Original article

Sodium Intake among Adults in the Western Region of Saudi Arabia

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Summary. *Background/Aim***:** This study aimed to assess sodium intake and its predictors among adults residing in the Western region of Saudi Arabia. *Material and Methods:* In this cross-sectional study, data were collected from 494 adults aged 20-50 years. Participants were recruited from two public universities and public places in Madinah and Jeddah. Data about demographics, sodium intake, salt-related practices, and anthropometrics (height and weight) were collected through face-to-face interviews. The World Health Organization (WHO) sodium intake recommendation (< 2000 mg per day) was used as a cutoff to categorize participants. *Results:* Median sodium intake was 4273 mg per day (IQR 3053-5979). The sodium intake in 93.5% of participants exceeded the WHO recommendation of < 2000 mg per day. Weight status and sex were not linked to sodium intake. Salt use while cooking predicted a lower sodium intake (p=.009), whereas salt use at the table and frequency of fast-food consumption predicted a higher intake of sodium (p=.039 and p=.001, respectively). Making effort to reduce salt intake and using salt alternatives did not predict sodium intake. *Conclusion:* Adults residing in the Western region of Saudi Arabia consumed high amounts sodium. Excessive sodium consumption among the study population highlights the urgent need for interventions to reduce sodium intake among adults in Saudi Arabia.

Key words: Sodium intake, recommendation, predictors, adults, Western region, Saudi Arabia

Introduction

Sodium is a major component of salt that can be found in many foods, added during the manufacturing process, or in many cases, added to foods while cooking or at the table to enhance flavor. The World Health Organization (WHO) has declared an urgency to assess and monitor sodium intake in populations due to its link to several chronic diseases, including elevated blood pressure, cardiovascular diseases, strokes, stomach cancer, and kidney stones (1–5). Since high sodium intake has become a global health concern, certain health authorities have established guidelines for sodium intake. For example, the WHO recommends an intake of < 2000 mg sodium per day (equivalent to < 5 g of salt per day) (1).

The recommendations were established after excessive sodium intake was reported in many populations. The average sodium consumption of Americans is 3400 mg per day (6), whereas that of Canadians is 2760 mg per day (7). In Saudi Arabia, sodium was found to be excessively consumed; however, data on this finding are outdated and only available in some regions (8–10). A study conducted among adults

in Riyadh city reported a median sodium intake of 3457 mg per day (8). More recent data from Aljouf region showed even higher sodium intake, 3700 mg per day (10).

Sodium consumption varies across different diets. For instance, in the US, sodium mainly (75-80%) comes from processed foods, while in China, most of the sodium comes from the salt added while cooking (11). In many Arabian Gulf countries, sodium mainly comes from table salt and salt in bread (12). In addition, evidence suggested that men have a higher sodium intake than women (9,13). Previously, higher total energy intake explained the association of sodium intake with sex and weight status. However, the relationship between sodium intake and weight status has become questionable after a study reported that the positive association between sodium intake and body mass index (BMI)/weight status is independent of energy intake (14).

Individuals living in different regions of Saudi Arabia might consume sodium in different amounts, as their diet and eating practices are somewhat different (15). Data regarding sodium intake in the Western region of Saudi Arabia are lacking. Therefore, this study aimed to assess sodium intake and its predictors among adults residing in the Western region of Saudi Arabia.

Materials and Methods

Subjects

The minimum number of participants required for this study was 384. The number was determined based on a 95% confidence level, precision of 200 mg of sodium intake per day, and standard deviation of 1000 mg of sodium intake per day based on the equation suggested by Charan and Biswas (16). We collected cross-sectional data from 494 participants aged 20-50 years from Madinah and Jeddah, two of the most populated cities in the Western region of Saudi Arabia. Participants were recruited from Taibah University in Madinah, King Abdulaziz University in Jeddah, and public areas, including malls and parks, in both cities. Pregnant women and individuals diagnosed with diabetes, hypertension, and cardiovascular diseases were excluded. Data were collected through face-to-face interviews conducted by trained professional after a signed consent form was obtained from each study participant.

Data collection

Potential participants were invited to the data collection stations for an interview in order to collect their data. Invitations were also sent via WhatsApp to potential participants to enroll in the study. Men were encouraged to visit the Home Care Service Center in Madinah during specific times while women were invited to visit the data collection station located in the College of Applied Medical Sciences, Taibah University. Ethical approval was granted by the Ethical Committee of the College of Applied Medical Sciences at Taibah University, Madinah, Saudi Arabia [certificate number: SREC/AMS 2019/33/CND].

