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Evaluation of Dietary Salt Intake among Healthy Students in Riyadh, Saudi Arabia

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Abstract

Background: High-salt intake is a major contributing risk factor for many chronic non-communicable diseases (NCDs) especially cardiovascular diseases. World Health Organization (WHO) recommended maximum salt intake of 5 g\day (equivalent to 2g/day of sodium) for adults. We therefore aimed to evaluate the mean salt intake by healthy individuals at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) and compare the levels to the WHO recommended salt intake guidelines.

Methods: This cross-sectional descriptive study used a validated electronic food frequency questionnaire (FFQ) to collect data to approximate the daily dietary salt intake of 3522 healthy undergraduate individuals in KSAU-HS, Riyadh, Saudi Arabia in 2016. Data were analyzed by the SPSS version 24.0. Descriptive statistics were used to describe the data. Continuous variables were delivered as the mean and standard deviation. Categorical variables were shown as frequencies and percentages. A T-test was used to assess the relationship between the food categories and consumption by gender. A p-value less than 0.05 was considered statistically significant.

Results: The mean age of the participants was 20.99 years with a Response rate of 9%. The study demonstrated that 97.8% of all participants had a total mean salt intake of 6.76 g/day, thus exceeding the WHO recommended daily salt intake. Females had a somewhat higher intake of salt while males showed higher consumption of fruits and vegetables. Most frequently consumed food categories in order are prepared meals, bakery products and cereals, and cheese and dairy products. The rate of the prepared meal utilization was 35.44%; with non-veg dishes having significant overall contribution with a p-value of 0.024

Conclusion: The amount of dietary salt intake among healthy Saudi individuals in KSAU-HS exceeds the WHO recommended daily value, which is alarming. Hence, this study highlighted the necessity of monitoring and decreasing individuals' daily salt intake through further researches, which in turn will assist in reducing an important risk factor of common NCDs within the Saudi community.

Keywords: Salt intake, WHO, cardiovascular diseases, KSAU-HS, students, Saudi Arabia

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1. Introduction

Global dietary patterns have undergone a change and as a result, populations are increasing the consumption of processed, canned, preserved and fast food, containing high levels of fat, carbohydrates, and salt [1]. In line with this, the prevalence of non-communicable diseases (NCDs) are steadily increasing and elevated salt utilization is one of the important contributing risk factors playing a crucial role in the pathogenesis of high blood pressure (BP) which was declared as the seventh principal cause of death around the globe, responsible for around 1.65 million mortalities annually [2, 3]. As described by the World Health Organization (WHO) [4], excessive salt consumption further enhances the risk of other leading causes of morbidity and mortality including stroke, cardiovascular diseases, diabetes mellitus, dyslipidemia, chronic kidney diseases, osteoporosis, gastric cancer and obesity [5-10].

World health organization acknowledged that high levels of sodium intake is a silent killer of people; accountable for approximately 2.3 million deaths i.e. 4% of global mortality in the year 2010 [4]. The latest guidelines by WHO suggested a maximum of 5 g\day salt intake for adults; corresponding to 2 g/day of sodium [11]. The global action plan for prevention and control of NCDs, has targeted to achieve a 25% decline in premature mortality from cardiovascular diseases, a 25% reduction in raised BP, and a 30% decrease in mean population salt intake up till 2025 [12].

By now, several countries such as Japan, Finland, and the United Kingdom have successfully decreased salt intake in their populations [10, 13]. However, it was also noticed that many nations consume more salt than what is suggested. For instance, Canadian children and adults were found to utilize approximately 3400 mg of sodium daily, far more than the Adequate Intake level (AI) i.e.1500 mg as well as Tolerable Upper Intake level (UL) i.e. 2300 mg [14] with 77% sodium obtained from prepared and packaged foods [15]. In Americans, the average sodium consumption was 3,330 mg per day in 2007-08 [16] where around 75% sodium comes from the diet having added salt such as beverages, processed and restaurant foods, [17] breads and pizzas [18], fresh meats, especially poultry and pork and injected with sodium to add moisture and weight [19]. For several other countries, specifically those from Asia, the daily sodium ingestion was more than 200mmol (12 grams/day) [20].

