

Sociodemographic factors associated with consumption of high-sodium foods: Evidence from Malaysia

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ABSTRACT

Introduction: The objective of the present study was to investigate the influences of sociodemographic factors on consumption of high-sodium foods among adults in Malaysia. **Methods:** Data were extracted from the Malaysian Community Salt Survey (MyCoSS) ($n=1046$). A seemingly unrelated regression (SUR) was utilised to assess factors associated with the number of servings of high-sodium foods (*nasi lemak*, *roti canai*, fried rice, fried noodles, and fried vermicelli) consumed per week. The independent variables were sociodemographic factors. **Results:** Younger individuals consumed more high-sodium foods than their older counterparts. Adults with secondary level education consumed more high-sodium foods compared with those with tertiary level education. Consumption of high-sodium foods was higher among males and Malays compared to females and non-Malays. **Conclusion:** Consumption of high-sodium foods was common in the population. Sociodemographic factors, such as age, education level, gender, and ethnicity, play an important role in influencing the decisions of people to consume high-sodium foods.

Keywords: age, food, gender, Malaysia, population study, salt, sodium

INTRODUCTION

Sodium is important for human health and it improves the tastiness of foods. However, in today's hectic lifestyle, people tend to consume too much sodium. Excessive consumption of sodium can lead to hypertension, which is one of the main factors causing chronic kidney disease and cardiovascular diseases, such as stroke and coronary heart disease (Morrison & Ness, 2011; Aburto *et al.*, 2013). These diseases are responsible for millions of deaths across the globe (WHO, 2021).

In Malaysia, the prevalence of chronic kidney disease had increased from 9.1% in 2011 to 15.5% in 2018 (Saminathan *et al.*, 2020), and the prevalence of known hypertension had risen from 12.8% in 2011 to 15.9% in 2019 (IPH, 2020). From 2011 to 2016, the total number of patients undergoing dialysis had increased by 11404 (Wong & Goh, 2018). Moreover, nearly forty thousand dialysis patients required renal replacement therapy in 2016, and this contributed to a large amount of national health expenditure (Saminathan *et al.*, 2020).

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Despite the negative impacts of excessive sodium intake on health, the consumption of high-sodium foods among Malaysian adults remains very high (IPH, 2019). On average, a Malaysian adult consumes about 3.17 grams of sodium per day, which is 1.17 grams higher compared to the amount recommended by the World Health Organization (IPH, 2019). Only 55.4% of Malaysian adults control their intake of sodium regularly, while approximately 47.7% have the habit of adding excessive salt to foods (IPH, 2019).

The objective of the present study was to examine the influences of sociodemographic factors on consumption of high-sodium foods among adults in Malaysia. To our knowledge, the present study was the first to use a rigorous methodological approach to explore this topic. With our findings, we were able to understand which group of population consumed more or less high-sodium foods. Thereby, a more effective policy directed towards reducing sodium intake in the Malaysian population can be formulated.

METHODS

Data

The present study conducted secondary analyses on data from the Malaysian Community Salt Survey (MyCoSS) (IPH, 2019). The survey period was between October 2017 and March 2018. A stratified cluster sampling approach was adopted in order to ensure that the collected data were nationally representative. Sample size was determined based on the number of populations in each of the states in Malaysia. In the first stage of sampling, Enumeration Blocks (EBs) were selected. Then, living quarters (LQs) were chosen in each selected EB using random probability sampling. Lastly, only one of the eligible household members in the selected LQs was surveyed. Inclusion criteria were individuals aged 18 years

and above across genders and ethnicities. Validated and pre-tested structured questionnaires were used by trained staffs to interview the respondents (face-to-face) (IPH, 2019). The respondents were asked to report their daily and weekly intake of foods with high sodium content (≥ 0.1 gram sodium per serving). A total of 104 high-sodium foods accompanied by images were presented in order to assist the respondents in answering the questionnaire. The survey found that fried vegetables, wholemeal bread, omelette, fried chicken with spice, fried rice, *nasi lemak*, *roti canai*, fried vermicelli, fried noodles, and chicken curry were the top ten high-sodium foods most consumed by Malaysian adults. Written consent was obtained from the respondents prior to the interview. Ethical approval was sought from the Medical Research and Ethics Committee, Ministry of Health Malaysia (NMRR-17-423-34969). The permission to use MyCoSS for secondary analyses and to publish this research article was given by the Ministry of Health Malaysia. Data use agreement was duly signed by the authors and the Ministry of Health Malaysia.

