, other members in the households are more likely to smoke (Ajzen, 1991). Since men are more likely to smoke than women, households with a male head tend to spend more on tobacco than households with a female head. It appears, therefore, that nationwide anti-smoking policies may not have a significant impact on reducing the smoking prevalence if the focus is on households headed by females, instead of those headed by males.

Interestingly, this study suggests that Bumiputera households are more likely to consume tobacco but consume less than non-Bumiputera households. This can be of interest to the policy makers. While previous studies found ethnicity to be significantly associated with participation decisions of tobacco, they did not answer how ethnicity affect level of tobacco (Rampal et al., 2006; Rampal et al., 2008; Cheah, 2012; Cheah and Naidu, 2012; Lim et al., 2013). In other words, previous studies left open the question whether the ethnic majority consumed more or less tobacco compared with other ethnic groups. The findings of this study appear to justify the need for an in-depth qualitative research that studies factors explaining the relationship between ethnicity and tobacco consumption. We hypothesise that culture, religion and ethnic privileges could be the mediating factors; however, because of data limitation, we are unable to test these hypotheses. Nevertheless, our findings have important implications for policy. In an effort to reduce smoking prevalence in Central and Southern regions of Malaysia, the government should pay special attention to Bumiputera households because they have a higher likelihood of smoking than non-Bumiputera households. However, focuses should be given to non-Bumiputera households if the goal of reducing the prevalence of smoking in Northern region is to be achieved as they tend to consume more tobacco than their Bumiputera counterparts.

Cheah and Naidu (2012) and Lim et al. (2013) found that married individuals were less likely to smoke than unmarried individuals. Similarly, we find that having a married head lowers participation decisions of tobacco among households in Northern and Southern regions, and reduces level decisions in all the regions. The reason for this outcome is that married heads tend to receive more social, psychological and financial supports than unmarried heads given the presence of spouses (Cheah and Naidu, 2012; Lim et al., 2013). Since stress can lead to smoking, married heads are less likely to indulge in smoking compared with their unmarried counterparts (Cheah and Naidu, 2012). As a result, members in the households with a married head have a lower likelihood of being motivated to smoke than members in the households with an unmarried head. Given these findings, anti-smoking intervention measures should be developed based on a good knowledge of the marital status in Malaysian population. Such measures are suggested to include discouraging smoking among members in the households with an unmarried head in all the regions.

The relationship between education and smoking has been widely investigated by previous studies, but the findings are mixed (Rampal et al., 2008; Tan, 2012; Cheah, 2012; Cheah and Naidu, 2012; Lim et al., 2013; Mizanur Rahman et al., 2015; Lim et al., 2016). On one hand, Mizanur Rahman et al. (2015) found that individuals with secondary-level education and above had higher odds of smoking tobacco than individuals who had no formal education. Lim et al. (2016), on the other hand, found that the elderly with tertiary-level education were less likely to smoke compared with the elderly having no formal education. Other past studies also showed likewise that high education level was associated with a decreased likelihood of smoking (Rampal et al., 2008; Tan, 2012; Cheah, 2012; Cheah and Naidu, 2012; Lim et al., 2013). This is attributable to the fact well-educated individuals have better health knowledge and are more aware of the adverse impacts of smoking on health than their less-educated peers (Cheah and Naidu, 2012; Lim et al., 2016). In addition, well-educated individuals have a lower rate of time preference than less-educated individuals (Van der pol, 2011). Somewhat interestingly, this study demonstrates that although households headed by well-educated individuals are less likely to consume tobacco than households headed by less-educated individuals, they consume more. This is an important finding. Previous studies that did not analyse the level of consumption may not offer a better understanding

of this phenomena, thus optimum policy may not be developed. A likely explanation for this finding is that while members in the households headed by well-educated people may have better awareness, they also have better financial capabilities to consume tobacco than their counterparts headed by less-educated people. In terms of policy implication, the government should design appropriate interventions to prevent smoking participation among members in the households headed by less-educated people and help those in the households headed by well-educated people withdraw from smoking. Equal focus should be given to all the regions.

