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HOUSEHOLD EXPENDITURE ON SUGAR-ADDED FOODS AND BEVERAGES IN MALAYSIA: EVIDENCE FROM QUANTILE ESTIMATION

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ABSTRACT

The present study attempts to examine factors affecting household expenditure on sugar-added foods and beverages (SAFB) in Malaysia. The spike in sugar-related diseases and the lack of comprehensive study related to factors associated with consumption of added sugar in Malaysia are the motivations for the present study. Acquiring a better understanding of what kind people consume more or less SAFB is important for policy development. A nationally representative data with a large sample size, i.e., the Malaysian Household Expenditure Survey (HES) 2014, was used for secondary analysis. In the survey, a two-stage stratified sampling approach was adopted. The first stage was based on Enumeration Blocks (EBs), while the second stage was based on living quarters (LQs). Quantile regressions were utilised to analyse the effects of household heads' demographic and household factors on quantiles of household expenditure on SAFB. On average, the monthly household income, age of household head and expenditure on tobacco were Ringgit Malaysia (RM) 5973.63, 46 years and RM 60.81, respectively. The majority of household heads were secondary educated (57%), Bumiputera (69%), males (85%), employed (93%) and married (80%). Education, age, ethnicity, employment status, marital status and smoking behaviour were associated with expenditure on SAFB. Households headed by individuals with no formal and primary-level education spent around RM 1.02-24.6 and RM 0.73-23.68 less on all the quantiles of SAFB, respectively, compared with households headed by individuals having tertiary-level education. An additional year of age of household heads increased all the quantiles of household expenditure on SAFB by RM 0.11-0.90. Compared to non-Bumiputera households, Bumiputera households spent approximately RM 1.02-2.53 more on 0.1-0.75 quantiles of SAFB. Households with employed and married heads spent about RM 1.11-9.16 and RM 1.28-6.41 more on all the quantiles of SAFB, respectively, than their counterparts with unemployed and single heads. Household expenditure on tobacco was positively associated with 0.25-0.9 quantiles of household expenditure on SAFB (RM 0.28-1.23). In conclusion, household heads' demographic and household profiles played an important role in influencing quantiles of expenditure on SAFB. Therefore, as a nationwide policy towards reducing consumption of added sugar, intervention measures should be designed in light of these profiles.

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1. INTRODUCTION

Sugar is a simple carbohydrate that provides energy for the body. However, excessive consumption of sugar is one of the main factors causing obesity (Rehm et al., 2008). It is clearly evidenced that obesity can cause various diseases, such as, cardiovascular diseases, diabetes, strokes and cancers (Must et al., 1999). A study pointed out that obesity results in a huge medical cost with an estimated United States Dollar (USD) 295 per person in a year, which is similar to the medical cost incurred from smoking and alcohol drinking (Sturm, 2002). There are studies showing that sugar can lead to obesity in several ways (Tappy, 2012; Bray, 2013). First, sugar has high calories. Second, consumption of sugar does not reduce the consumption of other foods. Third, the stimulants induced by sugar may cause one to eat more sweetened foods.

In today's market, foods and beverages with added sugar are readily available. Added sugar refers to sweeteners used in foods (Park et al., 2016). Consumers are advised to reduce consumption of added sugar. According to the guideline of the World Health Organization (WHO), added sugar intake per day must be less than ten percent of total calories intake, which is equivalent to 100-150 calories for an adult (Johnson et al., 2009; Amarra et al., 2016). On average, a Malaysian adult consumed about two servings of added sugar per day, which exceeded the recommendation of the WHO (Institute for Public Health, 2014).

Owing to an increase in consumption of added sugar across the globe, the prevalence of obesity has become an alarming issue. As the WHO (2017) showed, about 39% and 13% of adults were overweight and obese in 2016, respectively. Obesity is also a serious issue in Malaysia. A report illustrated that the proportion of overweight populations doubled from 16.6% in 1996 to 33.4% in 2015, while the obesity prevalence increased tremendously from 4.5% in 1996 to 30.6% 2015 (Institute for Public Health, 2015). Compared to other Asian countries, Malaysia has the highest prevalence of overweight and obesity (Lum, 2018). Based on the formulas of Population Attributable Fraction (PAF) and Disability Adjusted Life Year (DALY), the burdens of disease related to overweight and obesity among males were found to be 1582 and 1657 person years per 1000 people, respectively (Peng et al., 2018). For females, the burdens of disease related to overweight and obesity were 1146 and 1294 person years per 1000 people, respectively. These figures are considered alarming.