Variables

Consumption of high-sodium foods was used as the dependent variable. Its value was measured as number of servings consumed in a week. The high-sodium foods examined in the present study were *nasi lemak* (fragrant rice cooked with coconut milk and *pandan* leaf), *roti canai* (fried unleavened bread), fried rice, fried noodles, and fried vermicelli. These five food items are the most common, calorie-dense and unhealthy foods frequently consumed by Malaysian adults of all ethnicities. Based on the Food Frequency Questionnaire (FFQ), these food items were identified as five of the top ten high-sodium foods most consumed by Malaysians (IPH, 2019). According to the FFQ, the means of

sodium intake for *nasi lemak*, *roti canai*, fried rice, fried noodles, and fried vermicelli were 88mg/day, 99.3mg/day, 95.4mg/day, 82.8mg/day, and 53.7mg/day, respectively. Not all high-sodium foods found in the MyCoSS, including the top five, were assessed in the present study because some of them, such as fried vegetables, wholemeal bread, and omelette, are somewhat healthier and less energy-dense compared with others.

Sociodemographic characteristics were used as independent variables. They were selected in light of the findings from previous studies (Sarmugam, Worsley & Wang, 2013; Mestral *et al.*, 2017; Miyagawa *et al.*, 2018; Souza, Lima & Horta, 2019). Age was categorised into six categories (18-24, 25-34, 35-44, 35-54, 55-64, and ≥ 65 years), while monthly individual income [in Ringgit Malaysia (RM)] was grouped into five categories (\leq RM999, RM1000-1999, RM2000-2999, RM3000-3999, and \geq RM4000). Education level was categorised as no formal, primary, secondary, and tertiary. Ethnic variable was categorised into four groups [Malay, Chinese, Indian, and other ethnicities (Others)]. Employment status was grouped into employed and unemployed (e.g., retirees, housewives and students). Marital status comprised three categories: married, divorced/widowed, and single. Household locality was categorised as urban and rural areas.

Statistical analyses

A total of 1046 respondents were used for statistical analyses. The present study used a seemingly unrelated regression (SUR), i.e., a linear system of equations, to analyse consumption of each high-sodium food.¹ The regression was estimated using feasible generalised least squares. In general, consumption models, such as the model developed

in the present study, may consist of several equations because consumers may consume a number of related goods in a given period of time. Hence, the errors of equation could be correlated, and the use of ordinary least-squares linear regression to estimate each equation separately was inappropriate because it assumed that the errors were independent of one another. As such, a SUR that allowed errors in all the equations to be correlated must be used for jointly estimating the equations. Given that the present study had five dependent variables (*nasi lemak*, *roti canai*, fried rice, fried noodles, fried vermicelli), there were therefore five equations in the SUR. The residuals between these equations were expected to be correlated. This was because the same unobservable factors, such as health variables, that affected consumption of *nasi lemak*, may also affect consumption of *roti canai*, fried rice, fried noodles, and fried vermicelli. For example, individuals with heart diseases tend to consume less *nasi lemak*, and may also consume less *roti canai*, fried rice, fried noodles, and fried vermicelli than those without heart diseases because they are more aware of their health. Therefore, using a separate linear regression for each dependent variable may seem inappropriate. In order to confirm that the residuals between these five equations were correlated, we computed the correlation matrix of residuals and performed the Breusch-Pagan test of independence. Specifically, Breusch & Pagan (1980) used Lagrange multiplier to test whether residuals of two or more equations were uncorrelated, which was the null hypothesis of the Breusch-Pagan test. The 5% level of significance was selected. The Stata statistical software was used to perform all the analyses.