Several initiatives were taken to lessen the use of excessive salt. World Action on Salt and Health (WASH) was a recently formed partnership including healthcare practitioners from various countries with an objective of implementing alterations in the consumption of salt within their respective nations for reducing BP [21]. The Dietary Intervention Study of Hypertension (DISH) trial also validated that low sodium diet can contribute towards lowering BP in non-obese patients [22]. Moreover, the largest International Study on Salt and BP i.e. INTERSALT also demonstrated that sodium was significantly associated with BP [23]. Bibbins et al. determined that decline in dietary salt can considerably decrease cardiovascular problems as well as medical costs, hence should this strategy should be targeted at the level of public health primary prevention goal [24]. The American

Heart Association (AHA) also advocated for a step-wise decline in sodium intake up to 1500 mg/day in the U.S. diet by 2020 [25].

As per a meta-analysis comprising of 31 trials, decrease in sodium consumption by hypertensive patients up to 75 mmol/day; equivalent to 4g salt confirmed in an average drop of 2.7 mmHg in diastolic BP while 5.0 mmHg in systolic BP [10]. A recent study done in the United States worked on three epidemiological datasets to estimates the health benefits of controlling the community's overall salt intake which found that this reduction would result in saving approximately 280,000-500,000 of early deaths over 10 years [26]. For that, the US Food and Drug Administration is currently working with food industries by applying voluntary sodium reduction technique [27]. In addition, United Kingdom Food Standard Agency had started a campaign for voluntary reduction in salt in the food industry in 2003 which resulted in a mean drop of 7% in the populations' salt consumption [28].

Therefore, a reducing salt intake is greatly associated with a decrease in morbidity and mortality rates, which will also contribute to lower healthcare costs [11, 29, 30]. Although there are no specific salt restriction guidelines in Saudi Arabia, a study was done to suggest precise food based dietary guide for the Arabian Gulf countries including Saudi Arabia [31]. Furthermore, there are no current guidelines for salt restriction in the food industry in Saudi Arabia. To the best of our knowledge, the daily salt intake per person in Saudi Arabia has not been documented sufficiently, as no recent studies have estimated salt intake in Saudi Arabia [32, 33]. This study was designed to assess the mean salt intake of healthy individuals at King Saud bin Abdul Aziz University for Health Sciences (KSAU-HS) and compare the levels to the WHO recommended salt intake guidelines.

2. Methods

2.1 Study Design

This was a cross-sectional study.

2.2 Study setting and population

A total of 3,522 students who were 18-years-old or older studying in the campus of KSAU-HS Riyadh, Saudi Arabia were included in 2016.

2.3 Eligibility criteria

The study included all healthy students studying in KSAU-HS during 2016 and were 18 years of age or more and excluded those subjects having any medical comorbidities, such as hypertension, diabetes, kidney disease, heart disease, post-organ transplant, and pregnancy, and those who were following a special diet.

2.4 Study tool

A self-administered, electronic food frequency questionnaire (FFQ) was selected to collect data so as to approximate the daily dietary intake of healthy Saudi individuals. The language of FFQ was English and it was distributed through e-mail to the study participants.

Food-frequency questionnaire

Salt calculator questionnaire is web-based, publicly available tool to estimate the amount of salt intake [9]. The list of foods and their sodium content were adopted from a previous study that evaluated the nutritional status of Saudi Arabian people [10]. We modified the format of the questionnaire and the theme of the salt calculator to include the different Saudi food items. The food items were divided into broad groups that share similar nutritious properties, and then subdivided into categories based on similar sodium (Na^+) content. For the survey questions, the Na^+ value of each food item was added, and the mean was calculated. The questionnaire was a four-page document that consisted of two parts; a demographic section and the main research section. The demographic section consisted of six questions; covering age, gender, nationality, college, health status, and if the participant is on a special diet. The research section consisted of 55 questions on food consumption of six categories. Those were, respectively, as follow; Bakery products (9 items), processed food (5 items), cheese and dairy products (10 items), prepared meals (26 items), vegetables and fruits (3 items) and Arabian desserts (2 items). To evaluate the frequency of sodium intake, participants were asked to indicate their usual intake using 10 frequency categories ranging from never to 6+ times/day.