In spite of the high prevalence of obesity and disease burdens caused by excessive sugar intake, study related to factors affecting consumption of added sugar has seldom been conducted, especially in developing countries, such as Malaysia. Although in-depth analyses of consumption of added sugar have been carried out in developed countries (Thompson et al., 2009; Bleich and Wang, 2011; Rombaldi et al., 2011; Mullie et al., 2012; Park et al., 2013; Friis et al., 2014; Park et al., 2016), there is a lack of such analyses in Malaysia. Beside than one study that examined the amount of sugar intake and sources of added sugars (Amarra et al., 2016), writings on

consumption of added sugar were usually been published in the mass media articles. This may be because of data limitation.

The regression models estimated in previous studies, such as linear regression, poisson regression and logistic regression were based on mean values of the outcome variables (Thompson et al., 2009; Bleich and Wang, 2011; Rombaldi et al., 2011; Mullie et al., 2012; Park et al., 2013; Friis et al., 2014; Park et al., 2016). Using mean value to estimate the regressions is appropriate but it has a drawback because it assumes that sociodemographic differences in added sugar intake at one point of the distribution to be similar to the differences in other portions of the distribution. For instance, income may have a large effect on consumption of added sugar among people who consume the least amount of added sugar, whereas it may have a small effect among people who consume a large amount. Unfortunately, regressions that are estimated based on mean values cannot capture such effects.

The present study attempts to narrow these identified research gaps. The research objective of the present study is to use a large nationwide data to examine factors affecting quantiles of household expenditure on SAFB in Malaysia. In particular, demographic factors, such as income, education, age, ethnicity, gender, employment status, marital status are analysed. The present study is the first of its kind that estimates quantile regression on SAFB. It attempts to throw light on how quantiles of household expenditure on SAFB vary across demographic factors. The impacts of demographic and household factors on expenditure on SAFB among households that spend a small amount on SAFB are expected to be different from those that spend a large amount. Such impacts must be identified using quantile regression, instead of the regressions that are based on mean values. Acquiring a better knowledge of factors affecting quantile of expenditure on SAFB has important contributions to literature, as well as policy development.

2. LITERATURE REVIEW

The factors affecting added sugar intake were studied comprehensively elsewhere (Thompson et al., 2009; Bleich and Wang, 2011; Rombaldi et al., 2011; Mullie et al., 2012; Park et al., 2013; Friis et al., 2014; Park et al., 2016). Consumption of energy drinks, sport drinks and soft drinks, for instance, was often examined in previous studies. The impact of income on consumption of added sugar was inconclusive. Some studies showed that income was positively associated with added sugar intake, whilst there were also studies suggesting a negative relationship between income and consumption of added sugar. On one hand, using the Korean National Health and Nutrition Examination Surveys, Han et al. (2013) found that higher income individuals were more likely to drink sugar-sweetened beverages than lower income individuals. Similarly, Park et al. (2013) using the National Health Interview Survey data of the United States (US) found that individuals with higher household income had higher odds of consuming sports and energy drinks frequently than individuals with lower household income. On the other hand, study in New York City suggested that individuals with higher family income had a lower likelihood of being frequent soft drink drinkers compared to individuals with lower family income (Rehm et al., 2008). Findings of Thompson et al. (2009) and Bleich and Wang (2011) showed likewise.

Level of education was consistently found to be negatively associated with consumption of added sugar. Findings evidenced by Rehm et al. (2008) and

Thompson et al. (2009) suggested that well-educated individuals were less likely to consume added sugars than less-educated individuals. Park et al. (2016) used the National Health Interview Survey (NHIS) and also found that individuals who were less-educated had greater odds of consuming added sugars than the well-educated ones. Similar findings were noted by Zytnick et al. (2015) and Xu et al. (2017). They found that consumption of sugar-sweetened beverages and sport drinks was negatively related to educational attainments. These findings indicated that well-educated individuals were more aware of the negative consequences of added sugar than less-educated individuals because they had better health knowledge.