¹Stata example dataset: use <https://www.stata-press.com/data/r16/auto>. Stata command: sureg (price foreign length) (weight foreign length), corr

RESULTS

Results of the Breusch-Pagan test supported the use of SUR as the residuals were significantly correlated with each other. Individuals aged 18-24, 25-34, and 35-44 years consumed 0.442-0.751 and 0.386-1.217 servings more *nasi lemak* and fried rice, respectively, than those aged ≥ 65 years. Having secondary level education instead of tertiary level education increased the consumption of *nasi lemak* and fried noodles by 0.279 and 0.164 servings, respectively. Males consumed 0.264, 0.760, and 0.132 servings more *nasi lemak*, *roti canai*, and fried noodles, respectively, relative to females. Chinese and Others (other ethnicities) consumed 0.537-0.676, 0.703-0.738, and 0.376-0.737 servings less *nasi lemak*, *roti canai*, and fried rice, respectively, than Malays. While Indians consumed 0.450 serving less fried rice than Malays, they consumed 0.311 serving more fried vermicelli (Table 1 & 2).

DISCUSSION

Using data from the MyCoSS, we found that age, education level, gender, and ethnicity were significantly associated with the consumption of high-sodium foods. Surprisingly, however, there were no income, employment status, marital status, and household locality differences in the consumption of high-sodium foods. This implied that not all sociodemographic factors play an important role in affecting the decisions of people to consume high-sodium foods.

Findings of the present study showed that younger individuals consumed more high-sodium foods than older individuals, which lent support to previous studies that age was inversely associated with sodium intake (Sarmugam et al., 2013; Souza et al., 2019). Similar findings were also shared by Abdul Aziz et al. (2021) and Salleh et al. (2021), who found that young adults consumed more sodium compared to

the elderly. This is simply because older people are more aware of their health and tend to eat more home-cooked foods than their younger peers (Souza et al., 2019; Abdul Aziz et al., 2021; Salleh et al., 2021).

As past studies suggested, education improves health awareness and socio-economic status, thus reducing sodium intake (Mestral et al., 2017; Miyagawa et al., 2018). This is especially true if healthy foods are expensive. However, our findings did not show a strong relationship between education level and consumption of high-sodium foods as the differences in consumption between tertiary and primary level education were insignificant. It appeared that only secondary level education was related to an increased consumption of high-sodium foods. However, interestingly, findings of Salleh et al. (2021) suggested otherwise; well-educated people consumed more sodium than less educated people because they have less time for cooking and ate more food-away-from-home.

Previous studies have found that men consumed more sodium than women (Meneton et al., 2009; Sarmugam et al., 2013; Souza et al., 2019). Two Malaysian studies also suggested men to have a higher intake of sodium than women (Abdul Aziz et al., 2021; Salleh et al., 2021). Similar finding was evidenced in the present study, which showed that the consumption of high-sodium foods was higher among males than females. A plausible explanation for this outcome is that women are more concerned about their diet compared to men and consequently, more likely to opt for healthy foods (Souza et al., 2019; Abdul Aziz et al., 2021; Salleh et al., 2021). Moreover, men in general, tend to eat more foods than women because of different physical structure (Abdul Aziz et al., 2021).

The present study offered an important finding that there were ethnic differences in the consumption of high-

Table 1. Descriptive statistics of dependent and independent variables (n=1046)

