

Preplanned Studies

Salt-Related Knowledge, Behaviors, and Associated Factors Among Chinese Adults — China, 2015

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Summary

What is already known about this topic?

Excessive salt intake is an important risk factor for hypertension and cardiovascular diseases (CVDs). The amount of salt intake of Chinese is one of the highest all over the world. At a national level, the awareness of maximum daily salt intake recommended by the “Dietary Guidelines of Chinese residents” had not been reported.

What is added by this report?

This is the first nationally representative study about awareness of maximum daily salt intake in China. In 2015, the awareness rate of maximum daily salt intake and behavior rate of salt reduction among Chinese adults aged 18 years old and above was 6.1% and 37.3%, respectively. The awareness rate of maximum daily salt intake and behavior rate of salt reduction was low among adult residents in China.

What are the implications for public health practice?

To increase the behavior rate of salt reduction in China, awareness of the maximum daily salt intake needs to be strengthened to Chinese residents, especially in rural areas or for people with low education levels and low incomes.

According to the 2018 Report on Cardiovascular Disease in China, hypertension and cardiovascular diseases (CVDs) were estimated to account for more than 40.0% of all deaths in China and were the leading cause of all death (1). Excessive salt intake is an important risk factor for CVDs, and China has one of the highest salt intakes in the world. According to the “National Nutrition and Health Survey of Chinese Residents,” the average salt intake among Chinese residents was 12 grams/day (g/d) in 2002 and 10.5 g/d in 2012 (2), which were both much higher than the maximum daily salt intake (6 g/d) recommended by “Dietary Guidelines for Chinese Residents”. However, most Chinese residents were still unclear about the

recommended maximum daily salt intake. The awareness of maximum daily salt intake, the salt reduction behavior, and associated factors of Chinese residents aged 18 years old and above were analyzed by using data from the China Chronic Diseases and Nutrition Surveillance (CCDNS) system in 2015 for providing the evidence and basis for the follow-up control measures of salt reduction. This study found that the awareness rate of maximum daily salt intake and the behavior rate of salt reduction of Chinese adult residents was low, and nutrition education activities and targeted interventions should be enhanced, especially in rural areas, people with low education levels and low incomes.

Cross-sectional survey data for this study was obtained from the CCDNS in 2015, which used 298 surveillance points (counties or districts) across 31 provincial-level administrative divisions (PLADs) and a multistage stratified cluster randomized sampling method to select a national representative sample of households. Eligible residents aged 18 years old and above in the selected households were invited to participate by local CDCs. In a sample of the 88,250 households, 189,605 participants completed the survey, which yielded a 95.4% family response rate and a 94.9% individual response rate. After excluding 8,701 participants with incomplete data, 180,904 participants were included in this study. The study protocol was approved by the Ethical Committee of the National Center for Chronic and Non-Communicable Disease Control and Prevention of China CDC. All participants signed informed consent.

The CCDNS included face-to-face interviews, body measurements conducted by locally-trained personnel, and blood testing in the certified laboratories. The questionnaire related to this study included demographic characteristics (gender, age, education level, income, occupation, etc.), maximum daily salt intake recommended by “Dietary Guidelines for Chinese Residents”, salt reduction behaviors, and information on chronic diseases. The awareness rate of maximum daily salt intake was defined as the

percentage of people who had heard the Dietary Guidelines for Chinese residents and could correctly answer the recommended maximum daily salt intake (6 g/d). The behavior rate of salt reduction was defined as the percentage of people self-reporting taking salt reduction measures. Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg, or those who had been diagnosed with hypertension by township (community) and above hospitals and took antihypertensive medicine in the 2 weeks before surveying.

All statistical descriptions were weighted to obtain nationally representative estimates. Population data from the National Bureau of Statistics in 2015 was used to adjust the post-stratification weights. Rao Scott chi-square test was used to compare the disordered categorical variables, and the logistic regression model was used to test the trend of ordinal categorical variables. Multivariable logistic regression models were used to explore the factors associated with being aware of maximum daily salt intake and salt reduction. All statistical analyses were performed using software SAS (version 9.4, SAS Institute, Inc. Cary, NC, USA), and $p < 0.05$ was statistically significant.

