ORIGINAL ARTICLE

Sodium and Potassium Urinary Excretion Among Malaysian Adults Claiming to Practice Salt-control: Findings from the Malaysian Community Salt Survey (MyCoSS)

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ABSTRACT

Introduction: Raised blood pressure is associated with diet high in sodium and low in potassium. According to the Malaysian Community Salt Survey (MyCoSS), Malaysian adults consume a high sodium diet, despite half claiming that they control their salt intake. The objective of this study was to investigate the association of sodium and potassium with salt-control claims among adults from the MyCoSS study based on 24-h urinary excretion. **Methods:** Data of 1,047 respondents aged 18 years and above who completed the knowledge, attitude, and practice (KAP) questionnaire were used in this study. Face-to-face interviews were conducted to acquire information on sociodemographic, medical reports and KAP on salt intake. Sodium and potassium level were assessed from 24-hr urine specimen, anthropometric measurements were done using WHO criteria, while blood pressure was measured using validated digital blood pressure monitor. Descriptive and analysis of variance (ANOVA) were used to determine the associations between urinary sodium and potassium with salt-control claims and practices. **Results:** The consumption of sodium was higher than recommended, while potassium was lower among respondents who claimed to control their salt intake. Significant associations were found between sodium intake with marital status, ethnicity, education level and employment status. Meanwhile, significant associations were found between potassium intake with ethnicity and employment status. **Conclusion:** Sodium intake was high, and potassium intake was low among respondents who claimed they control their salt intake. Further study with detailed intervention on specific target group is required to improve sodium and potassium intakes among Malaysian adults.
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INTRODUCTION

The World Health Organization (WHO) global action plan aims to reduce global salt intake by 30% in 2025, with the goal of reducing 25% of premature mortality from non-communicable diseases (NCDs) (1). While 63% of global death is from NCDs (cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes), about 31% of NCD-related deaths are due to cardiovascular diseases (CVDs). Hypertension, one of the common risks for NCDs that leads to stroke and cardiovascular diseases, is also a leading cause of death worldwide, representing 12.8% of all deaths (2).

The risk factors for hypertension have been identified in numerous epidemiological research; high salt intake is one of the factors that has been related to the pathophysiology of hypertension. Nevertheless, dietary sodium may not be considered a sole contributor to the development of hypertension. When combined with increased dietary potassium, a moderate reduction in sodium is associated with increased blood pressure and considered to provide significant protection against CVD (3). Clinical and epidemiology data revealed that increasing potassium intake is also associated with a lower risk of all stroke and mortality in hypertensive adults (4), as well as other findings in non-hypertensive elderly women (5).

Salt-reduction strategies are being implemented over the world. In Malaysia, the Ministry of Health, in partnership with several agencies, raises salt awareness through the promotion of low salt programmes among the public. Malaysia's salt-reduction strategy is crucial, especially with the rising trend of hypertension prevalence in

the country (6). According to the National Health and Morbidity Survey (NHMS) in 2019, the national prevalence of hypertension among Malaysian adults was 30%, with elevated blood pressure among individuals with unknown hypertension at 14% (7). This has become increasingly concerning as more people are revealed to have high blood pressure without realising it.

A few studies involving a sub-population of health workers and others using small samples of adults have found that the average salt intake in Malaysia exceeded the WHO guideline limit of 5g/day (8), (9), (10). The Malaysian Community Salt Survey (MyCoSS), which was conducted on a nationwide representative sample of Malaysian adults, indicated that 79% consumed a high-sodium diet, with a daily mean intake of 7.9 g salt/day and daily potassium intake of 37 mmol which is way lower than the WHO recommendation of at least 90 mmol/day (11), (12).

Majority of sodium and potassium consumed in a day (90 to 95%) will be eliminated in the urine during the next 24 hours (13), (14). Hence, by using the gold standard measure of urine sodium and potassium excretion over a 24-hour period as bio markers provides the best indicator for assessing population dietary sodium and potassium intakes (15). These gold standard measures were used in the MyCoSS research. Aside from identifying salt intake, the primary sources of salt in the diet, as well as the population's knowledge, attitude, and practice (KAP) were also explored. The findings on KAP revealed that 55.4% of Malaysian adults usually controlled their salt intake; more than half claimed that their types of practices involved avoiding processed foods (60.8%) and not adding salt at the table (60.5%) (11). However, little is known about the actual sodium and potassium levels of people who claimed to control their salt intake, particularly based on 24 hours urinary excretion. Therefore, the goal of this study was to explore sodium and potassium urine levels, as well their associations with salt-control claims among the Malaysian population using data from the Malaysian Community Salt Survey (MyCoSS).