2.5 Pilot testing and finalization of questionnaire

The questionnaire in its final version was validated by piloting the survey to 30 students. The participants completed the questionnaire and were given instructions, not to alter their dietary habits during the validation phase. Same individuals then filled the questionnaire after one week. The average salt intake was 15 g/day (SD 7.8), which is correlated to the original FFQ (16.7 g/day). Reliability was tested through test-retest method with a mean of 16.8 g/day. The questionnaire was approved after reviewing by the King Abdullah International Medical Center (KAIMRC).

2.6 Statistical Analysis

All missing data and outliers were removed from the analysis. The data collected from the questionnaire were coded in Microsoft Excel and analyzed by the Statistical Package for Social Science version 24.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to describe the data. The main variables included age, gender, health status, and food intake frequency, and the main outcome was the approximate daily salt intake for each subject and for the whole sample. Normally distributed continuous variables (age and salt intake) were elaborated as the mean and standard deviation. Categorical variables (gender) were presented as percentages and frequencies.

A t test was used to assess the relationship between the food categories and consumption by gender. A *p*-value lesser than 0.05 was taken as statistically significant.

3. Results

In total, 319 students (9% response rate) from the KSAU-HS Riyadh campus undergraduate population (n=3522) completed the survey. The majority of the contributors were male (53.6%), while the mean age was 20.99 years (SD=2.29) between a range of 18 to 31 years. The mean salt intake was 6.76 g/day as shown in Table 1.

Table 1: Demographics of participants

Demographics		N(%) or mean ± SD
Age in years		20.99 ± 2.292
Gender	Male	148 (53.6)
	Female	171 (46.4)
Salt intake, g/day		6.76 ±3.89 g/day (range:0.89 - 23.43 g/day)

As shown in figure 1, no differences was observed between male and female subjects regarding mean salt intake (p=0.22, t test). Most frequently consumed food categories as shown in Table 2; in order are prepared meals, bakery products and cereals, and cheese and dairy products. The most regularly consumed items are burgers, chicken shawarma and sausage, bread products (samoli, Arabian, sliced white bread etc.), akawi, feta, white and sliced cheese.

Figure 1. Mean salt intake for male and female subjects for each food category

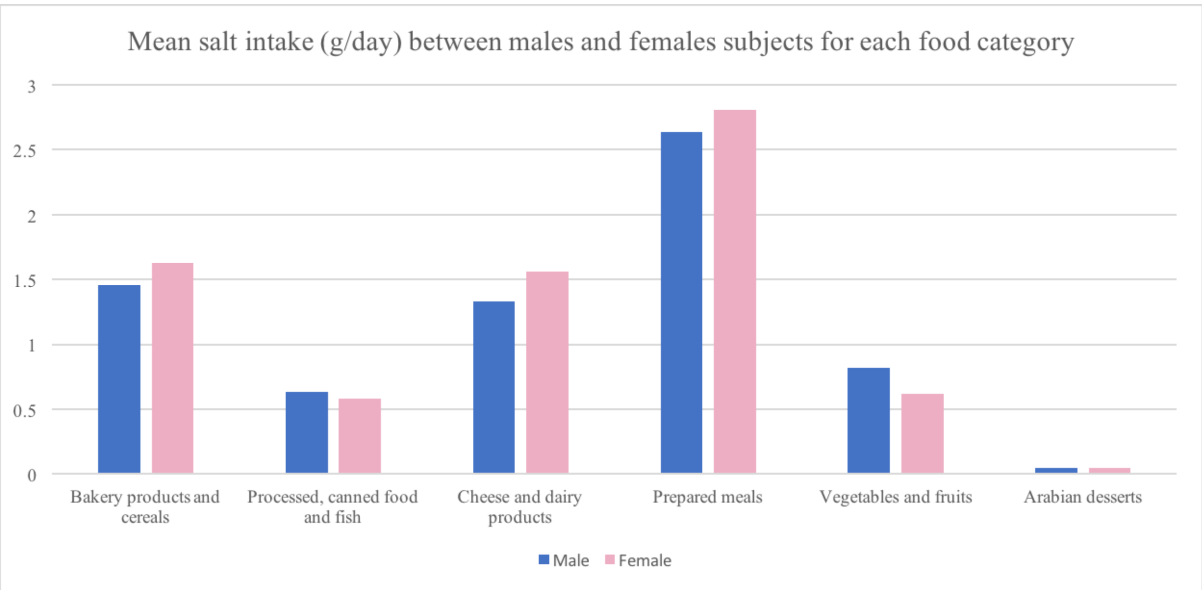

Table 2: Comparison between male and female salt intake according to food category.