Past studies consistently identified age as an important determinant of added sugar intake. Based on a Belgian sample, Mullie et al. (2012) found that age was negatively associated with consumption of sugar-sweetened beverages. Zytnick et al. (2015) evidenced that individuals aged ≥65 years had a lower probability of consuming sports drinks than their counterparts aged <65 years. Findings of other studies suggested likewise (Rehm et al. 2008; Bleich and Wang, 2011; Mullie et al., 2012). This may be because older individuals had poorer health condition than younger individuals and thus were more aware of their dietary behaviour.

Most of the studies suggested that gender was associated with intake of added sugar. In Brazil, Rombaldi et al. (2011) found that consumption of soft drinks was more prevalent among males than females. Also, a study conducted in Australia found that males were more likely to consume soft drinks than females (Pollard et al., 2016). Moreover, using a telephone survey, Berger et al. (2011) identified that males had a higher likelihood of consuming energy drinks than females. Other studies that suggested likewise include Bleich and Wang (2011), Berger et al. (2011) and Friis et al. (2014). As pointed out by Friis et al. (2014), women tended to have a healthier dietary lifestyle than men and thus were unlikely to consume sugar sweetened beverages.

The relationships between intake of sugar added and employment status, and marital status were seldom examined in previous studies. Drawing on a survey conducted in Denmark, Friis et al. (2014) found that employed individuals were more likely to consume energy drink than their unemployed counterparts. Park et al. (2013) identified that unmarried individuals had a higher tendency to consume sport drinks than married individuals. Similar findings were evidenced by Xu et al. (2017), who used the Behavioral Risk Factor Surveillance System. It appeared, therefore, that while job commitment promotes consumption of sugar-added beverages, household commitment reduced it.

With regard to smoking, studies by Rombaldi et al. (2011), Mullie et al. (2012), Park et al. (2013), Friis et al. (2014) and Park et al. (2016) found that smoking was positively associated with intake of sugar added. In other words, they found that smokers were more likely to consume sugar-sweetened beverages than non-smokers. These findings may be attributable to time preference. Smokers usually had a higher rate of time preference, i.e., they were more present oriented, and thus were less likely to take care of their health than non-smokers (Van Der Pol, 2011).

There appeared to be a few studies conducted in Southeast Asia. Atmarita et al. (2018) did a systematic review of studies related to sugar consumption in Indonesia and found that on average, an adult consumed more than 25 grams of sugar per day. The most common sources of added sugar were confectioneries and soft drinks. Another systematic review of study related to sugar intake was conducted in Thailand

(Kriengsinyos et al., 2018). The authors found that the average household expenditure on sugar was more than 50 grams per day, and the sources were mainly soft drinks and sweetened snacks. Amarra et al. (2016), who did a comprehensive review of study related to sugar intake in Malaysia, found that in 2003, an adult typically consumed about 37 grams of added sugar, and sweetened beverages, such as tea and coffee were the main sources of added sugar. Furthermore, the authors also found that in 2009, the per capita expenditure on added sugar was RM 6.30 per month. However, these three studies did not examine factors affecting demand for added sugar in great detail.

The present study contributes to the literature in two ways. First, the present study uses a quantile regression to examine factors affecting quantiles of household expenditure on SAFB. Although estimating a regression based on mean value is useful and important, the marginal effect of an explanatory variable on outcome variable may have dissimilar impacts across different cohorts of population being studied. Such impacts can only be examined using a quantile regression. In other words, the common slopes of regression line can be estimated based on quantiles. The uniqueness of quantile regression is that at each of the quantiles, different linear models are estimated. Second, the country of interest of the present study is Malaysia, which is a country in Southeast Asia, where only a few studies related to factors affecting added sugar consumption exist. Findings of the present study can be used to compare with the findings evidenced in developed countries documented in the literature.

3. METHOD

3.1 Data

Secondary analysis of the data extracted from the Malaysian Household Expenditure Survey (HES) 2014 was performed. The survey was conducted throughout the Malaysia. While the survey is not the latest dataset, it has a large sample size and comprehensive information on household profiles and household expenditure pattern. Nevertheless, the survey characteristic is quite similar to that of the HES 2016, which is the latest HES (Department of Statistics Malaysia, 2016). The average monthly household expenditures in the HES 2014 (RM 3578) and HES 2016 (RM 4033) are quite alike. Furthermore, the proportions of household income allocated for food and beverages in these two surveys are also identical (HES 2014 – 18.9%; HES 2016 – 18%). Taken together, this implies that the HES 2014 reflects the recent scenarios of household expenditure pattern.