MATERIALS AND METHODS

Samples

This study was based on the secondary data from MyCoSS study, a cross-sectional survey that took place from October 2017 to March 2018, using stratified cluster sampling method. The sampling design covered both rural and urban areas in every state of Malaysia to ensure national representation. The sample size for knowledge, attitude and practice was estimated to be 1,300, based on the previous prevalence reported in My Salt (2015), with a standard deviation of 94%, estimated design effect of 1.5, and 20% non-response rate (10), (11).

The participants were randomly selected from the Department of Statistics Malaysia's selection of residential units. A Kish Table was used to select one eligible adult participant within these criteria: Malaysian citizen, adult 18 years and above, and willing to be a respondent. Documented consent was obtained prior to participation. For urinary sampling, complete urine samples with a volume of more than 500 ml were included in the study. Pregnant mothers, women having menses, fasting, on recent diuretic therapy treatment, and with difficulty to collect 24-hr urine were excluded from the survey.

Material

A structured set of questionnaires was developed to gather information on medical history and socio-demographic characteristics such as age, gender, ethnicity, education level, employment status, and household income. All data were collected by a trained research assistant via face-to-face interview at the respondent's house using mobile devices specially developed for the study. Validated and calibrated equipment were used for anthropometric measurements - TANITA HD-319 digital weighing scale for weight, with an accuracy of 0.1 kg; SECA 213 (SECA, GERMANY) stadiometer for height, with an accuracy of 0.1 cm; and SECA measuring tape for waist circumference, to the nearest 0.1 cm. Classification of body mass index (BMI) was based on the 1998 WHO guidelines (16).

Blood pressure was measured three times by using an Omron HBP-1300 blood pressure monitor, with a one to two minutes gap in between each measurement. The average of the last two measured values of systolic blood pressure (SBP) and diastolic blood pressure (DBP) were used for analysis. High blood pressure was defined as respondents who had been diagnosed with hypertension and had continuous raised SBP >140 mmHg and/or DBP >90 mmHg (17). Meanwhile, the normal group consisted of respondents who were in the normal or pre-hypertensive range.

The urine collection kit consisted of a 5 litres screw-capped plastic tub, an identifier label, a urine collection jug, plastic carrier bag for transferring and storing, a safety pin for clothing attachment, and a poster reminder to collect urine. The first urine of the day was discarded; only urine output from the next 24 hours was collected. The time of onset for 24-hour urine collection was recorded individually by the participants. The completed 24-hour urine samples were collected by research assistants and the labelled samples were sent for analysis on the same day. The urine bottles were kept cold in cooler or polystyrene boxes before being sent to the nearest ISO qualified private laboratory. Any discrepancy on urine collection was notified and reported. The overall urine sampling process was reported online and could be accessed with a restricted code.

Urinary creatinine level and urine volume output were used as indicators for the completeness of urine collection. Samples were eliminated if (i) urinary creatinine level was less than 6 mmol/day for men or 4 mmol/day for women, (ii) there were extreme outliers for urinary creatinine (i.e., more than 3 SDs from the mean), or (iii) 24-hour urine volume was less than 500 ml for both genders (18). The 24-hour sodium excretion value (mmol/day) was calculated as sodium concentration in urine (mmol/L) multiplied by urinary volume (L/day) for each participant. It was then divided by 17 to convert sodium from mmol to grammes [Na (g)=Na (mmol)ч17] and multiplied by 2.542 to convert sodium (Na) to salt (NaCl) [NaCl(g)=Na (g) x 2.542].