<i>Variables</i>	<i>Mean/Frequency</i>	<i>Standard deviation/Percent</i>
Dependent		
<i>Nasi lemak</i>	0.8	1.5
<i>Roti canai</i>	0.8	1.5
Fried rice	1.0	1.7
Fried noodles	0.5	1.0
Fried vermicelli	0.5	1.0
Independent		
Age (years)		
18-24	77	7.4
25-34	155	14.8
35-44	176	16.8
45-54	215	20.6
55-64	244	23.3
≥65	179	17.1
Income (RM)		
≤999	557	53.3
1000-1999	234	22.4
2000-2999	98	9.4
3000-3999	63	6.0
≥4000	94	9.0
Education		
No formal	96	9.2
Primary	220	21.0
Secondary	502	48.0
Tertiary	228	21.1
Gender		
Male	428	40.9
Female	618	59.1
Ethnicity		
Malay	662	63.3
Chinese	115	11.0
Indian	63	6
Others	206	19.7
Employment		
Employed	549	52.5
Unemployed	497	47.5
Marital status		
Married	760	72.7
Divorced/widowed	153	14.6
Single	133	12.7
Locality		
Urban	433	41.4
Rural	613	58.6

Note: For dependent variables, the values refer to mean and standard deviation. For independent variables, the values refer to frequency and percent.

Source: MyCoSS (IPH, 2019)

Table 2. Estimated SUR models for consumption of *nasi lemak*, *roti canai*, fried rice, fried noodles, and fried vermicelli ($n=1046$)

<i>Variables</i>	<i>Nasi Lemak</i>	<i>Roti canai</i>	<i>Fried rice</i>	<i>Fried noodles</i>	<i>Fried vermicelli</i>
Constant	0.332 (0.296)	0.649* (0.298)	0.572 (0.334)	0.348 (0.206)	0.805* (0.195)
Age (years)					
18-24	0.751* (0.248)	0.111 (0.250)	1.217* (0.280)	0.140 (0.172)	-0.237 (0.163)
25-34	0.611* (0.187)	0.270 (0.188)	0.816* (0.211)	0.139 (0.130)	-0.115 (0.123)
35-44	0.442* (0.174)	0.098 (0.175)	0.386* (0.197)	0.085 (0.121)	-0.050 (0.115)
45-54	0.201 (0.164)	0.083 (0.165)	0.271 (0.185)	0.045 (0.114)	-0.035 (0.108)
55-64	0.108 (0.147)	0.004 (0.148)	-0.057 (0.166)	0.039 (0.102)	0.039 (0.097)
≥65	Ref.	Ref.	Ref.	Ref.	Ref.
Income (RM)					
≤999	-0.189 (0.190)	-0.261 (0.191)	-0.079 (0.215)	-0.164 (0.132)	-0.105 (0.125)
1000-1999	-0.206 (0.190)	-0.213 (0.192)	-0.117 (0.215)	-0.186 (0.132)	-0.145 (0.125)
2000-2999	-0.344 (0.212)	0.021 (0.214)	0.113 (0.240)	-0.101 (0.148)	0.019 (0.140)
3000-3999	-0.071 (0.235)	-0.142 (0.237)	-0.378 (0.266)	-0.316 (0.164)	-0.190 (0.155)
≥4000	Ref.	Ref.	Ref.	Ref.	Ref.
Education					
No formal	0.211 (0.202)	-0.068 (0.204)	-0.079 (0.229)	0.136 (0.141)	-0.105 (0.133)
Primary	0.191 (0.161)	0.026 (0.163)	0.320 (0.183)	0.142 (0.112)	-0.072 (0.106)
Secondary	0.279* (0.127)	0.086 (0.128)	0.110 (0.144)	0.164* (0.089)	-0.057 (0.084)
Tertiary	Ref.	Ref.	Ref.	Ref.	Ref.
Gender					
Male	0.264* (0.103)	0.760* (0.103)	0.116 (0.116)	0.132* (0.071)	-0.074 (0.068)
Female	Ref.	Ref.	Ref.	Ref.	Ref.
Ethnicity					
Malay	Ref.	Ref.	Ref.	Ref.	Ref.
Chinese	-0.537* (0.147)	-0.703* (0.148)	-0.737* (0.166)	-0.036 (0.102)	0.072 (0.097)
Indian	-0.296 (0.191)	-0.242 (0.193)	-0.450* (0.216)	-0.018 (0.133)	0.311* (0.126)
Others	-0.676* (0.118)	-0.738* (0.119)	-0.376* (0.133)	0.369* (0.102)	-0.078 (0.078)

