

The Complex Role of Cognitive and Behavioral Factors in Salt Intake Levels of Women

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Background: High salt intake is responsible for some serious health consequences. This study aims to investigate the interrelationship between salt intake cognitive and behavioral factors and urinary sodium excretion levels in women.

Methods: A descriptive analytical cross-sectional study was conducted in two residential complexes in Ahvaz city, Iran. 260 female participants were selected using systematic random sampling. Data on salt-related cognitive factors, including knowledge, perceived susceptibility, perceived severity, attitude, intention, self-efficacy, and behavior, were collected using a validated questionnaire. To determine true salt intake, 24-hour urinary sodium excretion level was measured. Data was analyzed using Pearson correlation, one-way Anova, and linear regression tests.

Results: 81.2% of the participants' salt intake was higher than the WHO recommended value (5 grams/day). A significant relationship between sodium excretion level and knowledge ($r = -0.332$, $p < 0.001$), attitude ($r = -0.144$, $p = 0.02$), behavior ($r = -0.130$, $p = 0.036$), and perceived severity ($r = -0.135$, $p = 0.03$) was found. An R^2 of 0.134 demonstrates a 13.4% variation in urinary sodium excretion, associated with knowledge and perceived severity.

Conclusion: Future interventions should aim to improve all the salt-related cognitive factors with placing an emphasis on increasing salt-related knowledge and perceived severity.

Key Words: Salt intake, Urinary sodium excretion, Cognitive factors

INTRODUCTION

With 17 million attributable deaths per year, Coronary Heart Disease (CHD), is the leading cause of mortality in

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the world [1]. The most important modifiable risk factor for CHD is hypertension [2] and the main behavioral risk factor for hypertension is high salt intake [3]. Studies show that 30% of hypertension is attributable to the salt content in food [4]. High salt intake may also lead to increased risk of other non-communicable diseases (NCDs) such as obesity, chronic kidney disease, kidney stones, osteoporosis, gastric cancer, severity of asthma, and obesity [5-8]. In 2010, 1.65 million deaths were attributable to high salt intake, globally [9]. Reducing salt intake at the population level is considered to be one of the most cost-effective and efficient public health interventions to reduce morbidity and death from NCDs [10].

In most countries, mean salt intakes are approximately 9-12 grams/day, but in the majority of Asian countries this estimate increases to more than 12 grams/day [11]. Both of these estimates, are well above the World Health Organization's (WHO) recommended salt intake of 5 grams/day (equal to approximately 2 grams sodium) [11]. In Iran, increased sodium consumption fits within this trend, with an estimated mean salt intake is 9.52 grams/day in the country [12].

Salt is consumed in different ways, ranging from adding salt while cooking and at the table, to consuming ready-to-eat foods, snacks, and beverages. Increasingly, individuals may try to control their salt consumption in their everyday lives, by incorporating salt reduction strategies, such as daily consumption monitoring and reading food labels. Therefore, five key salt consumption behaviors can be considered in general: adding salt while cooking, adding salt at the table, consuming high salt food products, calculating daily salt intake, and reading food labels.

Correctly identifying key behavioral and cognitive determinants or factors of sodium/salt intake levels, could help increasing the cost-effectiveness of salt reduction campaigns. The aim of this study was to (1) estimate the actual salt intake/urinary sodium excretion level, and (2) explore the inter-correlation of a set of cognitive and behavioral factors related to salt intake: salt-related knowledge, attitude, perceived susceptibility, perceived severity, self-efficacy, intention, and behavior, as well as their correlation with actual salt intake/urinary sodium excretion level measured using a 24-hour urinary test. This study is the first phase of an interventional study to reduce salt intake in two residential complexes in Ahvaz city, Iran.

Accurate measurement and monitoring of population salt intake are critical for developing, implementing, and evaluating population salt reduction interventions [13]. Different methods are available for monitoring and estimating salt intake, including, indirect estimation through dietary assessments and behavior surveys, and direct estimation through laboratory tests that measure sodium levels in urine as a biomarker [13]. Measuring sodium in 24-hour urine collection is known as the gold standard assessment of salt intake [14], but is not always practical as resources are limited in samples at the population level.

MATERIALS AND METHODS

A descriptive analytical cross-sectional study was conducted among urban women living in two residential complexes owned by the Iran National Oil Company in Ahwaz city, the capital of the Khuzestan province in the Southwest of Iran. Households had similar economic and environmental conditions. However, as inhabitants were originally from different regions in Iran, a large dietary and cultural diversity was present within these two complexes, making this a suitable sample for our study.