The knowledge, attitude, and practice (KAP) components on the necessity of salt intake were based on the World Health Organization/ Pan American Health Organization protocols for population level sodium determination (19). To assure validity, the original version in English was translated into the Malay language and checked via back translation. The questionnaire was also checked for any discrepancies and a pre-test was done before it was used for data collection. However, particularly for this study, only two of the eight questions from the KAP questionnaire were used for statistical analysis. Respondents were asked on the practice of reducing their sodium intake: 'Do you do anything on a regular basis to control your salt intake?'; if the response was "yes", it was coded as having sodium control practice and if the response was "no" or 'did not know", it was coded as not having sodium control practice. For the response of "yes", respondents could choose more than one answer on how they controlled their salt intake: "avoid or minimise consumption or processed food", "look at the salt or sodium labels on food", "do not add salt at the table", "buy low salt alternatives", "do not add salt when cooking", "use spices other than salt when cooking", "avoid eating out" or "others." Only 'Yes' responses were used and analysed in this study to identify sodium and potassium-related characteristics.

Statistical analysis

All analyses were conducted using the Statistical Package of Social Science (SPSS) software version 22.0, which took account of the complex sample design and weights. The 95% confidence interval was used to characterise all results and a p-value of <0.05 was considered as statistically significant. Descriptive analysis was used for socio-demographic status related to sodium intake. Gender variables of men and women were used to stratify the population who were controlling their salt intake. Analysis of variance (ANOVA) was performed to identify differences between group variables, as well as correlations between socio-demographic status with salt and potassium consumption among individuals who controlled their salt intake. Results were presented as mean (SD) and/or as percentages.

Ethics approval

The Medical Research and Ethics Committee granted the ethical permission for this survey (NMRR-17-423-34969). The respondents signed a consent form to allow the storage of their urine samples for further research. A dummy identification was created for each respondent for anonymity and confidentiality.

RESULTS

Out of 1,300 samples, 1,047 adults were willing to participate and answered the KAP questionnaire (80.5% response). About 960 participants contributed their urine samples; however, only 798 were valid for analysis based on the completeness of urine collection. Out of the total of 502 missing values, 253 were drop-outs, 87 refused to contribute urine samples, and 162 were invalid samples. Meanwhile, among the respondents who answered the KAP questionnaire, 601 claimed that they controlled their salt intake (57.4%), with the proportion of 33.8% men (n=203) and 66.2% women (n=398).

Participants' Characteristics

Table I describes the characteristics of participants who claimed that they controlled their salt intake. Mean age of the participants was 50 years old. Mean body weight was 66.5+14.6 kg while mean BMI was 27.0 + 5.3 kg/m2. The average systolic blood pressure observed was 136.4 + 20.8 mmHg, and the average diastolic blood pressure was 80.8 +12.4 mmHg. About 40% were found to have high blood pressure.

Table II shows the socio-demographic distribution of participants. Most respondents were from the rural areas (58.4%), Malay ethnic group (65.7%), with secondary education level (47.9%), and belonged to the income group of more than RM1,000/month (71.5%). However,

Table I: Characteristics of participants who claimed practise salt controlled (*n*=601)

Variables	Total *n*=601 Mean (SD)	Men *n* =203 Mean (SD)	Female *n* =398 Mean (SD)
Age (years)	50 (14.8)	51 (14.9)	49 (14.7)
Height (cm)	156.8 (8.6)	165.3 (6.8)	152.4 (5.7)*
Weight (kg)	66.5 (14.6)	71.3 (14.4)	64.1 (14.0)*
BMI (kg/m^2)	27 (5.3)	26 (4.5)	27 (5.6)*
Systolic blood pressure (mmHg)	136.4 (20.8)	138.3 (19.3)	135.4 (21.5)
Diastolic blood pressure (mmHg)	80.8 (12.4)	83.2 (11.9)	79.5 (12.4)
Blood pressure** (*n*,%)			
Normal	354 (58.9)	117 (57.6)	237 (9.5)
Hypertensive	247 (41.1)	86 (42.4)	161 (40.5)

Results are mean (SD) or as percentage, *P < 0.001
**Definition refers to material methods

Table II: Socio-demographic of participants with salt-control claiming practice (n=601)