In order to ensure that the HES 2014 was nationally representative, a two-stage stratified sampling approach designed for the Population and Housing Census was adopted. Enumeration Blocks (EBs), which were categorised into urban (≥10000 population) and rural (<10000 population) areas, were selected at the first stage. Households in living quarters (LQs) were selected at the second stage. In particular, each EB consisted of 80 to 120 LQs. Households that stayed at residential institutions (e.g. prisons, hospitals and hotels) were excluded from the survey. The data distributions based on states are presented in Table 1.

Multi-lingual structured questionnaires were used. The survey was conducted using face-to-face interview. All the interviewers were given professional training prior to conducting the interview. The survey contained details about household heads' demographic characteristics, household profiles, and household expenditure pattern. Overall, 14838 households were interviewed. The sample size was adjusted based on four criteria: i) number of targeted population; ii) design effects from

previous survey; iii) expected non-response rates; and iv) requirement of analysis. Quality control was done at several stages. At the first stage, correct survey design was ensured and questionnaires were pretested. At the second stage, Identification Numbers (IDs) of the selected LQs were checked. In addition, interview and data collection process were supervised by the Field Supervisor. At the last stage, the filled questionnaires were reviewed and checked thoroughly by trained staff at several stations before they were recorded and analysed. The details about HES had been described elsewhere (Department of Statistics Malaysia, 2014).

Table 1: Data distributions based on states.

States	Enumeration Blocks (EBs)	Living Quarters (LQs)
Johor	555	4441
Kedah	393	3142
Kelantan	383	3063
Melaka	198	1585
Negeri Sembilan	234	1872
Pahang	316	2527
Pulau Pinang	378	3025
Perak	468	3747
Perlis	137	1012
Selangor	699	5597
Terengganu	293	2345
Sabah	789	6314
Sarawak	924	7390
Kuala Lumpur	422	3375
Labuan	54	432
Putrajaya	40	320

Source: Malaysian Household Expenditure Survey 2014

3.2 Explanatory variables

Considering the findings of previous studies discussed in the Literature Review section, the explanatory variables used in the present study were household heads' demographic (education, age, ethnicity, gender, employment status and marital status) and household (income and expenditure on tobacco) variables. Given that household heads played a very important role in influencing SAFB consumption behaviour of other household members, their demographic profiles were taken into account.

Monthly household income (INCOME) was formatted as a continuous variable (in RM). Household heads' educational attainment was represented by four categories, i.e., no formal education (NO), primary-level education (PRIMARY) (<7 years of schooling), secondary-level education (SECONDARY) (7-11 years of schooling) and tertiary-level education (TERTIARY) (>11 years of schooling). AGE denoted the age of household heads, and it was formatted as a continuous variable (in years). In order to allow for a non-linear relationship between age and expenditure on SAFB, a square term of AGE (i.e., AGE^2) was included in the regressions.

In terms of ethnic variable (BUMI), a value of 1 referred to Bumiputera households, and 0 referred to non-Bumiputera households. MALE variable took on a value of 1 if households were headed by males and 0 if females. EMPLOY was given a value of 1 if household heads were employed and 0 if unemployed. Marital status of

household heads was categorised into three groups: MARRIED, WIDOW and SINGLE. MARRIED referred to being married, WIDOW referred to being widowed or divorced, and SINGLE referred to being single. SMOKING referred to monthly household expenditure on tobacco (in RM). It assessed the smoking behaviour of household members. Households that reported non-zero expenditure on tobacco were considered having smoker(s) in the households.

3.3 Statistical analyses

The objective of using quantile regression is to estimate the quantile of the outcome variable, subject to the values of the explanatory variables. Quantile regression is different from linear regression, which estimates the mean value of the outcome variable. Quantile regression generates a regression line from the data that minimises the sum of the residuals, instead of the sum of the squares of the residuals. In other words, quantile regression shows the quantile of the distribution of the outcome variable as a linear function of the explanatory variables. Estimating several linear quantiles can help to identify the effects of explanatory variables on different parts of the distribution. In general, the idea of quantile regression is to identify variation of the effects of the explanatory variables in quantiles. Wooldridge (2010) provides in-depth discussion of quantile regression.