Table 2. Estimated SUR models for consumption of *nasi lemak*, *roti canai*, fried rice, fried noodles, and fried vermicelli ($n=1046$) [Cont'd]

Variables	Nasi Lemak	Roti canai	Fried rice	Fried noodles	Fried vermicelli
Employment					
Employed	0.130 (0.111)	-0.006 (0.112)	-0.119 (0.125)	0.016 (0.077)	0.041 (0.073)
Unemployed	Ref.	Ref.	Ref.	Ref.	Ref.
Marital status					
Married	0.229 (0.168)	0.148 (0.170)	0.318 (0.190)	0.020 (0.117)	-0.104 (0.111)
Divorced/widowed	0.113 (0.212)	0.121 (0.214)	0.349 (0.240)	0.125 (0.148)	-0.169 (0.140)
Single	Ref.	Ref.	Ref.	Ref.	Ref.
Locality					
Urban	0.024 (0.095)	0.003 (0.096)	-0.004 (0.107)	0.010 (0.066)	0.019 (0.063)
Rural	Ref.	Ref.	Ref.	Ref.	Ref.
Chi-squared [†]	221.988*				

Note: The values refer to Beta coefficients and are interpreted as number of servings consumed in a week. Standard errors are shown in parentheses. Ref. refers to reference category.

* $p < 0.05$

[†]Breusch-Pagan test of independence between the residuals. Since there are five equations in SUR (five dependent variables), five columns for the food items are presented separately.

Source: MyCoSS (IPH, 2019)

sodium foods. The study by Salleh *et al.* (2021) also found ethnic variations in sodium intake because different ethnicities have different dietary practices. Our finding led to a conclusion that cultural factor plays an important role in dietary behaviour. Culture could be seen as a mediator for ethnicity and food consumption. An in-depth qualitative study is therefore needed to supplement a better understanding of the independent effects of culture and ethnicity on the demand for high-sodium foods.

Although an evaluation of food policy is not within the scope of the present study, some policy implications of our findings are noteworthy. Firstly, an intervention measure aimed at reducing the consumption of high-sodium foods could pay special attention to young adults with a focus on those aged 18-44 years. Secondly, while educating people about the adverse effects of excessive

intake of sodium is mandatory, the government must bear in mind that having considerable knowledge may not be able to reduce one's consumption of high-sodium foods. Thirdly, it may be worthwhile for policy makers to make a concerted effort to discourage specific groups, especially men and Malays, from consuming high-sodium foods, especially *nasi lemak* and *roti canai*.

One of the limitations of the present study was that the causal relationships between sociodemographic factors and consumption of high-sodium foods could not be well-identified because of cross-sectional data. Furthermore, some health variables that may affect the consumption of high-sodium foods were omitted from analyses due to data limitation. Moreover, the sample size was not large enough. Otherwise, analysis stratified by ethnic groups could be conducted. Another limitation was that condiments used in cooking

and other food items that have high-sodium content, such as salted fishes and anchovies, were not considered in the present study. Also, there was no complex sample analysis for the SUR. Otherwise, the SUR could be estimated based on three stages of sampling: 1) enumeration blocks; 2) living quarters; 3) members of households.

CONCLUSION

Sociodemographic factors, such as age, education level, gender and ethnicity, are associated with consumption of high-sodium foods. In particular, adults are more likely to consume high-sodium foods if they are younger, less-educated, male or Malay. These sociodemographic differences need to be recognised in policy formulation.

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Authors' contributions

CYK, conceptualisation, funding acquisition, methodology, validation, formal analysis, investigation, writing of original draft, reviewing & editing manuscript, visualisation and supervision; SASN, methodology and validation; KCC, reviewing & editing manuscript; LHK, reviewing & editing manuscript; OMA, methodology and validation.

Conflict of interest

The authors have no competing interests to declare.

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