Variables	Total *n* (%)	Men *n* (%)	Female *n* (%)
Strata			
Urban	250 (41.6)	87 (42.9)	163 (41.0)
Rural	351 (58.4)	116 (57.1)	235 (59.0)
Ethnicity			
Malay	395 (65.7)	87 (42.9)	163 (41.0)
Chinese	71 (11.8)	26 (12.8)	45 (11.3)
Indian	26 (4.3)	6 (3.0)	20 (5.0)
Bumiputera Sabah	55 (9.2)	20 (9.9)	35 (8.8)
Bumiputera Sarawak	44 (7.3)	15 (7.4)	29 (1.5)
Others	10 (1.7)	4 (2.0)	6 (7.3)
Marital Status			
Single	63 (10.5)	27 (13.3)	36 (9.1)
Married	444 (74.0)	166 (81.8)	278 (20.9) *
Widow/Widower/ Divorcee	93 (15.5)	10 (4.9)	83 (20.9)
Education Level			
No formal	42 (7.0)	8 (3.9)	34 (8.5)
Primary	119 (19.8)	43 (21.2)	76 (19.1)
Secondary	288 (47.9)	90 (44.3)	198 (22.6)
Tertiary	152 (25.3)	62 (30.5)	90 (22.6)
Occupation			
Public sector	93 (15.5)	39 (19.2)	54 (13.6)
Private sector	82 (13.6)	37 (18.2)	45 (11.3)
Self-employed	125 (20.8)	73 (36.0)	52 (13.1)
Housewives	199 (33.1)	0 (0)	199 (33.1) *
Unemployed	102 (17.0)	54 (26.6)	48 (12.1)
Income group			
< 1000	171 (28.50	46 (22.7)	125 (31.4)
1000 -1999	113 (18.8)	46 (22.7)	125 (31.4)
2000 - 2999	113 (18.8)	38 (18.7)	75 (18.8)
3000 - 3999	65 (10.8)	24(11.8)	41 (10.3)
> 4000	154 (25.6)	63 (31.1)	91 (22.9)

Results are mean (SD) or as percentage, *P < 0.001

among all the variables, the female respondents' marital status and employment status were found to have a significant effect on salt control.

Daily urine excretion among participants with salt-control practice

Samples with complete urine, were included for further sodium and potassium analyses. Daily urine excretion can be seen in Table III, with an average total volume of 1,482 mL per day, mean sodium of 109.9 mmol/day, and mean potassium of 26.9 mmol/day. Between men and women, there was a significant mean difference in total urine volume, sodium, and potassium levels. Men were found to excrete more urine than women. Men also consumed significantly more sodium and potassium on average than women (p<0.001). Mean urinary sodium excretion (109.9 mmol/day) was converted into mean salt intake, therefore sodium consumption was 2,508.9 mg/day. Mean potassium consumption was 1,050.3 mg/day, equivalent to 26.9 mmol/day.

Table III: Daily urinary excretion among claimed to practise salt-control participants (n=588)

Variable	Total Mean (SD) [a]	Men Mean (SD) [a]	Women Mean (SD)[a]	P – value [b]
Volume (mL/24h)	1482.5 (902.8)	1622 (989)	1410 (836)	0.011 *
Sodium (mmol/24h)	109.9 (55.6)	124.5 (60.5)	102.9 (51.6)	<0.001 *
Potassium (mmol/24h)	26.9 (13.5)	30.9 (14.9)	25.0 (12.3)	<0.001 *
Sodium intake (mg/day)	2508.9 (1535.4)	2850.9 (1705.5)	2351.7 (1443.1)	<0.001 *
Potassium intake (mg/day)	1050.3 (575.3)	1193.1 (654.1)	994.3 (523.3)	<0.001 *

*[a] Mean (SD). [b] Independent t-test *Significant p-value < 0.05*

Socio-demographic factors associated with sodium and potassium intakes among participants who claimed to have salt-control practice.

Table IV shows sodium and potassium intakes by socio-demographic status adjusted for sex and age among the population who claimed to practise salt-control. There was a significant mean difference in sodium intake between all groups for the variables of ethnicity (p<0.001), marital status (p<0.05), education level (p<0.001), and employment status (p<0.001). Meanwhile, there was a significant mean difference in potassium intake across the variables of ethnicity (p<0.001) and employment status (p<0.05) across all groups.

DISCUSSION

In this present study, it was found that 57.4% of the respondents indicated that their salt intake was under control. In comparison to other studies that utilised the same questionnaire, the result seemed higher than adults in Montenegro (34.3%) and US (45%), but lower than Australian adults (63%) (20), (21), (14). Women were found to be more engaged in controlling their salt intake, a finding shared by Zhang J et al. (22). Men, on the other hand, were found to be less interested in salt control. This may be because minimising daily salt intake is more difficult in men who usually require more total energy than women (23).

