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Salt Intake and Knowledge of Salt Intake in a Chinese Population: A Cross-sectional Study

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Abstract

Consuming too much salt greatly increases the risk of heart disease and stroke, and limited studies focused on knowledge of salt intake in relation to salt consumption. Our study aimed to investigate salt intake and knowledge of salt intake in a Chinese population. Altogether 42114 adults aged 18 years and above were selected by multi-stage cluster sampling method. Salt consumption and knowledge of salt intake were assessed by self-reported questionnaire. The average salt intake was 15.5 ± 11.9 g/d, and 85.2% of subjects with excessive salt intake. Almost 80% of dietary salt came from salt, followed by salty vegetable (13.5%) and soy sauce (3.3%). There were 28.3% participants knowing the National recommended salt intake, and 29.7% with knowledge of excess salt intake resulting in hypertension. Overall 57.6% participants had ever been received health education on low-salt diet. After adjustment of confounders, subjects without knowledge of salt intake had a higher risk of excessive salt intake. Salt intake is high in the Chinese population. Awareness of salt intake is low, and it is inappropriate with current health education.

Keywords: Salt intake; Knowledge of salt intake; Recommended salt intake; Health education; Cross-sectional study

Introduction

World Health Organization (WHO) recommends 2 g sodium/day (equivalent to 5 g salt/day) for adults [1]. However, population around world usually consumes much more than the current recommendation [2-5]. Consuming too much salt is one of the presumed causative factors of hypertension [6], and greatly increases the risk of heart disease and stroke [7]. Estimated 1.65 million deaths from cardiovascular worldwide in 2010 were attributable to excess sodium consumption [6]. Reducing population salt intake is one of the easiest, more efficient and cost-effective ways to lower blood pressure, reduce the burden of cardiovascular diseases and save health care costs [2,8,9]. Therefore, WHO calls for a 30% relative reduction in mean population intake of salt/sodium, one of the strategies for prevention and control of non-communicable diseases [10].

Hypertension is the leading preventable risk factor for death among adults 40 years of age and above in China [11]. China already has 177 million adults with hypertension [6], and total mortality was 48% higher among hypertensive patients than those without hypertension [11]. The three leading causes of death (diseases of the heart, malignant neoplasms, and cerebrovascular disease) account for 66% of deaths from all causes.

As one of the countries with the highest salt consumption in the world, the average daily salt intake for a reference adult male (aged 18 years with a light level of physical activity) was 12 g per day in Chinese adults using dietary survey in 2002 [12], twice that recommended by the China Nutrition Association in 2011 [13]. Most dietary sodium came from salt and high-salt condiments added during cooking [14,15]. In addition, salt intake is higher in North part of China than that of South counter parts [12]. Xuzhou City is one of the thirteen cities in Jiangsu Province, eastern part of China. While, dietary habit among Xuzhou residents is more likely the same as North part of China, such as Shandong, where study found a higher salt intake of 13.9 g/d, estimated from 24 h urinary sodium excretion [16].

Although relationship of excess salt intake and health is concerned globally, limited studies focused on knowledge of salt intake. The main objectives of the study were to assess salt intake among Xuzhou residents, and the proportion of excess consumption of salt in the city. The survey also assessed the knowledge related to salt intake, and the association between the knowledge and excess salt intake.

Material and Methods

Sampling

The study was conducted from March to November in 2012, and the subjects were selected with probability proportional to size from all of the eleven regions in Xuzhou city. In the first stage, five sub-districts/townships in urban/rural areas were selected from each region/county. In the second stage, two communities/villages were selected from each sub-district/township. In the final stage, one person at least 18 years old who has lived in their current residence for at least five years was selected as participant from each household using a Kish selection table [17]. Written consents were obtained from all the participants. The study was approved by the Human Investigation Review Committee at Xuzhou Centre for Disease Control and Prevention.

Salt intake

A validated Food Frequency Questionnaire (FFQ) [18] was used to collect information on salt intake from condiments, including salt, monosodium glutamate, soy sauce, other sauce, and salted vegetables, and members of a household for meals at home over the past month. The five condiments were then calculated to salt intake per month by the household according to the food composition tables. Individual salt intake was calculated with salt intake per month per household divided by members of the household based on the participant's food consumption at home. The salt intake was then categorized into two groups with normal (≤6 g/d) and excessive (>6 g/d) salt intake.

Knowledge of salt intake

Salt intake related knowledge included three questions. "Do you know the National recommended Salt intake?", "Do you know excess salt intake results in hypertension?" and "Have you ever been received health education on low-salt diet?" Positive answers were categorized as having knowledge or education.

Other information

A standard questionnaire was administered by trained investigators to obtain information on demographic characteristics, diseases history and family diseases history of selected Non-Communicable Chronic Diseases (NCDs), cigarette smoking, and alcohol drinking. Subjects who had been diagnosed hypertension, cardiovascular disease, stroke or diabetes by hospital of township level and above was defined as history of NCDs. Of the selected NCDs, hypertension was defined as having been diagnosed hypertension with treatment, or field measurement of SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg [19]. Diabetes was defined as having been diagnosed diabetes with treatment, or field measurement of fast glucose ≥ 7.0 mmol/L [20]. Other selected NCDs were self-reported. Family history of NCDs was defined as having hypertension, cardiovascular, stroke and diabetes in first degree relatives.