Data were collected using a questionnaire that consisted of four sections: demographics, anthropometrics, dietary assessment of sodium intake, and practices related to salt intake. Demographic variables included data regarding age, sex, marital status, education level, and household income.

Assessment of sodium intake. A semi-validated food frequency questionnaire (FFQ) was used to collect data on sodium intake (8). The FFQ was developed specifically to assess sodium intake among the Saudi population. Additional food items that are high in sodium, including spices, sauces, and savory snacks, were added into the FFQ. Food items that contain low quantities of sodium (< 5 mg of sodium in 100 g) were excluded. The FFQ included 11 food groups as follows: milk and alternatives; fruits; vegetables; meat, fish, and eggs; mixed dishes; sandwiches and snacks; breads, cereals, and starches; beverages, juices, and drinks; sweets; seeds and nuts; and fat and oils. The sodium contents in all food items were updated according to the data obtained from the Nutritics software® (version 5.09, Dublin, Ireland). Local food items and recipes were manually entered into the Nutritics software when needed. The internal consistency of the FFQ used to evaluate sodium intake in this study was high (α= 0.92), which was assessed by the Cronbach's alpha test. Data on sodium intake were compared to the

WHO sodium recommendation of less than 2000 mg per day (1).

Assessment of practices related to salt intake. Participants were asked five questions as follows: 1) Question concerning the effort to reduce salt intake; 2) Question concerning the use of salt alternatives; 3) Question concerning the frequency of salt use while cooking; 4) Question concerning the frequency of salt use at the table; 5) Question concerning the frequency of fast-food consumption per week. Responses to questions one and two were "yes" and "no," while responses to questions three and four were "never=0"; "rarely=1"; "sometime=2"; "usually=3"; and "always=4". Data regarding the frequency of fast-food consumption per week were collected as a continuous variable. Fast-food consumption was later categorized into two groups: participants who consumed fast-food < 2 times per week were considered "non-consumers=0," while those who consumed fast-food ≥ 2 times per week were considered "consumers=1."

Assessment of anthropometrics. Anthropometrics were measured twice following a standardized procedure. Height was measured using a measuring tape placed to a straight wall, and the readings were recorded to the nearest 0.5 cm. Weight was measured using digital weight scale (Omron BF 508) to the nearest 0.1 kg. Measurement of height and weight were used to calculate BMI. The WHO guideline was used to define the weight status of the study participants (17).

Statistical analysis

Descriptive statistics were presented for continuous variables as mean ± standard deviation (SD), median (interquartile range, IQR). For categorical variables, data were presented as frequency (percentage, %). Shapiro-Wilk test was used to assess normality of distributions of all continuous variables. Fisher's Exact test was used to examine the association between categorical variables. Mann-Whitney U test was used to compare mean of age across the two groups of sodium intake. Linear regression analysis was performed to investigate predictors of sodium intake. The statistical analysis used in this study was performed using the Statistics Package of Social Science (SPSS 20, SPSS Inc., Chicago, IL), and all two-tailed p-values <0.05 were considered statistically significant.

Results

The final analysis included 494 participants, 79.8% (n= 394) of whom were recruited from Madinah. The mean age of participants was 29.0 ± 9.10 years, with female and married participants accounting for 58.9% (n= 291), and 57.7% (n= 285), respectively. Of all participants, 49.4% (n=244) had a high school degree or diploma, and 52.6% (n= 260) reported a monthly income of <SR 5000 (equivalents to <US$ 1333). The prevalence of overweight among the study population was 26.7% (n= 132), and that of obesity was 26.3% (n= 130). No association was found between sodium intake (< 2000 mg/day and ≥ 2000 mg/day) and weight status (underweight, healthy weight, overweight, and obesity) (p=.223).

Median sodium intake was 4273 mg per day (IQR 3053-5979). The sodium intake in 93.5% of participants (n= 462) exceeded the WHO recommendation (≥ 2000 mg/day). These participants were significantly younger (28.7 ± 8.97 years) compared to participants who consumed sodium with the WHO recommendation (< 2000 mg/day) (32.7 ± 10.2 years), p=.027. Other characteristics of participants who exceeded the WHO recommendation for sodium intake and participants who consumed sodium with the WHO recommendation were similar. Detailed description of the characteristics of these participants are shown in Table 1.