The average daily salt intake of 6.3g among adults who claimed to practise salt control appeared to be higher than the WHO target limit of not more than 5g/day for salt intake (24). However, it was less than the daily salt intake previously reported for the Malaysian population, which were 7.9 g in MyCOSS and 7.1g in MySalt (11), (10), respectively. Men were found to consume more salt in their diet even though they controlled their salt intake. This observation may be contributed by the fact that men are taller and heavier than women (20).

Men were also seen to be significantly associated with high urinary sodium in a few salt studies (25), (26).

Table IV: Sodium and potassium intakes among claimed to practise salt-control participants by socio-demographic (age and sex adjustment) *n*=588

Variables	Sodium				Potassium			
	n	Mean (SD)	F/t-statistic* (df)	*p* value	n	Mean (SD)	F/t-statistic* (df)	*p* value
BMI								
Underweight	17	1939.1(1412.39)	1.059 (3,584)	0.366	17	1160.2(600.64)	0.740 (3,582)	0.528
Normal	199	2449.8(1414.63)			198	1042.4(507.18)		
Overweight	223	2574.8(1562.67)			223	1079.9(649.78)		
Obese	149	2554.1(1656.30)			148	1050.3(575.33)		
Strata								
Urban	248	2633.7(1467.0)	1.686 (586)	0.092	247	1034.5(583.15)	-0.565(584)	0.572
Rural	340	2417.2(1579.82)			339	1061.7(570.15)		
Ethnicity								
Malay	391	2410.0(1552.19)	5.39 (5, 582)	<0.001	391	1037.3(552.87)	4.568 (5,580)	<0.001
Chinese	69	3370.1(1559.54)			69	1204.2(630.69)		
Indian	26	2520.8(1248.50)			25	808.3(474.11)		
Bumiputera Sabah	51	2369.2(1136.67)			51	1022.3(492.74)		
Bumiputera Sarawak	42	2312.4(1627.60)			41	1222.5(745.24)		
Others	9	1875.3(816.67)			9	481.1(191.17)		
Marital status								
Single	59	2764.9(1587.28)	3.124 (2,584)	0.045	59	1038.9(599.71)	1.690 (2,582)	0.185
Married	437	2544.9(1564.85)			436	1072.4(578.08)		
Widow/Widower/ Divorcee	91	2173.83(1313.04)			90	950.4(543.51)		
Education level								
No formal	39	2119.5(1464.64)	6.334 (3,584)	<0.001	39	1059.8(642.62)	0.400 (3,582)	0.753
Primary	118	2123.2(1396.55)			117	1042.7(545.70)		
Secondary	280	2529.3(1512.19)			279	1029.4(532.08)		
Tertiary	151	2873.0(1617.52)			151	1092.3(654.71)		
Occupation								
Public sector	92	2935.3(1485.60)	6.502 (4,583)	<0.001	91	1189.2(675.16)	3.317 (4,581)	0.011
Private sector	81	2727.2(1642.54)			81	1014.4(581.84)		
Self-employed	121	2776.1(1692.99)			121	1133.8(601.20)		
Housewives	196	2136.8(1279.29)			195	960.9(490.82)		
Unemployed	98	2342.2(1589.04)			98	1025.5(566.19)		
Income group								
<RM1000	164	2347.3(1587.23)	1.626 (4,583)	0.166	163	1031.5(595.48)	0.486 (4,581)	0.746
RM1000-1999	111	2388.2(1445.72)			111	1014.6(509.32)		
RM2000-2999	97	2479.6(1611.50)			97	1079.7(559.61)		
RM3000-3999	64	2611.5(1456.61)			63	1125.9(522.75)		
>RM4000	152	2746.8(1511.48)			152	1046.3(630.37)		

*One-way ANOVA test

This is possible since men and women have different physical structures and caloric needs. According to Malaysia's Recommended Nutrient Intakes (RNI), the energy requirement for a 50-year-old adult man is 2,190 kcal/day, while for a woman is 1,900 kcal/day (27). Greater energy intake may lead to the consumption of more food and thus, more sodium, especially when it is related to unhealthy food choices.

Meanwhile, potassium intake among adults who claimed to practise salt control was found to be 26.9 mmol/day, which was lower than the WHO's recommendation (28) and considerably lower than the data from MyCoSS (11). Men showed higher potassium intake than women in this study, which was in line with other findings that men consume more potassium because they require more energy (12), (23).