In all participants, height, weight, waist circumferences were measured by standard methods. Body mass index (BMI) was calculated as weight in kilograms divided by height in squared meters. Subjects were classified into BMI categories as underweight (BMI<18.5 kg/m^2), normal weight (BMI>18.5 kg/m^2<24 kg/m^2), overweight (BMI≥24 kg/m^2<28 kg/m^2) and obese (BMI≥28 kg/m^2) according to Chinese standards. Abdominal obesity was defined as waist circumference≥85 cm in males or ≥80 cm in females [21].

Statistical analysis

Variables were presented as percentage or mean ± standard deviation (SD). Chi-square test was used to determine subgroup differences for salt intake and knowledge of salt intake, respectively. Logistic regression analysis was performed using SPSS 18.0 to analyse relationship between knowledge of salt intake and salt intake adjustment by age, gender, educational level, BMI, central obesity, NCD history and family history of NCD. Statistical significance was set at α=0.05.

Results

Overall 43285 residents aged 18 years old and above were interviewed, and 42114 were included in the study after excluding those with incomplete questionnaire. The responsible rate was 97.3%. The sex ratio was 0.93 (20340/21774). Among them, 27.7% were urban residents and 72.3% were rural counterparts. The educational level in most subjects was middle school and below. The prevalence of central obesity and overweight/obesity was 40.4% and 43.9% respectively. There were 26.0% of subjects with diagnosed NCDs and 25.1% with family history of NCDs.

The average salt intake was 15.5 ± 11.9g/d, and 85.2% of subjects with excessive salt intake. Rural residents and those with central obesity and with family of NCDs had a higher prevalence of excessive salt intake than their counterparts, respectively. The prevalence increased with age, BMI, and low educational level. There was no difference between male and female, those with or without NCD history. With respect to the sources of salt intake, 79.2% came from salt, followed by salty vegetable (13.5%), soy sauce (3.3%), monosodium glutamate (2.0%) and other sauce (2.0%).

There were 28.3% participants knowing the National recommended salt intake, and 29.7% with knowledge of excess salt intake resulting in hypertension. Overall 57.6% participants had ever been received health education on low-salt diet. Salt intake related knowledge by demographic characteristics was presented in Tables 1 and 2. Female, urban residents and those with central obesity and high educational level had a higher prevalence with the knowledge related to salt intake.

Subjects without knowledge of salt intake had a significant higher prevalence of excessive than those with knowledge. After adjustment of confounders, subjects without knowledge of salt intake had a higher risk of excessive salt intake (Table 3).

Variables		n	% of excessive salt intake	OR	95%CI
Gender	Male	20340	85.5	1	
	Female	21774	84.9	0.95	0.89-1.02
Residents	Urban city	11647	65.7	1	
	Rural city	30467	92.7*	5.84	5.45-6.25
Age (yrs)	18-	10923	83.8	1	
	35-	15327	85.0	1.08	1.00-1.17
	55-	13110	86.8	1.27	1.15-1.39

	75-	2754	84.4*	1.07	0.93-1.24
Educational level	High school and above	11067	74.9	1	
	Middle school	15156	86.9	1.17	1.08-1.26
	Primary school and below	15891	90.7*	1.44	1.31-1.58
Abdominal obesity	Yes	24992	84.5	1	
	No	17122	86.2*	1.13	1.05-1.21
BMI (kg/m2)	18.5	1171	84.9	1	
	18.5~23.9	22453	81.7	0.88	0.75-1.04
	≥24	14579	85.8	0.99	0.92-1.06
	≥28	3911	85.8*	0.88	0.79-0.99
NCD history	No	31168	85.3	1	
	Yes	10946	85.0	0.92	0.85-0.99
Family history of NCD	No	31545	84.1	1	
	Yes	10569	88.5*	1.34	1.24-1.44
Notes:*P<0.01, **P<0.05; NCD history was defined as subjects who had been diagnosed hypertension, cardiovascular disease, stroke or diabetes by hospital of township level and above. Abdominal obesity was defined as waist circumference ≥ 85 cm in males or ≥80 cm in females.					

Table 1: Excessive salt intake by demographic characteristics.

Variables		**Knowing the National recommended salt intake (%)**	**Knowing excess salt intake results in hypertension (%)**	**Have been receiving health education on low-salt diet (%)**
Gender	Male	27.6	28.8	54.7
	Female	29.0	30.4	60.3
Residents	Urban city	57.6	63.3	64.5
	Rural city	17.1	16.8	54.9
Age (yrs)	18-	30.1	31.8	60.4
	35-	28.2	29.4	58.1
	55-	26.4	27.3	55.9
	75-	31.0	33.9	51.6
Educational level	High school and above	46.4	49.8	65.1
	Middle school	24.4	25.3	57.8
	Primary school and below	19.5	19.8	52.2
Abdominal obesity	No	27.1	28.3	56.7
	Yes	29.2	30.6	58.2
BMI	18.5	29.3	30.6	58.0
	18.5~23.9	31.1	32.7	60.8
	≥24	27.4	28.9	56.9
	≥28	25.2	26.3	56.7

NCD history	No	28.6	29.8	57.7
	Yes	27.7	29.4	57.3
Family history of NCD	No	28.2	29.2	56.9
	Yes	28.9	31.1	59.7

Table 2: Knowledge of salt intake by demographic characteristics.