A total of 180,904 participants were included in this study, including 84,407 men and 96,497 women, 73,738 in urban areas, and 107,166 in rural areas. In 2015, the awareness rate of maximum daily salt intake among Chinese adults aged 18 years old and above overall was 6.1% (95% CI: 5.2%–6.9%), males 5.4% (95% CI: 4.7%–6.2%), females 6.7% (95% CI: 5.7%–7.7%), urban residents 9.3% (95% CI: 7.7%–10.9%), and rural residents 2.6% (95% CI: 2.2%–3.0%). The awareness rates of the 30–39 age group (7.8%, 95% CI: 6.6%–9.0%), residents of the eastern region (7.6%, 95% CI: 5.9%–9.3%), retired residents (14.3%, 95% CI: 12.3%–16.2%) and hypertension group (6.4%, 95% CI: 5.5%–7.4%) were significantly higher than those of others residents ($p < 0.001$) and tended to increase with an increase in education level, family per capita income, and high body mass index (BMI). (Table 1)

In 2015, the behavior rate of salt reduction of Chinese adult residents was overall 37.3% (95% CI: 35.5%–39.1%), males 33.8% (95% CI: 32.1%–35.4%), females 40.9% (95% CI: 38.8%–43.0%), urban residents 44.6% (95% CI: 42.4%–46.7%), and rural residents 29.7% (95% CI: 27.6%–31.7%). In males or urban areas, the behavior rate of salt reduction of the 18–29 age group was significantly lower than that of other age groups ($p < 0.001$), while in females or rural areas, there were no significant differences among

different age groups. The behavior rate of salt reduction was higher in eastern regions, retired residents, the hypertension group, and people who knew the maximum daily salt intake and increased with an increase in education level, family per capita income, and BMI. (Table 2)

Multivariate logistic regression models showed that age, sex, residential area, educational level, family per capita income, employment status, and BMI were related to the awareness of daily maximum salt intake and behavior of salt reduction. The awareness rate of daily maximum salt intake and behavior rate of salt reduction of high-income families were significantly higher than those of the low-income group, and retired people were higher than the employees. Regions and hypertension were not associated with awareness of maximum daily salt intake but were associated with salt reduction behaviors. There was a significant association between awareness of daily maximum salt intake and behavior of salt reduction (OR=3.20, 95% CI: 2.77–3.70). (Table 3)

DISCUSSION

This study showed that the awareness rate of maximum daily salt intake and behavior rate of salt reduction among adult residents in China was quite low, especially in rural areas and people with low education levels. In this study, only 6.1% of Chinese adults knew of the daily maximum salt intake, and 37.3% of Chinese adults took salt reduction measures. Previous studies have shown that reducing salt intake can decrease blood pressure, reduce the incidence of hypertension, and the burden of cardiovascular events (3). Therefore, it is necessary to take measures to increase the awareness rate of daily maximum salt intake and reduce salt intake in China.

Previous studies had shown that the awareness of daily maximum salt intake varied greatly between different countries or regions. A sample survey of 5 PLADs in rural northern China showed that 5.0% of 5,050 elderly Chinese residents knew of the daily maximum salt intake (4). Claro et al. showed that the awareness rate of daily maximum salt intake was 6.3% in Argentina and 54.1% in Canada (5). Differences in results between studies may be related to the education level and economic development in the regions and countries. This study found that social inequality had a negative impact on salt-related awareness and behavior. Awareness of maximum daily salt intake and the behavior rate of salt reduction was higher in people living in the urban areas, or with higher education

TABLE 1. Awareness rate of the maximum daily salt intake among Chinese adults aged 18 years old and above — China, 2015.