Overall, among all the variables in this study, marital status ($p<0.05$), ethnicity($p<0.001$), education level ($p<0.001$), and employment status ($p<0.001$) were found to have a significant mean difference in sodium intake. Meanwhile, as seen in potassium intake, there was a significant mean difference in the variable of ethnicity ($p<0.001$) and employment status ($p<0.05$).

In prior Malaysian sub-population salt studies, ethnicity was reported as an independent factor associated with high sodium intake (29), (30), (31). Salt sensitivity generally describes a significant increase in blood pressure when more salt is consumed (32). According to one study, the perception of saltiness intensity was seen to be associated with demographic characteristics, whereby ethnic Chinese scored much higher compared to Indians in Malaysia (33). Despite the fact that Chinese dietary habits have changed compared to their origins in mainland China, the influence of salt and other seasonings in Chinese food preparation, as well as in processed foods, remains (34). These factors may contribute to our findings that Chinese consumed more sodium than other ethnic groups.

In consideration of potassium intake, Indian were found to have the lowest level of potassium intake at 20.7 mmol/day, despite mostly living and practising a vegetarian lifestyle, involving mostly plant-based foods with occasional dairies. When compared to other ethnic groups in Malaysia, 13.2% of Indian adults followed a vegetarian diet (35). However, according to NHMS 2019, 95% of adults do not consume the recommended 5 servings of fruits and vegetables per day (7). Vegetables, fruits, and dairy products are the main sources of potassium in diet, which may explain why Malaysian Indians in our study had low potassium intake.

Marital status was positively associated with high sodium intake among participants who claimed to practise salt control. Those who were not engaged in any relationship and remained single had a higher sodium intake compared to married or widower/divorcees. A recent study showed that living alone was related to an unhealthy dietary pattern, particularly among the elderly (36); whereas other findings indicated that living alone was associated with a low-sodium diet among adult women in Korea (37). Hypertension was also proven to be more common among Japanese people who were unmarried and living alone (38). Hence, there appears to be a definitive relationship between nutritional intake with single or living alone.

In this study, education level was seen to be positively associated with high sodium consumption; those with higher education level had the highest sodium intake. This was consistent with data from Mozambique, which showed that higher level of education was associated to more frequent use of salt in food preparation (39). Another study, on the other hand, indicated that there was no correlation between education and healthy salt intake behaviour (22). Moreover, there was a study result revealing that sodium intake knowledge, perception and practice among Malaysian adults were not associated with excessive dietary sodium intake (40). In summary, no matter how many years one has spent in school or how advanced one's education level is, it does not ensure healthy salt practices in daily life.

This study also revealed that employment status was positively associated with both high sodium and low potassium intakes, consistent with findings that showed a strong association between economic status and low urinary potassium (41), (42). Another study, however, showed that following the implementation of national salt reduction initiatives, social economic status (SES) remained imbalance and unchanged (29). The difficulty in obtaining accurate data might be one of the reasons why economic status, particularly in the areas of employment and education level, is said to be inconsistent between studies.

The study's strength was in assessing a representative pool of Malaysians' average salt and potassium intakes by 24hr urine excretion. The limitation of this study was that it was based on self-claims of salt control practises among the respondents, since the study data were based on a set of questionnaires with no accurate assessment or monitoring of salt intake. As a result, this study could only establish the associations between salt-control practises with sodium and potassium intakes, instead of cause and effect relationship between these variables. Another issue was the discarding of samples in the absence of urine that could lead to the risk of selection bias, which could subsequently affect the dropout rate. We suggest that future intervention research utilise a randomised controlled trial concept to investigate how salt control might help Malaysians enhance their salt reduction efforts.

CONCLUSION

Based on KAP questionnaire, half of the population studied in the salt survey claimed that they controlled their salt intake. However, sodium intake was high, while potassium intake was low among them. Ethnicity, marital status, education level, and employment status had a significant mean difference in sodium intake; while ethnicity and employment status had a significant mean difference in potassium intake. This study is important for understanding the pattern of salt consumption among the Malaysian population and serves as a baseline for future preventive strategies aimed at changing public consumer behaviours in salt-reduction programmes, which at the same time, can be used to improve potassium intake in daily diet. Nevertheless, future research should focus on developing a detailed intervention study on salt intake among Malaysians.

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