	% of excessive salt intake		OR**	95%CI
Knowledge of recommended salt intake	With	74.9	1	
	Without	89.3*	1.36	1.28-1.45
Knowledge of excess salt intake resulting hypertension	With	74.8	1	
	Without	89.6*	1.28	1.20-1.37
Ever received low-salt diet education	With	81.9	1	
	Without	89.6*	1.67	1.57-1.77

Table 3: Knowledge of salt intake and excessive salt intake.

Discussion

The physiological need for sodium intakes is 10-20mmol/day, equivalent salt intake of no more than 1 g/d. The present study indicates that salt consumption in the Chinese population is very high. It is in fact triple the recommended intake of not more than 5 g salt/day issued by WHO in 2012 [1]. As matter of fact, most adult populations have mean sodium intakes >100 mmol/day, and mean intakes are >200mmol/day for many countries (particularly the Asian countries) [2]. Salt intake was found 11.5 g/d in young Swedish men [4], 11.3 g/d in Slovene population [3], 18.01 g/day in Turkish population [22], 9.8 g/d in Spanish population [5], 7.1-10.6 g/d in Danish population [23], and 9 g/d in adults of United Kingdom (UK) and Australia is approximately 9 g/d [24] Salt intake was even high (73% of excessive intake) in children from a England report [25].

Inconsistently with European and Northern American countries, salt added at home (in cooking and at the table) and soy sauce were the largest sources in China and other Asian countries [26]. However, due to urbanization in China, there are still some possible sources of salt 'hidden' in everyday food items, such as processed foods and salt added in the preparation of meals in canteens and restaurants which have been discussed in other studies [4,24]. A previous study in a North City of China has ever reported that 38% of the total sodium intake came from processed foods and condiments in urban residents [27]. However, the proportion seemed too low for condiments. Assessment of sodium intake from processed foods is quite difficult due to different sodium content in a huge number of foods. Nevertheless, salt intake in urban residents in our study may be underestimated, which may partly explain the significant difference between urban and rural residents in our study.

Obesity subjects had a higher salt intake, consistent with other reports [4,5]. The result may indicate that persons with high body weight consume more energy and therefore had higher Na excretion. Our study further indicated that subjects with a lower educational level had a higher salt intake, which suggested social class may be a determinant for salt intake, consistent with other report [23].

Previous studies were mainly focused on hypertension in respect with knowledge of salt intake [28-30], and seldom study reported knowledge of salt intake in relation to salt consumption. A study conducted in consumers indicated that overall consumers were aware of positive relationship between high blood pressure and excessive salt consumption, but many of them were unaware of the other associated health conditions.

Most participants were unsure of the dietary recommendation for salt [24], consistent with our reports. Furthermore, the current study found a relative higher proportion of receiving health education on low-salt diet with a lower awareness of salt intake. Moreover, a lower awareness of salt intake was related to a higher salt intake. An intervention study suggested that improved salt-restriction-spoon and corresponding health education could be considered as an alternative for salt reduction strategy in China and other countries where salt intake comes mainly from home cooking [31].

Study strengths include its large sample size and high response rate. It is acknowledged that this study has a number of limitations which should be considered when interpreting the findings. Firstly, as a cross-sectional study, the main limitation is that we cannot establish a causal relationship between dietary patterns and high blood pressure. Misclassification of salt intake may have occurred, although we used a validated food frequency questionnaire in the survey. The salt intake is estimated based on household salt consumption, which may underestimate or overestimate the real intake. Urine sodium measurement may be a better method for estimation of salt intake than dietary surveys. However, it is difficult to collect urine samples in a large sample or survey. The validated food frequency questionnaire for salt intake is used widely in Chinese nutrition surveys [32], and the results could give a good estimation in a population level. Furthermore, a large sample size and a high response rate could balance the bias. Information on knowledge and lifestyle was self-

reported, which may not exclude the possibility of misclassification in a certain number of individuals.

In summary, our study found that salt intake is high in the Chinese population. Having knowledge of salt intake lowers the risk of excessive salt intake. Targeted monitoring of the sources of salt intake, especially processed food in Chinese population is further required. The findings also highlight that current health education is not enough to improve awareness of recommended salt intake and salt intake related health risks. Given excess salt intake is related with shortage of knowledge, it is recommended for development of sustainable, simplified education sessions targeted common populations and communities to raise residents' knowledge of the health risks related to excessive salt intake.

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Conflicts of Interest: All authors have read and approved the final manuscript. All authors declare no conflicts of interest.

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