The outcome variable, i.e., monthly household expenditure on SAFB, was used as a continuous variable (in RM). Then, quantile regressions were expressed as:

$$\text{Quant}_{\tau}(y|\mathbf{x}, y > 0) = a(\tau) + \mathbf{x}\boldsymbol{\beta}(\tau) \quad (1)$$

where Quant_{τ} is τth quantile ($0<\tau<1$), y is monthly household expenditure on SAFB, **x** is row vector for explanatory variables. In the present study, five quantiles were estimated, i.e., τ = 0.10, 0.25, 0.50, 0.75 and 0.90. Households that reported zero expenditure on SAFB were removed from the sample, so that the problem of censored data could be prevented. Of the total 14838 households, only 810 reported zero expenditure. Hence, 14028 were used for analysis. Since only about 5.5% of observations were removed, the data was still nationally representative.

In an effort to identify the best model for SAFB, the present study estimated three linear regression models using ordinary least squares (OLS). These three models were nested. Model 1 was the first restricted model that omitted AGE^2 and SMOKING. Model 2 was the second restricted model that omitted SMOKING. Model 3 was the unrestricted/full model, which consisted of all the explanatory variables. Adjusted R^2 of these three models were compared and F-tests for exclusion restrictions (i.e., AGE^2 and SMOKING) were performed. In addition, variance inflation factors (VIFs) for each model were calculated in order to detect possible multicollinearity issue. Comparing these three models could help us to identify whether SMOKING was a relevant variable and the relationship between age and expenditure on SAFB was quadratic. The significance level of all the tests was based on p-value < 0.05. The statistical analyses were performed using Stata statistical software (StataCorp, 2015).

3.4 Characteristics of survey respondents

The average monthly household income was RM 5973.63. The mean age of household heads was 46 years. Each month, a household spent about RM 60.81 on tobacco on average. About 4%, 18%, 57% and 21% of household heads had no formal education,

primary-level education, secondary-level education and tertiary-level education, respectively. The majority of households were Bumiputera (69%) and headed by males (85%). Approximately 93% of household heads were employed. In terms of household heads' marital status, the majority were married (80%), and only a small proportion were widowed/divorced (9%) and single (12%) (Table 2).

Table 2: Definitions and means of the explanatory variables (n = 14028).

Variables	Definitions	Means
Continuous		
INCOME	Monthly household income (in RM)	5973.63 (6201.25)
AGE	Age of household heads (in years)	46.44 (12.91)
SMOKING	Monthly household expenditure on tobacco (in RM)	60.81 (112.99)
Categorical		
NO	Household heads with no formal education	0.04 (0.20)
PRIMARY	Household heads with primary-level education	0.18 (0.38)
SECONDARY	Household heads with secondary-level education	0.57 (0.50)
TERTIARY	Household heads with tertiary-level education	0.21 (0.41)
BUMI	Bumiputera households	0.69 (0.46)
MALE	Male household heads	0.85 (0.36)
EMPLOY	Employed household heads	0.93 (0.26)
MARRIED	Married household heads	0.80 (0.40)
WIDOW	Widowed/divorced household heads	0.09 (0.28)
SINGLE	Single household heads	0.12 (0.32)

Note: Standard deviations in parentheses.
Source: Malaysian Household Expenditure Survey 2014

4. RESULTS

Comparing among the three nested models, Model 3 had the highest adjusted R^2. In addition, F-test for exclusion restrictions (AGE^2, SMOKING) was statistically significant. Furthermore, multicollinearity for Model 3 was also not an issue as the maximum VIF was only 2.09. Taken together, it could be concluded that Model 3 was the best model. In other words, quadratic relationship between age and expenditure on SAFB was appropriate, and SMOKING was a relevant variable (Table 3).