Food categories	Mean± SD daily intake		*P*-value
	Male (n=148)	Female (n=171)	
Bakery products and cereals	1.46±1.13	1.63±1.53	0.241
Processed, canned food and fish	0.62±1.13	0.58±1.21	0. 763
Cheese and dairy products	1.33±1.21	1.56±1.69	0.180
Prepared meals	2.64±2.81	2.81±1.91	0. 045
Vegetables and fruits	0.82±0.99	0.62±0.84	0. 049
Arabian desserts	0.05±0.08	0.05±0.07	0. 313
Total	6.92±3.67	6.63±4.08	0.501

Although both genders consumed prepared meals the most, female subjects had a slightly higher intake than that of the male subjects (2.81± 1.91 and 2.64 ± 2.81 g/d, respectively; *p*=0.045) which is evident from Table 2. Conversely, male subjects had a slightly higher intake of vegetables and fruits than that of the female subjects (0.82±0.99 and 0.62±0.84 g/day, *p*=0.049).

Table 3: Total contribution rate of each food category and comparison between male and female contribution rate.

Food categories	Total contribution rate (%)	Contribution rate (%)	
		Male	Female
Bakery products and cereals	22.91	21.03	24.61
Processed, canned food and fish	8.88	8.99	8.79
Cheese and dairy products	21.51	19.28	23.53
Prepared meals	35.44	38.21	32.94
Vegetables and fruits	10.53	11.86	9.34
Arabian desserts	0.73	0.64	0.79

The total contribution rate of the prepared meal category was 35.44%; however, meat dishes had the most significant total contribution rate with a *p*-value of 0.024. The detailed components of the prepared meals category are presented in Table 4.

Table 4: Comparison between male and female salt intake according to each food item consumed

* Estimated sodium content adopted from Alnozha et al.

Food category	Estimated salt per meal (g/day)*	Mean±SD daily dietary salt intake (g/day) Male (n=148)	Female (n=171)	*P*-value
Bakery products and cereals				
Bread products (samoli, sliced white or brown, Arabic, mafrood, corn, millet, burr, Turkish, and fateet)	0.33	0.536±0.299	0.565±0.397	0.857
Tamees	0.79	0.117±0.245	0.149±0.376	0.816
Tannouri	0.083	0.057±0.02	0.06±0.038	0.397
Cakes	0.25	0.046±0.078	0.068±0.171	0.757
Sponge cake and donuts	0.066	0.01±0.01	0.011±0.021	0.686
Biscuits	0.403	0.216±0.28	0.197±0.297	0.207
Fatayer	0.48	0.147±0.245	0.178±0.279	0.680
Breakfast cereals	1.16	0.318±0.801	0.384±0.959	0.981
Corn puffs	0.45	0.058±0.222	0.069±0.290	0.442
Processed, canned food and fish				
Canned tuna\sardines in oil	0.47	0.085±0.194	0.068±0.170	0.200
Sardine in tomato sauce	0.7	0.023±0.101	0.26±0.121	0.620
Grilled fish	0.52	0.086±0.349	0.071±0.321	0.075
Fried fish	0.15	0.008±0.024	0.071±0.022	0.068
Shrimps	3.84	0.417±0.967	0.409±1.05	0.052
Cheese and dairy products				
Cheese (Egyptian, double cream\processed, mozzarella)	0.36	0.342±0.398	0.370±0.443	0.918
Akawi, feta, white or sliced cheese	1.23	0.401±0.611	0.590±0.936	0.211
Processed cheese or Bulgarian cheese	1.23	0.328±0.699	0.347±0.907	0.331
Cheddar cheese	0.058	0.023±0.481	0.015±0.034	0.516
Milk (whole fat, low fat, with chocolate, skimmed, camel)	0.064	0.057±0.068	0.058±0.076	0.635
Laban	0.046	0.021±0.04	0.015±0.027	0.055
Powder milk	0.47	0.097±0.281	0.094±0.229	0.157
Evaporated or condensed milk	0.012	0.021±0.048	0.028±0.085	0.685
Flavored yogurt or labnah	0.077	0.034±0.066	0.033±0.073	0.548
Plain yogurt	0.016	0.006±0.011	0.005±0.009	0.406
Prepared meals				
Rice (except: mandi rice)	0.31	0.23±0.252	0.226±0.291	0.363
Mandi rice	0.019	0± 0.0	0±0.0	0.753
Pasta	0.29	0±0.15	0.067±0.183	0.770
Pizza	0.44	0.084±0.124	0.071±0.109	0.155
Cooked potatoes	0.01	0±0.0	0 ±0.0	0.188
Chicken (roasted and boiled)	0.077	0.08±0.08	0.078±0.091	0.272
Meat beef or lamb (boiled, grilled, fried)	0.06	0.02±0.024	0.016±0.025	**0.024***
Grilled chicken or mandi meat	0.041	0.183±0.316	0.134±0.229	0.094
Liver (kebdah\kabdah)	0.019	0.02±0.044	0.024±0.054	0.792
Muttabaq with eggs, boiled eggs, or fried eggs	0.22	0.426±0.105	0.03±0.068	0.418
Shakshoukah, or egg omelette	1.53	0.282±0.576	0.24±0.458	0.174
Kubbah, manto, yagmoush, or sambosah with meat	0.39	0.05±0.199	0.027±0.064	0.473
Sambousah with cheese	0.67	0.061±0.165	0.064±0.167	0.675
Burger, chicken shawerma, or sausage	0.71	0.262±0.368	0.236±0.541	0.158
Sandwiches (cheese, meat, chicken, liver, boiled egg, shakshoukah, kidney, mixed beef shawerma	0.312	0.208±0.302	0.164±0.229	0.246
Any of mtaziz, qursan, saleeq, harees, marqooq, jereesh, fattah, mulokhiyah, or moussaqaa	0.22	0.044±0.087	0.0345±0.059	0.778
Bamyah (okra)	0.06	0±0.01	0±0.01	0.960
Stuffed (mahshi) tomato, squash, or red pepper	0.72	0.058±0.123	0.07±0.171	0.748
Stuffed grape leaf (waraq einab)	0.59	0.05±0.104	0.077±0.151	0.181