Regarding a previous study in Iran [15] in which standard deviation (SD) in a two continued measuring were 7.68 and 6.82, with confidence level of 95%, and statistical power of 90%, to reach 1 unit difference in salt intake after the intervention, the least sample size was estimated 100 for each residential complex. In each complex, 130 households were selected using systematic random sampling. A woman in each household, who was responsible for the family food shopping and cooking, was chosen to participate in the study in case of her informed consent. Women are usually the ones who bring the nutritional messages to the table and are in a position to make changes in family nutrition and nutrition habits [16]. The study sample included 260 people. According to the WHO Protocol for Population Level Sodium Determination in 24-hour urine samples [13], a representative sample of 120 to 240 individuals is needed to estimate population-level sodium intake. Exclusion criteria included: pregnancy, dietary restrictions, or a diagnosis of any sodium-related disease, heart disease, hypertension, or diabetes.

A comprehensive literature review on influential factors of salt intake [17-21], as well as analysis of relevant questionnaires [22,23] were used to develop the first draft of the questionnaire, including 30 questions. Content and face validity investigated by estimating Content Validity Index (CVI) and Content Validity Rate (CVR), and Item Impact Score respectively. Also, reliability investigated by doing test-retest and estimating Interclass Correlation Coefficient (ICC). The final questionnaire comprised of 26 questions including: four questions on demographics, four on salt-related knowledge, five on attitude, one on perceived susceptibility, one on perceived severity, three on self-efficacy,

three related to intention and five behavior-based questions related to salt intake. The researcher team completed the questionnaires during individual interviews within each household.

To estimate salt consumption, urinary sodium level was measured through a 24-hour urine test. Participants were provided with a special urine container and instructed how to collect their 24-hour urine samples appropriately. A mutually agreed upon date was set to ensure that the participant could stay at home and access the urine sample container to complete the urinary collection effectively. After this period, the sample was promptly collected by the research team and delivered to the laboratory. If a urine sample contained less than 250 mL urine [13], it was excluded and the participant were asked to conduct the test again. Sodium levels of urine samples were calculated using flame-photometry method [24]. Daily salt intake of each participant was estimated based on their sodium urinary excretion level, considering that salt is made of 40% sodium and 60% chloride [25].

Data collected from the survey was analyzed using SPSS software Edition 16. Statistical tests, including a Pearson correlation, one-way Anova, and linear regression analysis, were conducted to investigate the relationship between urinary sodium level and cognitive and behavioral factors. Level of 0.05 was used to determine statistical significance.

RESULTS

Mean age of the participants was 36.99 ± 11.96 years (ranging from 18-66 years). In Table 1 participants' demographic characteristics are presented.

1. 24-hour urinary sodium excretion/salt intake level

The mean 24-hour urinary sodium excretion was 3029.23 ± 1295.31 mg/lit/day (minimum and maximum, 897 and 6969, respectively). The estimated mean salt intake was 8350.58 ± 3624.43 mg/day (minimum and maximum, 2492.22 and 19358.33, respectively). Approximately 81.2% of the participants consumed more salt than the international recommended maximum level of 5 grams/day.

2. Salt-related cognitive and behavioral factors

The mean total obtained scores of salt-related cognitive and behavioral questions was 25.86 out of 59 (minimum and maximum, 12 and 41, respectively).

While only 28% of participants were aware of recommended maximum level of salt intake (5 grams/day), more than half of the participants believed that their daily salt intake was within the acceptable range. The majority of participants were aware of some health consequences related to high salt intake, mainly hypertension. 55% of participants had no idea about the usefulness of checking food labels for salt content. The majority of participants believed that high salt intake was harmful for health.

About 70% of participants perceived their salt intake levels to be harmless. Of participants who thought that their salt consumption levels may hurt their health, only 5.8% believed that this harm was serious. In terms of salt reduction strategies, 46.5% of participants noted that they could add less salt while cooking, 54.6% stated that they could buy low-sodium food products, and 26.5% said they could refuse to add salt at the table.

55% of participants expressed an intention to not to add salt while cooking. 23.8% expressed a similar intention to

Table 1. Participants' demographic characteristics (N = 260)

Variable	Number (%)
Age group	
18-29 years	68 (26.2)
30-39 years	81 (31.2)
40-49 years	63 (24.2)
50-59 years	15 (5.8)
60-69 years	21 (8.1)
No response	12 (4.6)
Ethnicity	
Arab	69 (26.5)
Bakhtiari*	154 (59.2)
Other	37 (14.2)
Education qualification	
High school and less	58 (22.3)
Bachelor	180 (69.2)
Post graduated	22 (8.5)
Employing status	
Employed	151 (58.1)
Unemployed	109 (41.9)

*One of the major ethnicities in Ahwaz city, Iran.

not to add salt at the table and 41.5% of participants intended to buy low-salt food products.