Characteristics	Total		Men		Women		Urban		Rural	
	N [†]	Prevalence/% (95% CI)	N [†]	Prevalence/% (95% CI)	N [†]	Prevalence/% (95% CI)	N [†]	Prevalence/% (95% CI)	N [†]	Prevalence/% (95% CI)
Total	180,904	6.1(5.2–6.9)	84,407	5.4(4.7–6.2)	96,497	6.7(5.7–7.7)	73,738	9.3(7.7–10.9)	107,166	2.6(2.2–3.0)
Age (years)										
18–29	15,881	6.2(5.2–7.2)	7,078	4.9(4.0–5.8)	8,803	7.6(6.3–8.9)	6,636	9.2(7.4–10.9)	9,245	2.6(2.0–3.2)
30–39	21,740	7.8(6.6–9.0)	9,704	6.3(5.1–7.5)	12,036	9.3(7.7–10.9)	9,415	10.5(8.3–12.7)	12,325	4.4(3.3–5.4)
40–49	39,965	6.5(5.5–7.5)	17,954	6.2(5.1–7.2)	22,011	6.8(5.7–7.8)	15,174	9.7(7.9–11.6)	24,791	3.1(2.5–3.7)
50–59	44,221	4.8(3.8–5.7)	20,354	4.6(3.7–5.5)	23,867	4.9(3.8–6.0)	17,702	8.2(6.4–10.0)	26,519	1.6(1.3–1.9)
60–69	40,093	4.6(3.6–5.5)	19,461	4.7(3.9–5.5)	20,632	4.5(3.3–5.6)	16,659	8.6(6.8–10.4)	23,434	1.4(1.0–1.8)
70+	19,004	4.2(3.5–5.0)	9,856	5.2(4.2–6.1)	9,148	3.4(2.6–4.2)	8,152	8.4(6.9–9.9)	10,852	0.9(0.5–1.4)
<i>p</i> value for trend		<0.001		0.449		<0.001		0.130		<0.001
Geographic Location										
Eastern	67,378	7.6(5.9–9.3)	31,273	6.7(5.3–8.1)	36,105	8.5(6.5–10.6)	33,247	9.9(7.1–12.7)	34,131	4.1(3.1–5.1)
Central	51,539	5.1(4.0–6.3)	24,131	4.6(3.5–5.8)	27,408	5.6(4.3–6.9)	21,038	8.9(6.6–11.2)	30,501	1.9(1.6–2.1)
Western	61,987	4.7(3.6–5.8)	29,003	4.3(3.3–5.3)	32,984	5.1(3.7–6.5)	19,453	8.6(6.5–10.8)	42,534	1.7(1.2–2.3)
<i>p</i> value for difference		0.002		0.007		0.003		0.727		<0.001
Education										
Primary or less	88,819	1.0(0.8–1.2)	35,105	1.1(0.9–1.4)	53,714	0.9(0.6–1.1)	24,514	1.8(1.3–2.3)	64,305	0.6(0.4–0.7)
Junior High	55,243	4.2(3.6–4.8)	29,964	3.9(3.3–4.4)	25,279	4.6(3.9–5.3)	23,296	5.8(4.6–7.0)	31,947	2.8(2.3–3.2)
Senior High	23,346	10.1(8.4–11.8)	12,796	8.1(6.5–9.7)	10,550	12.9(10.8–15.0)	14,555	11.8(9.2–14.4)	8,791	6.7(5.6–7.7)
College or above	13,496	17.8(15.6–20.0)	6,542	14.1(12.2–15.9)	6,954	21.7(18.9–24.5)	11,373	18.3(15.9–20.7)	2,123	14.3(9.4–19.2)
<i>p</i> value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Family per capita income, CNY										