Holding other demographic factors (age, income, household size, gender, ethnicity, marital status, education, employment status, household location) constant, this study finds that having employed heads is positively associated with household consumption likelihood of tobacco, as well as the amount consumed. Although household income is not strongly related to tobacco consumption among household members, the relationship between household heads' employment status and household consumption of tobacco is highly significant. This finding is in agreement with the evidences of Cheah (2012) and Cheah and Naidu (2012). They were among a few researchers that examined the independent relationship between employment status and smoking. They argued that employed adults faced more stress than unemployed adults and consequently were more likely to adopt smoking behaviour in order to release their stress (Cheah, 2012; Cheah and Naidu, 2012). Hence, we conclude that stress faced by household heads is a mediator that links household heads' employment status to household consumption of tobacco, instead of household income given that the value of household income variable has been held constant in our regression model. If household heads are under a lot of stress, they are likely to smoke. As a result, other members in the household are encouraged to smoke. This explanation is based on the TPB (Ajzen, 1991). With data availability, future studies may want to control for stress related variables when analysing the impact of employment status on smoking, so that the relationships between smoking and employment status, and stress can be better understood. With regard to policy implication, this study's findings indicate that an intervention directed towards reducing smoking among households headed by employed adults in all the regions may yield promising results.

The relationship between house locality and smoking has been evidenced in previous studies conducted by Cheah and Naidu (2012), Tan (2012) and Lim et al. (2013). They found a positive relationship between residing in a rural area and smoking, and claimed that being less aware of the consequences of smoking and a lack of anti-smoking programmes in rural areas were the contributing factors. However, we find that although urban households are less likely to consume tobacco than rural dwellers, they spend more. Perhaps, this is because tobacco products are easily accessible to households in urban areas. Our findings imply that if policy makers only consider the extensive margin of tobacco consumption (whether to consume or not) like those evidenced in previous studies may not develop an effective intervention measure because the intensive margin of tobacco consumption (how much to consume) is influenced by location of household as well. More importantly, their relationships are opposite. Policy makers may want to focus on reducing tobacco expenditure level among urban households in Northern, East coast and Central regions, but at the same time pay attention to participation decisions of tobacco among urban households in East coast region.

Cheah (2012) found that drinkers were more likely to smoke than non-drinkers. His finding is consistent with the evidence of the present study that households which consume alcohol are more

likely to consume tobacco and also consume more than their counterparts which do not consume alcohol. To some extent, our finding indicates that tobacco and alcohol are complementary goods. This is attributable to the fact that alcohol drinkers are less likely to be concerned about their health than non-drinkers (Cheah, 2012). Obviously, anti-alcohol policies play an important role in reducing smoking prevalence. In order to lower the prevalence of smoking-induced diseases, the Malaysian government should also make a concerted effort to reduce household consumption of alcohol with a special focus on Northern and Southern regions. This is in light of the results that the estimates of alcohol variable are positive and significant in both participation and level equations in the sample of Northern and Southern regions.

Several limitations of the present study are acknowledged. Firstly, because of cross-sectional data, the present study is unable to examine the causal effects of sociodemographic factors on tobacco consumption. Secondly, all the details obtained from the survey are self-reported, which may reduce the reliability. Thirdly, the measure of tobacco consumption is based on household data rather than individual data. Hence, individuals' consumption decisions of tobacco are not well-identified. In spite of these limitation, the present study is the first to our knowledge that examines the independent relationships between sociodemographic factors and tobacco consumption across all the regions of Malaysia. The analysis of tobacco consumption is divided into participation and level, which has not been considered by previous Malaysian studies.

6. CONCLUSION

In view of sharp increases in the prevalence of smoking, the present study makes efforts to use a nationwide data and a rigorous statistical model to examine sociodemographic determinants of tobacco consumption among households in Malaysia. Our findings have important contributions to the literature, as well as policy development. Household head sociodemographic (age, gender, ethnicity, marital status, education, employment status) and household (income, household size, household location, alcohol consumption) characteristics are significantly associated with household consumption of tobacco.

Several findings are worth to be highlighted. First, although households headed by older individuals are less likely to consume tobacco than households headed by younger individuals, they tend to consume more. Second, household size is positively associated with the likelihood of consuming tobacco, as well as the amount spent. Third, having a married or unemployed household head reduces participation and amount decisions of tobacco. Fourth, households with a well-educated head are less likely to consume tobacco than households with a less-educated head, but they consume more. Last, alcohol consumption is positively associated with tobacco consumption.

Our findings imply that special attention should be paid to the groups of households that have high consumption likelihood and expenditure on tobacco if the objective of reducing the prevalence of smoking in the country is to be met. These include household with a large household size, households headed by males, households having single heads, households with employed heads, as well as households that consume alcohol.

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