Practices related to sodium intake among the study participants stratified by sodium intake groups (< 2000 mg/day and ≥ 2000 mg/day) are described in Table 2. In total, 42.5% of the participants (n= 210) reported making effort to reduce salt intake. However, there was no difference in sodium intake between individuals who made efforts to reduce salt intake and those who did not (p=.267). Only 2.80% (n= 14) reported using salt alternatives. Sodium intake was similar between participants who reported using salt alternatives and those who did not use salt alternatives (p=.614). Regarding salt use while cooking, participants who reported "always" had the highest percentage (75.7%, n= 374), followed by those who reported "usually" (12.1%, n= 60), "sometimes" (7.70%, n= 38), "rarely" (2.80%, n= 14), and "never" (1.60%, n= 8). Regarding salt use at the table, participants who reported "never" had the highest percentage (79.8%, n= 345),

Table 1. Characteristics of study participants stratified by sodium intake groups.

	Sodium intake < 2000 mg (n= 32)	Sodium intake ≥ 2000 mg (n= 462)	Total (n= 494)	p
Age, years, mean ± SD	32.7 ±10.2	28.7 ± 8.97	29.0 ± 9.10	.027 *
Sex, n (%)				
Males	10 (4.90)	193 (95.1)	203 (41.1)	.270
Females	22 (7.60)	269 (92.4)	291 (58.9)	
Marital status, n (%)				
Single	18 (8.61)	191 (91.4)	209 (42.3)	.096
Married	14 (4.91)	271 (95.1)	285 (57.7)	
Education, n (%)				
High school/Diploma	19 (7.80)	225 (92.2)	244 (49.4)	.275
University/ Postgraduate	13 (5.20)	237 (94.8)	250 (50.6)	
Income, SR, n (%)				
<5000	16 (6.20)	244 (93.8)	260 (52.6)	.858
5000-10000	8 (7.60)	97 (92.4)	105 (21.3)	
>10000	8 (6.20)	121 (93.8)	129 (26.1)	
Weight status, n (%)				
Underweight	1 (2.30)	42 (97.7)	43 (8.70)	.223
Healthy weight	9 (4.80)	180 (95.2)	189 (38.3)	
Overweight	9 (6.80)	123 (93.2)	132 (26.7)	
Obese	13 (10.0)	117 (90.0)	130 (26.3)	

SR: Saudi Riyal (SR 3.75= $1.00).
* Alpha was set at .05 to denote significance across the different groups.

Table 2. Practices related to sodium intake among the study participants stratified by sodium intake groups.

	Sodium intake < 2000 mg (n= 32)	Sodium intake ≥ 2000 mg (n= 462)	Total (n= 494)	*p*
Make efforts to limit salt intake				
Yes	17 (8.10)	193 (91.9)	210 (42.5)	.267
No	15 (5.30)	269 (94.7)	284 (57.5)	
Use of salt alternatives				
Yes	0 (0.00)	14 (100)	14 (2.80)	.614
No	32 (6.70)	448 (93.3)	480 (97.2)	
Use of salt while cooking				
Never	0 (0.00)	8 (100)	8 (1.60)	.962
Rarely	0 (0.00)	14 (100)	14 (2.80)	
Sometimes	2 (5.30)	36 (94.7)	38 (7.70)	
Usually	3 (5.00)	57 (95.0)	60 (12.1)	
Always	27 (7.20)	347 (92.8)	374 (75.7)	

Table 2 (*Continued*)

Table 2. Practices related to sodium intake among the study participants stratified by sodium intake groups. (*Continued*)

	Sodium intake < 2000 mg (n= 32)	**Sodium intake ≥ 2000 mg (n= 462)**	**Total (n= 494)**	***p***
Use of salt at the table				
Never	26 (7.50)	319 (92.5)	345 (69.8)	.757
Rarely	2 (4.50)	42 (95.5)	44 (8.90)	
Sometimes	3 (6.00)	47 (94.0)	50 (10.1)	
Usually	0 (0.00)	23 (100)	23 (4.70)	
Always	1 (3.10)	31 (96.9)	32 (6.50)	
Fast food consumption				
Non-consumer (< 2 times per week)	18 (10.1)	161 (89.9)	179 (36.2)	.021*
Consumer (≥ 2 times per week)	14 (4.40)	301 (95.6)	315 (63.8)	

* Alpha was set at .05 to denote significance across the different groups.

followed by those who reported "sometimes" (9.10%, n= 45), "rarely" (8.90%, n= 44), "always" (6.50%, n= 32), and "usually" (4.70%, n= 23). No significant association was found between sodium intake and salt added while cooking and table salt use (p=.962 and p=.757, respectively). In total, 63.8% (n= 315) of the participants were fast-food consumers (≥ 2 times per week). A significant association was found between sodium intake and fast-food consumption (p=.021).