Q1 (<6,000)	45,278	2.7(2.1–3.2)	21,699	2.7(1.9–3.5)	23,579	2.6(2.1–3.2)	9,531	4.4(3.1–5.7)	35,747	2.0(1.5–2.5)
Q2 (6,000–11,999)	38,741	4.3(3.7–4.9)	18,059	4.4(3.6–5.1)	20,682	4.3(3.5–5.0)	12,536	6.5(5.2–7.8)	26,205	2.7(2.3–3.2)
Q3 (12,000–21,599)	36,932	7.2(6.2–8.1)	17,022	6.2(5.3–7.1)	19,910	8.2(7.1–9.4)	19,546	9.2(7.9–10.5)	17,386	3.7(3.0–4.4)
Q4 (21,600+)	29,527	12.5(10.1–14.8)	13,780	10.4(8.5–12.3)	15,747	14.7(11.8–17.6)	21,114	14.4(11.4–17.3)	8,413	4.8(2.7–6.9)
Don't know/refused [§]	30,426	4.1(2.7–5.6)	13,847	3.6(2.5–4.8)	16,579	4.7(2.8–6.6)	11,011	7.1(4.1–10.0)	19,415	1.6(1.2–1.9)
<i>p</i> value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Employment status										
Employed	130,625	6.1(5.3–6.9)	68,241	5.3(4.6–6.0)	62,384	7.1(6.0–8.2)	44,637	9.5(7.9–11.2)	85,988	2.8(2.4–3.3)
Housework	25,112	2.2(1.7–2.7)	4,597	1.6(1.0–2.3)	20,515	2.3(1.8–2.8)	9,098	3.6(2.5–4.6)	16,014	1.2(0.8–1.6)
Retired	16,606	14.3(12.3–16.2)	7,624	12.2(10.6–13.7)	8,982	16.0(13.6–18.5)	15,010	15.2(13.1–17.2)	1,596	4.8(2.4–7.3)
Unemployed	8,561	5.6(4.0–7.2)	3,945	4.3(2.7–5.8)	4,616	6.9(4.8–9.0)	4,993	7.6(5.3–9.9)	3,568	2.1(1.3–2.9)
<i>p</i> value for difference		<0.001		<0.001		<0.001		<0.001		<0.001
Body weight status (BMI categories)										
Underweight, BMI<18.5	6,822	4.7(3.2–6.3)	2,986	2.8(1.4–4.2)	3,836	6.3(4.3–8.2)	2,177	7.4(4.1–10.7)	4,645	1.9(1.2–2.6)
Normal weight, BMI: 18.5–23.9	85,129	6.0(5.1–6.8)	40,103	4.4(3.9–5.0)	45,026	7.3(6.2–8.5)	31,491	9.7(8.2–11.2)	53,638	2.2(1.8–2.6)
Overweight, BMI: 24–27.9	63,232	6.1(5.2–7.0)	29,975	6.1(5.2–7.1)	33,257	6.1(5.2–7.1)	27,898	9.1(7.5–10.7)	35,334	2.9(2.3–3.5)
Obesity, BMI≥28	25,721	6.8(5.5–8.0)	11,343	7.6(6.2–8.9)	14,378	5.8(4.3–7.3)	12,172	9.4(7.1–11.7)	13,549	3.6(2.9–4.2)
<i>p</i> value for trend		0.014		<0.001		0.006		0.910		<0.001
Hypertension										
Yes	71,642	6.4(5.5–7.4)	35,181	5.3(4.5–6.0)	36,461	7.5(6.3–8.7)	28,940	9.7(7.9–11.4)	42,702	2.8(2.3–3.2)
No	109,262	5.2(4.4–5.9)	49,226	5.7(4.9–6.6)	60,036	4.4(3.7–5.1)	44,798	8.5(7.0–9.9)	64,464	2.2(1.8–2.6)
<i>p</i> value for difference		<0.001		0.207		<0.001		0.025		0.002