Households headed by individuals with no formal education, primary-level education and secondary-level education spent approximately RM 0.48-1.02. RM 1.51-3.31, RM 4.54-8.33, RM 8.43-15.15 and RM 18.46-24.60 less on 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles of SAFB, respectively, than households headed by individuals with tertiary-level education. If factors other than age were held fixed, an additional year of age of household heads increased 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles of household expenditure on SAFB by RM 0.11, RM 0.20, RM 0.29, RM 0.59 and RM 0.90, respectively. Moreover, the negative estimates of AGE^2 suggested there were inverted U-shape relationships between household heads' age and all the quantiles of household expenditure on SAFB (Table 4).

Bumiputera households spent around RM 1.02, RM 1.68, RM 1.88 and RM 2.52 more on 0.1, 0.25, 0.5 and 0.75 quantiles of SAFB, respectively, than non-Bumiputera households. Households with employed heads spent RM 1.11, RM 1.59, RM 3.82, RM 6.24 and RM 9.16 more on 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles of SAFB, respectively, compared to households with unemployed heads. With regard to marital

status, households with married heads spent about RM 1.28, RM 2.45, RM 4.89, RM 6.41 and RM 6.01 more on 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles of SAFB, respectively, compared to households with single heads. Having widowed/divorced heads instead of single heads, median expenditure on SAFB increased by RM 1.57. An increase of RM 100 in monthly household expenditure on tobacco raised 0.25, 0.5, 0.75 and 0.9 quantiles of household expenditure on SAFB by RM 0.28, RM 0.42, RM 0.93 and RM 1.23, respectively.

Table 3: Linear regression on monthly household expenditure on SAFB (n = 14028).

Variables	Model 1	Model 2	Model 3
Constant	18.61* (1.62)	8.46* (2.59)	8.52* (2.59)
INCOME	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
NO	-14.35* (1.22)	-13.54* (1.23)	-13.53* (1.23)
PRIMARY	-11.65* (0.77)	-11.36* (0.77)	-11.40* (0.77)
SECONDARY	-8.09* (0.57)	-8.20* (0.57)	-8.24* (0.57)
AGE	0.07* (0.02)	0.63* (0.11)	0.63* (0.11)
AGE^2	–	-0.01* (0.01)	-0.01* (0.01)
BUMI	0.33 (0.48)	0.44 (0.48)	0.46 (0.48)
MALE	-0.91 (0.75)	-0.72 (0.75)	-0.91 (0.75)
EMPLOY	6.88* (0.95)	5.23* (1.00)	5.07* (1.00)
MARRIED	4.04* (0.76)	2.96* (0.79)	3.06* (0.79)
WIDOW	-0.10 (1.11)	-0.90 (1.12)	-0.84 (1.12)
SMOKING	–	–	0.01* (0.01)
F-statistics	–	25.37^{a}*	15.39^{b}*
Adjusted R^2	0.0301	0.0317	0.0321
Max. VIF	1.98	2.08	2.09

Note: [a]exclusion restriction is AGE^2. [b]exclusion restrictions are AGE^2 and SMOKING. *$p < 0.05$.
Source: Malaysian Household Expenditure Survey 2014

Table 4: Quantiles of monthly household expenditure on SAFB (n = 14028).

Variables	Quantiles				
	0.10	0.25	0.50	0.75	0.90
Constant	0.05 (0.75)	2.26 (1.31)	6.49* (1.79)	11.78* (3.16)	27.01* (5.55)
INCOME/100	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
NO	-1.02* (0.36)	-3.31* (0.62)	-8.33* (0.85)	-15.15* (1.50)	-24.60* (2.64)
PRIMARY	-0.73* (0.22)	-2.49* (0.39)	-6.52* (0.53)	-12.04* (0.94)	-23.68* (1.65)
SECONDARY	-0.48* (0.17)	-1.51* (0.29)	-4.54* (0.39)	-8.43* (0.70)	-18.46* (1.22)
AGE	0.11* (0.03)	0.20* (0.06)	0.29* (0.08)	0.59* (0.14)	0.90* (0.24)
AGE^2	-0.01* (0.01)	-0.01* (0.01)	-0.01* (0.01)	-0.01* (0.01)	-0.01* (0.01)
BUMI	1.02* (0.14)	1.68* (0.24)	1.88* (0.33)	2.52* (0.59)	-0.53 (1.03)
MALE	-0.01 (0.22)	-0.48 (0.38)	-0.62 (0.52)	-0.60 (0.92)	0.63 (1.61)
EMPLOY	1.11* (0.29)	1.59* (0.51)	3.82* (0.70)	6.24* (1.23)	9.16* (2.15)
MARRIED	1.28* (0.23)	2.45* (0.40)	4.89* (0.55)	6.41* (0.97)	6.01* (1.70)
WIDOW	0.22 (0.33)	-0.02 (0.57)	1.57* (0.78)	1.34 (1.38)	1.12 (2.41)
SMOKING/100	0.07 (0.05)	0.28* (0.10)	0.42* (0.14)	0.93* (0.24)	1.23* (0.43)