Foul medammes or falafel	1.23	0.2±0.433	0.143±0.261	0.086
Lentil soup (adas)	1.36	0.18±0.541	0.12±0.275	0.615
Oatmeal soup	0.22	0.034±0.096	0.015±0.043	0.076
Vegetables soup	0.71	0±0.02	0±0.01	0.911
Green olives	2.02	0.373±1.185	0.24±0.58	0.756
Jam or tahini	0.04	0.08±0.01	0±0.01	0.531
Pickles, tomato sauce or hummus	0.04	0.081±0.182	0.078±0.141	0.568
Vegetables and fruits				
Any of lettuce, cucumber, tomato, onions, or carrots	0.031	0.39±0.046	0.034±0.044	0.094
Any of orange, apples, or pears	0.005	0.00±0.00	0.00±0.00	0.208
Green salad	0.88	0.377±0.963	0.581±0.803	**0.028***
Arabian desserts				
Klaijah, kunafah (cheese, or nuts), jelly, luqaimat, or kustard	0.044	0.017±0.041	0.016±0.039	0.358
Any of marassia, basbousah, kunafah (crème), baqlawah, mutabaq banana, aseeda, henaini, or muhalabiah	0.192	0.027±0.06	0.037±0.062	**0.014***

While comparing the intake of salt between male and females; as per each food item utilized, it was noticed that significant differences were found for Meat beef or lamb whether boiled, grilled or fried (p=0.024), Green salad (p=0.028), Arabian desserts including marassia, basbousah, kunafah, baqlawah, mutabaq banana, aseeda, henaini, or muhalabiah (*p*=0.014).

4. Discussion

The findings of the present study show that the mean age of the study participants was 20.99 years. Females showed higher intake of salt whereas males consumed more fruits and vegetables. However, food categories that were most frequently consumed included burgers, sausage, chicken shawarma and bakery products, prepared meals, cereals, dairy products and cheese. Most of the respondents had a high intake of salt averaging up to 6.76 g/day which was similar to that of the mean salt intake (6.79 g/day) of a study conducted in the eastern region of Saudi Arabia [33] but greater then India i.e. >5 g/day [34] and less than the mean salt intake of a study conducted in Australia (8-9 g/day), Italy (8.3-10 g/day), and Czech Republic (10-16.5 g/day) [30]. This result is however similar to the results of other studies on different populations around the world that also found individual daily salt intake to exceed the WHO recommended value [6, 11, 35].