* CI=confidence interval.

† N=Number of participants.

§ Participants answering “don't know or refuse” were not included in the trend test.

TABLE 2. Behavior rate of salt reduction among Chinese adults aged 18 years old and above — China, 2015.

Characteristics	Total		Men		Women		Urban		Rural	
	N†	Prevalence/% (95% CI)	N†	Prevalence/% (95% CI)	N†	Prevalence/% (95% CI)	N†	Prevalence/% (95% CI)	N†	Prevalence/% (95% CI)
Total	180,904	37.3(35.5–39.1)	84,407	33.8(32.1–35.4)	96,497	40.9(38.8–43.0)	73,738	44.6(42.4–46.7)	107,166	29.7(27.6–31.7)
Age (years old)										
18–29	15,881	32.3(30.4–34.2)	7,078	27.4(25.1–29.6)	8,803	37.3(35.0–39.5)	6,636	36.0(33.6–38.5)	9,245	27.6(25.2–30.1)
30–39	21,740	39.6(37.2–42.0)	9,704	35.5(33.3–37.7)	12,036	43.8(40.8–46.9)	9,415	47.0(44.0–50.0)	12,325	30.1(27.9–32.4)
40–49	39,965	39.5(37.5–41.6)	17,954	36.9(34.9–38.9)	22,011	42.2(39.8–44.7)	15,174	48.0(45.4–50.7)	24,791	30.7(28.5–32.9)
50–59	44,221	38.8(36.8–40.8)	20,354	35.2(33.3–37.2)	23,867	42.5(40.2–44.7)	17,702	47.1(44.6–49.6)	26,519	31.2(28.9–33.5)
60–69	40,093	38.7(36.4–41.0)	19,461	35.5(33.2–37.8)	20,632	41.9(39.5–44.4)	16,659	48.3(45.7–51.0)	23,434	31.0(28.2–33.8)
70+	19,004	35.9(32.6–39.2)	9,856	35.0(32.1–37.8)	9,148	36.7(32.5–40.8)	8,152	47.8(44.1–51.6)	10,852	26.3(22.7–30.0)
<i>p</i> value for trend		0.001		<0.001		0.309		<0.001		0.448
Geographic Location										
Eastern	67,378	44.6(41.9–47.2)	31,273	40.7(38.1–43.2)	36,105	48.6(45.5–51.6)	33,247	49.2(45.8–52.6)	34,131	37.4(34.0–40.9)
Central	51,539	33.2(30.3–36.1)	24,131	29.8(27.4–32.3)	27,408	36.6(33.1–40.0)	21,038	40.1(36.4–43.7)	30,501	27.4(24.3–30.5)
Western	61,987	30.5(27.3–33.8)	29,003	27.4(24.4–30.5)	32,984	33.7(30.1–37.4)	19,453	39.7(35.4–43.9)	42,534	23.6(20.0–27.2)
<i>p</i> value for difference		<0.001		<0.001		<0.001		<0.001		<0.001
Education										
Primary or less	88,819	29.3(27.3–31.2)	35,105	25.5(23.8–27.3)	53,714	31.9(29.7–34.1)	24,514	36.3(33.4–39.2)	64,305	25.8(23.8–27.8)
Junior High	55,243	36.4(34.5–38.4)	29,964	32.0(30.2–33.8)	25,279	41.9(39.5–44.4)	23,296	42.3(39.8–44.8)	31,947	31.2(28.9–33.5)
Senior High	23,346	44.2(42.2–46.2)	12,796	39.7(37.8–41.7)	10,550	50.4(47.8–52.9)	14,555	48.2(45.4–51.1)	8,791	35.8(33.2–38.4)
College or above	13,496	50.7(48.5–52.9)	6,542	46.1(43.2–49.0)	6,954	55.4(52.5–58.4)	11,373	51.4(49.0–53.8)	2,123	45.4(39.8–50.9)
<i>p</i> value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Family per capita income, CNY										