86.5% of participants said that they always add salt while cooking. An additional 41.2% add salt at the table while eating meals. Among participants 47.3% consumed pre-packaged food, food prepared at a restaurant or 'fast food' from a takeaway shop. A reported 92.3% of participants never calculated their daily salt intake value and 80.8% of participants never checked food labels for salt or sodium content while shopping.

3. Correlation between urinary sodium excretion level and cognitive, behavioral and demographic factors

A Pearson correlation showed that questions of knowledge, attitude, perception, intention and behavior did not have a significant relationship with urinary sodium excretion. There was a significant association between urinary sodium excretion level and knowledge ($r = -0.332$, $p < 0.001$), attitude ($r = -0.144$, $p = 0.02$), behavior ($r = -0.130$, $p = 0.036$), and perceived severity ($r = -0.135$, $p = 0.03$). The higher were these factors in participants, the lower was their sodium excretion level in their urine sample. Sodium excretion level had no significant association with self-efficacy ($r = -0.093$, $p = 0.134$), intention ($r = -0.064$, $p = 0.303$), and perceived susceptibility ($r = -0.03$, $p = 0.629$). A one-way Anova test showed that there was not a significant relationship between sodium excretion level and age, ethnicity, or education level.

4. Correlation between cognitive, behavioral and demographic factors

As portrayed in Table 2, data analysis showed some correlation between studied salt-related cognitive, behavioral and demographic factors. Salt-related knowledge and attitude had no statistically significant relationship with education level, ethnicity, or age. Salt-related behavior was positively correlated to salt-related knowledge ($r = 0.155$, $p = 0.012$), positive attitude ($r = 0.137$, $p = 0.027$) and perceived severity ($r = 0.131$, $p = 0.034$). No significant correlation was seen between intention and behavior ($r = 0.104$, $p = 0.093$) (Table 3). None of any single question of the cognitive and behavioral factors had significant relationship with urinary sodium level.

The one-way Anova test showed that a significant relationship between salt-related behavior was significantly better among younger participants (7.22 ± 2.32 vs. 5 ± 3.24 , $p = 0.021$), but there was no significant relationship between salt-related behavior and ethnicity ($p = 0.993$) or ed-

Table 3. Results of stepwise multiple linear regression for assessing the concurrent effect of cognitive factors on urinary sodium excretion

Variable	Est	SE	p-value
Knowledge	-354.65	60.53	< 0.001
Perceived severity	-223.85	84.7	0.009
$R^2 = 0.134$			

R^2 : the coefficient of determination, is the proportion of the variation in the dependent variable that is predictable from the independent variable.

Table 2. Correlation coefficients between cognitive and behavioral factors

	Attitude	Perceived susceptibility	Perceived severity	Self-efficacy	Intention	Behavior	Urinary sodium
Knowledge	.239*	-.058	-.055	.119	.169*	.155**	-0.332
Attitude		.142**	.031	.193*	.352*	.137**	-0.144
Perceived susceptibility			.351*	-.091	-.036	.010	-0.03
Perceived severity				-.089	.155**	.131**	-0.135
Self-efficacy					.569*	.006	-0.093
Intention						.104	-0.064
Behavior							-0.13**

*Correlation is significant at the 0.01 level.

**Correlation is significant at the 0.05 level.

education level ($p = 0.604$).

In the first stage of a stepwise multiple linear regression analysis, the knowledge variable was included ($p < 0.001$). In the second stage the perceived severity variable was added to the initial method ($p = 0.009$) (Table 3).

The R^2 (Coefficient of Determination) of 0.134 shows that about 13.4% of variation in urinary sodium excretion can be described by knowledge and perceived severity.

DISCUSSION

This study utilized the golden, but most expensive method of estimating salt intake. It showed that more than 80% of the study's population consume high levels of salt daily. The mean daily salt intake estimated in this study was 8.35 grams (8350 mg), which is higher than the WHO's maximum recommended value of 5 grams/day. Other studies in Iran, also found salt intake levels above 5 grams/day [12,26-29]. Some studies even estimate that daily salt intake is as high as 9.52 grams/day in Iran [12], double the maximum healthy intake level. These studies demonstrate the urgency to identify and address the key determinants of salt intake in Iran. Addressing high salt consumption is vital as cardiovascular diseases (CVDs) is the leading cause of mortality in Iran [12]. Prevalence of hypertension in Ahvaz city and the Khuzestan province, has been reported at 25% (20.05-30) [12].