Several other studies were also conducted that focused on University staff, similar to our study setting and age group. However, literature showed only a small number of known tools that were available for screening individuals providing personalized knowledge about sodium content in the diet. For the sake of assessing daily sodium ingestion, the University of Toronto designed a web-based sodium consumption screening tool known as the Salt Calculator was developed by to assess daily salt intake [36]. Similarly, Tasnim and colleagues evaluated individuals from University of Jordan between 20 to 40 years of age. They used three-day food record and then analyzed food for sodium. Findings indicated that the intake of sodium was around 5176 ± 2,841 mg which was more than AI limits. The main foods that were considered as sources for high sodium included table salt, fast foods, sandwiches and Jordanian bread [37].

Mondal and team [38] studied the dietary and salt intake patterns of 280 Bangladeshi undergraduate medical and nonmedical students by carrying out a cross sectional survey in which a semi-structured form was used for collecting data; with the help of WHO Modified Salt Module of STEPS Questionnaire. Similar to the present study, male predominance was seen in the sample and the mean age was 22.0±2.0. Nearly 64.3% medical students were taking added salt in their meal in comparison to 71.4% nonmedical students. In our study, the difference in consumption of the prepared meals, vegetable, and fruit categories was statistically significant between male and female subjects. Though, this difference may not be clinically significant and should be further explored using the 24-hour urine collection method, a gold standard for measuring salt intake per day [39-40].

Another cross-sectional study involving 72 undergraduates from different universities of Asuncion measured BP and also examined urinary sodium excretion in a sample of 24-hour urine. Among study participants, 48.6% were females and 51.3% were male between 22 to 30 years of age and a mean age of 25.3 years; similar to the present study. Only 7% of the total sample consumed lesser than the suggested upper limit of 5 g/day whereas 10% had a salt intake of extreme quantities i.e. more than 14 g per day. Therefore, the daily average salt intake was 9.4 grams. The food item contributing to this increased salt intake was red meat (5 times/week) while low sodium items i.e. fruits, and vegetables were used in smaller quantities; likely because they were comparatively expensive. The study also found no significant association between excretion of sodium in urine and BP [41] though this association was not studied in the present study.

4.1 Limitations and Recommendations

The original data of food salt content was obtained from an unpublished research. In addition, the original food salt content data was obtained from an old research done in 1991 which may not reflect the current actual salt content in food nowadays. Using a dietary questionnaire to estimate daily salt intake is susceptible to several limitations, including recall bias, variation of amount of sodium in common foods, lack of information regarding the addition of salt in cooking or serving, and the imprecision of portion size [39,40,42, 43]. Since the questionnaire attempted to cover an individual's every dietary aspect, completion of the questionnaire took longer than 10 minutes. This time factor is considered a limitation because it significantly lowered the expected response rate. Further, the questionnaire was distributed to the study population via e-mail, which is a method known to have a low response rate. In addition, results of this study provide insight into the salt consumption habits of only a chosen sample within Riyadh City.

Consequently, by measuring the salt intake of this particular population, the study can only offer approximate knowledge on the salt intake status of Saudi Arabia's central region. Therefore, findings from the present study can add into the existing pool of data regarding the habit of salt utilization among young adults. Thus, future studies are needed to provide general estimates of the whole population and to evaluate and develop nutritional strategies specific to the general Saudi Arabian population. Apart from this, longitudinal studies are required that can reflect the relationship between BP and salt intake; so as to design national level policies to control its excessive ingestion.

5. Conclusions and Implications

The amount of dietary salt intake among healthy Saudi individuals in KSAU-HS exceeds the WHO recommended daily value. Therefore, this study highlights the necessity of monitoring and decreasing individuals' daily salt intake through further researches, which in turn will reduce an important risk factor of common NCDs within the Saudi community. Thus, increasing population awareness and implementing nutritional guidelines should be adopted promptly to improve the dietary habits of the population and food industry to prevent and lower the incidence of the adverse health effects associated with high salt intake.

6. Conflict of interest

All authors reviewed and agreed for the final manuscript and have no competing interests

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