Note: Household income and household expenditure on tobacco are divided by 100. *$p < 0.05$.
Source: Malaysian Household Expenditure Survey 2014

5. DISCUSSION

There was a positive relationship between household heads' education level and household expenditure on SAFB. The effects of education on expenditure seemed to increase with quantiles. Specifically, from the lowest to the highest quantiles, the effects were elevated more than ten-fold. This indicated that education factor played a very important role in influencing expenditure on SAFB among households that spent a large amount on SAFB. Surprisingly, however, the present study's findings contradicted the evidences of previous studies that level of education reduced consumption of added sugars (Rehm et al., 2008; Thompson et al., 2009; Zytnick et al., 2015; Park et al., 2016; Xu et al., 2017). Based on the present study's findings, one could conclude that while well-educated individuals had better health knowledge than their less-educated counterparts, they may consume more added sugar, especially those who had consumed a lot. Since income variable was held constant in the regressions and was insignificant, it was inappropriate to argue that well-educated individuals had higher income and were more capable of purchasing SAFB.

Household heads' age was positively related to household expenditure on SAFB, which was in contrast to the findings of previous studies that older individuals were less likely to consume added sugar than younger individuals (Rehm et al. 2008; Bleich and Wang, 2011; Mullie et al., 2012; Zytnick et al., 2015). The present study's results estimated based on quantiles added to previous findings that the impact of age factor

on consumption of SAFB was greater among people who consumed a lot of SAFB than those who consumed a small amount. As the amount spent on SAFB increased, the age factor became more and more important. In addition, the inverted U-shape relationships between household heads' age and household expenditure on SAFB suggested that consumption of SAFB increased with age when household heads were young, but it decreased with age when household heads were old. Because the regression used in the present study was non-linear, it could not use derivative to identify the year of age with maximum consumption of SAFB. A plausible explanation for findings of the present study was that added sugar was an addictive good, thus stock of past consumption of added sugar may increase the current consumption of it (Becker and Murphy, 1988). It appeared that although older people were more aware of their health than younger people, they may be more addicted to added sugar.

Bumiputera households had an increased consumption of SAFB across all quantiles, except the highest quantile. The ethnic magnitude at 0.75 quantile was about three times more than that at the lowest quantile. The present study's findings could be a reason explaining the fact that Malays were more likely to be obese (Tan et al., 2011) and use blood glucose screening (Cheah and Goh, 2017; Cheah and Tang, 2017) compared with other ethnic groups. It was, however, that why Bumiputera households consumed more SAFB remained unclear, but the cultural and religious factors may be an explanation. A more in-depth study with qualitative methodologies was, therefore, needed to offer a better understanding of how ethnicity affected consumption of added sugar across quantile.

In terms of employment status, findings of the present study showed that being employed increased all the quantiles of expenditure on SAFB, which were somewhat similar to the findings evidenced by Friis et al. (2014) who estimated average consumption of energy drink. The present study's findings also highlighted that the greater the amount of SAFB expenditure, the larger the effect of employment status. This indicated that among households that consumed a lot of SAFB, being employed had a very large impact on expenditure level, whereas among those that consumed the least amount of SAFB, being employed had a very small effect. The rationale for these outcomes was quite straightforward. Households with employed heads were more financially capable than households with unemployed heads and thus were able to consume more SAFB. It should be noted, however, that one could not simply conclude that SAFB was a normal good because income elasticity of demand for SAFB was not estimated in this study.