Knowledge about the relationship between salt and its health consequences (mainly hypertension) was good similar to studies in other countries [30]. But there was a gap between salt-related behavior and knowledge, risk-related perceptions, and beliefs. For example, while many participants believed that reading food labels is useful, they did not report reading labels more frequently. Furthermore, while more than 80% of participants consumed high levels of salt, more than 50% of participants believed their salt intake was within a healthy range. Even, of those participants who were not aware of recommended maximum levels of salt intake, more than half believed their daily salt intake was at an acceptable level. Similar findings have been reported in other studies [19,20,31]. People have difficulty correctly estimating how much salt they consume daily as their diet is composed of different sources of salt. Furthermore, without

apparent clinical symptoms and disease, people will remain unaware of their actual salt intake, continuing their unhealthy behavior without knowing its associated risks.

Since most of the participants do not know that there are no differences between sea salt and common salt for their health consequences, considering emerging interest toward natural substances beside unrealistic commercial advertisements in the local market about health benefits of sea salt, they consumed sea salt unlimitedly believing it is good for their health.

Adding salt while cooking, similar to some other low and middle income countries [32], was the main source of salt intake in the target population. Although consuming pre-packaged food or fast food is quite low in the city compared to the rest of the country [12], an increasing trend of consuming fast food and nutrition transition nationwide is apparent [33-35], indicating that salt intake level in the target population will continue to increase in the future if action is not taken.

This study examined the link between several individual demographic, cognitive and behavioral factors with true salt intake levels. Although many individual and environmental factors influence on salt intake, their link with salt consumption is rather complex. Four factors were identified in this study to have significant relationship with salt intake: knowledge, attitude, and behavior, similar to other studies [18,30,36,37], and also, perceived severity. But salt intake levels had no significant relationship with any single questions of the cognitive and behavioral factors, amongst them, none of any single question of the four significant factors. It can be concluded that it is the combination of the factors which determine the levels of salt intake (Fig. 1). It also shows that, without having detailed knowledge, a general knowledge with appropriate risk perception can also lead to a Better health status, as it triggers incentive to avoid threat and conduct protective behavior [38]. Additionally, none of the five behaviors as a single behavior were correlated to salt intake levels significantly. However, their combination or aggregated value was influential.

Influencing factors of salt-related behavior and salt intake level were similar except for age which had significant impact on behavior but not on salt intake level. Like other studies [18,22,37], higher scores of knowledge and attitude

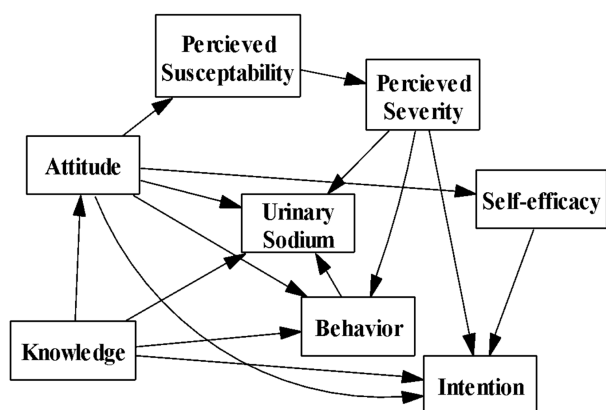


Fig. 1. Complex effect diagram of cognitive and behavioral determinants of salt intake.

were associated with more desirable salt-related behaviors.

None of the demographic factors had significant influence on salt intake levels. One possible explanation, as discussed before, is the complexity of interaction between multiple factors for determining salt intake levels. Some factors might reduce, increase, or neutralize the impact of other factors. For example, the impact of intention to consume less salt might be prevented by absence of opportunity to make healthy decision, forgetfulness, craving a salty snack, or a disposition to eat salty food as a result of high exposure to cheap salty food products. Alternatively, the high perceived susceptibility of the consequences of high salt intake levels cannot prevent salt consumption, if not accompanied by high perceived severity of the consequences.

Due to sodium excretion fluctuations in different days and/or different people, estimating sodium excretion based on one-day sample, may have bias. Still, 24-hour urine test is the most effective method to estimate population mean salt intake [13] which is used in this study. Also, the result may not be generalizable to all population groups.

CONCLUSION

Considering high salt consumption of the population in this study, taking effective actions is needed to reduce salt intake. Although knowledge and perceived severity are shown to be the most influential variables on salt intake in this study, a complex role of cognitive and behavioral factors in determining true salt intake levels also should be

considered. Future interventions should aim to improve all the cognitive and behavioral factors with placing an emphasis on increasing salt-related knowledge and perceived severity at the population level.

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