Linear regression analysis performed to investigate the predictors of sodium intake showed that salt use while cooking predicted a lower sodium intake (B= -354, SE= 136 [95% CI: -621 to -87.3], p=.009, r-square=0.01), whereas salt use at the table and frequency of fast-food consumption predicted a higher intake of sodium (B= 201, SE= 97.3 [95% CI: 9.94 to 392], p=.039, r-square=0.01; (B= 613, SE= 184 [95% CI: 251 to 975], p=.001, r-square=0.02, respectively). Making efforts to reduce salt intake and using salt alternatives did not predict sodium intake among our study participants (Table 3).

Discussion

A high consumption of sodium was revealed by data obtained from the FFQ, with a median sodium intake that was more than double the amount recommended by the WHO. Salt use while cooking predicted a lower sodium intake, whereas salt use at the table and higher frequency of fast-food consumption predicted a higher intake of sodium among the study sample.

Table 3. Linear regression analysis of practices related to sodium intake in relation to sodium consumption (n= 494).

	B	**SE**	***p***	**95% Confidence Interval**	**R-square**
Make efforts to limit salt intake	-136	243	.577	-614 to 342	0.00
Use of salt alternatives	141	710	.843	-1253 to 1535	0.00
Use of salt while cooking	-354	136	.009*	-621 to -87.3	0.01
Use of salt at the table	201	97.3	.039*	9.94 to 392	0.01
Fast food consumption	613	184	.001*	251 to 975	0.02

* Alpha was set at .05 to denote significance

The diet in Saudi Arabia and in many other Middle Eastern countries has shifted towards a more Westernized diet, which is characterized by high amounts of sugar, fat, and salt (15,18). Sodium intake-related data are currently available in some regions of Saudi Arabia (Riyadh, Eastern and Aljouf), and all studies conducted in these regions reported a high consumption of sodium (8–10). Sodium intake has been reported to increase as fast-food consumption increases (19). In Saudi Arabia, high consumption of fast-food has been reported previously (20). Our study findings also showed high consumption of fast-food, which clearly predicted increased sodium intake. In addition, affordable prices of high-sodium foods and taste preference for salty foods (e.g. fast-food) might explain the high sodium intake among our study participants (21,22).

Due to the high consumption of sodium among many populations, the WHO has recommended close monitoring and reduction in sodium intake (1). Reducing sodium intake is crucial, as excessive intake may result in a number of negative health outcomes, including hypertension, cardiovascular diseases, strokes, stomach cancer, and kidney stones (1–5). In fact, interventions that aim to reduce sodium intake are more cost-effective than the treatment of chronic diseases resulting from high sodium intake, and these interventions found to be beneficial (23,24). Strategies have been adopted to reduce sodium intake among many populations, including the US population (21,25). In the Gulf Cooperation Council countries, an effort to reduce salt intake has been initiated and Saudi Arabia specifically proposed a plan to reduce the salt content in bread by 30% in addition to the reduction of the salt content in all bakery products (12). However, additional interventions are urgently needed at the national and community levels to reduce sodium intake among the Saudi population. Increase in taxation of high-salt foods might be a successful approach to limit sodium consumption among the Saudi population (26).

Identifying factors related to excessive sodium intake among adults in Saudi Arabia is necessary to plan effective interventions. In this study, salt use while cooking predicted lower sodium intake, whereas use of table salt predicted a higher sodium intake. Using limited amounts of salt while cooking without using table salt might explain the relationship between sodium intake and salt use while cooking. In this study, large proportion of participants whose sodium intake exceeded the WHO recommendation were younger. Taste preference of younger individuals for salty food leading them to use table salt could explain the positive association between sodium intake and table salt use (27).

The present study shows no association between sex and sodium intake. Previous research conducted in Jordan and in the Eastern region of Saudi Arabia reported higher consumption of sodium among males than among females (9,13). It has been suggested that higher energy intake among males can explain the increased consumption of sodium (28). In fact, sodium recommendation did not differentiate between the two sexes. The lack of such associations in our study might result from the overwhelming proportion of the study population with excessive sodium intake (93.5%).

Obesity has been reported to be positively associated with sodium intake (29,30). However, our findings showed no association between weight status and sodium intake. The lack of association could also be explained by the large proportion of the study population with excessive sodium intake. In addition, the prevalence of overweight and obesity was extremely high, as over half of the participants were overweight or obese.

Limitations

To the best of our knowledge, this is the first study conducted in the Western region to assess sodium intake and its related practices. However, convenient sampling method was used to recruit the participants in this study. Thus, the generalizability of our findings might be limited.

Conclusion

Adults residing in the Western region of Saudi Arabia consumed high amount of sodium. This finding sodium highlights the urgent need for interventions to reduce sodium intake among adults in Saudi Arabia. Future research should focus on investigating food sources of sodium as well as planning and assessing

the effectiveness of interventions that aim to reduce sodium intake among the Saudi population.

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