The positive relationship between being married and quantiles of household expenditure on SAFB was evidenced. Compared to households with single heads, households with married heads spent more on all the quantiles of SAFB. Of note, among households that spent 0.75 and 0.9 quantiles of SAFB, the effects of marital status on SAFB expenditure were almost similar. However, among households that spent the lowest quantile and median SAFB, the difference in the effects of marital status was large. The present study's findings contradicted the evidence of Park et al. (2013) that being married reduced added sugar consumption. Expansion of household size could be seen as a plausible explanation for the findings. The greater the number of family members in a household, the greater the amount of money that a household spent on SAFB. It was assumed that households with married heads had a larger family size than households with unmarried heads. Hence, they were likely to

consume more SAFB. If data allowed, future studies may want to use household size as an explanatory variable. Thereby, the independent effect of marital status on consumption of added sugar could be well-identified.

Consistent with the findings of Rombaldi et al. (2011), Mullie et al. (2012), Park et al. (2013), Friis et al. (2014) and Park et al. (2016), there was a positive relationship between smoking and consumption of added sugar. Among households that spent 0.25-0.9 quantiles of SAFB expenditure, expenditure on tobacco raised expenditure on SAFB by significant amount. However, smoking did not affect added sugar consumption among households that spent very less on SAFB. This implied that lifestyle factor was an important determinant of consumption of added sugar among people with high consumption. Although the effect of smoking on consumption of SAFB was not large, it was highly significant and should not be neglected. The present study's findings confirmed the conjecture that smoking was positively associated with rate of time preference (Kenkel, 1991). In other words, smokers were less future oriented than non-smokers and thus were more likely to indulge in unhealthy dietary behaviour.

6. CONCLUSION

In view of the huge spike in the prevalence of diseases induced by excessive consumption of added sugar, especially cardiovascular diseases, the main objective of the present study is to examine factors affecting consumption of SAFB among households in Malaysia. As pointed out by Jay (2019), the mortality associated with cardiovascular diseases increased from 8776 cases in 2007 to 13503 cases in 2017. Various demographic factors were found to be significantly associated with quantiles of household expenditure on SAFB. These include education, age, ethnicity, employment status, marital status, as well as smoking behaviour. In particular, being well-educated, age, Bumiputera ethnic group, being employed, being married and smoking were positively associated with quantiles of expenditure on SAFB. However, there was no relationship between income and consumption of SAFB, concluding that people consumed add sugar regardless of their income.

Findings of the present study have numerous important implications for policy. Firstly, given that education is positively associated with quantiles of expenditure on SAFB, policy aimed at discouraging well-educated people from consuming added sugar may be effective. While special attention should be paid to people who consume a lot of added sugar, those who consume less should not be overlooked. Secondly, population-based intervention measures directed toward reducing consumption of SAFB among all expenditure levels of older people instead of younger people may yield promising results. Policy makers should make an effort to identify which age group of people that has the highest consumption of added sugar as there is an inverted U-shape relationship between age and demand for added sugar.

Thirdly, Bumiputera rather than non-Bumiputera should be given special consideration by public health administrators. However, if the focus is people who consume a lot of added-sugar, ethnic factor should not be a concern. This is because the effect of ethnic factor is insignificant in the highest quantile. Fourthly, policy makers should pay special attention to households headed by employed and married individuals with a focus on those that have large consumption of added sugar. This is in light of the findings that households headed by employed and married individuals are associated with increases in all the quantiles of expenditure on SAFB. Because

married household heads have a larger household size than unmarried household heads, they tend to spend more on SAFB. This implies that policy makers should also devote their attention to households with a large household size. Lastly, public policies that can improve the awareness of disadvantages of added sugar among smokers may yield desirable outcomes. In particular, the policies must ensure that the dietary behaviour of smokers will be changed if the goal of reducing the consumption of added sugar is to be achieved. Policy makers should bear in mind that among people who consume very less amount of added sugar, smoking behaviour does not influence consumption.

The present study has several limitations. First, data used in the present study is a household data instead of individual data. Hence, individual consumption decision of SAFB has not been well-identified. Second, cross-sectional data used in the present study does not allow for causality tests. Third, the information obtained from the survey are self-reported, and this may reduce the reliability of data. In spite of these limitations, the present study is the first study that uses quantile regressions to investigate factors affecting household expenditure on SAFB among different expenditure levels of households. Results of the present study are estimated based on a nationally representative data with a large sample size. Hence, important findings are generated.

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