Q1 (<6,000)	45,278	30.1(27.8–32.5)	21,699	26.6(24.5–28.6)	23,579	33.7(30.8–36.5)	9,531	35.9(32.3–39.5)	35,747	27.9(25.2–30.6)
Q2 (6,000–11,999)	38,741	34.8(32.7–36.9)	18,059	31.4(29.1–33.6)	20,682	38.2(35.9–40.5)	12,536	40.9(37.7–44.1)	26,205	30.4(28.1–32.6)
Q3 (12,000–21,599)	36,932	41.9(39.7–44.2)	17,022	37.9(35.7–40.2)	19,910	46.1(43.1–49.1)	19,546	46.4(43.9–48.9)	17,386	34.4(31.7–37.1)
Q4 (21,600+)	29,527	49.2(46.5–52.0)	13,780	45.0(42.3–47.6)	15,747	53.8(50.6–56.9)	21,114	52.0(48.6–55.4)	8,413	37.9(33.6–42.1)
Don't know/refused [§]	30,426	30.7(27.7–33.7)	13,847	27.6(24.6–30.5)	16,579	33.6(30.0–37.3)	11,011	38.1(33.5–42.6)	19,415	24.1(21.5–26.8)
<i>p</i> value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Employment status										
Employed	130,625	36.4(34.4–38.3)	68,241	33.2(31.5–34.8)	62,384	40.4(38.0–42.8)	44,637	43.7(41.5–45.9)	85,988	29.3(27.3–31.4)
Housework	25,112	35.9(33.1–38.8)	4,597	28.2(24.2–32.2)	20,515	37.4(34.6–40.3)	9,098	43.9(40.2–47.6)	16,014	30.3(26.8–33.8)
Retired	16,606	57.2(54.2–60.3)	7,624	53.4(50.4–56.3)	8,982	60.6(57.1–64.0)	15,010	58.7(55.5–61.8)	1,596	42.3(34.6–50.1)
Unemployed	8,561	34.9(31.5–38.2)	3,945	30.5(26.0–35.0)	4,616	38.9(35.6–42.3)	4,993	37.3(32.4–42.2)	3,568	30.5(26.5–34.5)
<i>p</i> value for difference		<0.001		<0.001		<0.001		<0.001		<0.001
Body weight status (BMI categories)										
Underweight, BMI<18.5	6,822	27.5(23.3–31.6)	2,986	23.2(18.3–28.2)	3,836	30.9(26.8–35.0)	2,177	31.8(23.0–40.5)	4,645	23.0(20.5–25.5)
Normal weight, BMI: 18.5–23.9	85,129	35.1(33.2–36.9)	40,103	29.5(28.0–31.0)	45,026	40.2(37.7–42.6)	31,491	42.3(39.9–44.6)	53,638	27.8(26.0–29.7)
Overweight, BMI: 24–27.9	63,232	40.0(37.9–42.1)	29,975	37.5(35.5–39.6)	33,257	42.9(40.4–45.4)	27,898	47.9(45.6–50.1)	35,334	31.4(28.9–34.0)
Obesity, BMI≥28	25,721	42.0(39.5–44.5)	11,343	41.0(38.4–43.7)	14,378	43.0(40.0–46.0)	12,172	48.1(45.2–50.9)	13,549	34.5(31.1–38.0)
<i>p</i> value for trend		<0.001		<0.001		<0.001		<0.001		<0.001
Hypertension										
Yes	71,642	39.3(37.4–41.3)	35,181	37.4(35.4–39.3)	36,461	41.7(39.6–43.8)	28,940	47.6(45.4–49.8)	42,702	31.9(29.6–34.2)
No	109,262	36.5(34.6–38.4)	49,226	32.1(30.5–33.7)	60,036	40.6(38.3–42.9)	44,798	43.4(41.1–45.7)	64,464	28.6(26.6–30.7)
<i>p</i> value for difference		<0.001		<0.001		0.214		<0.001		<0.001
Awareness of maximum daily salt intake										
Yes	9,335	71.8(69.0–74.7)	4,081	68.6(65.0–72.3)	5,254	74.4(71.3–77.6)	6,935	73.6(70.5–76.7)	2,400	28.7(26.7–30.8)
No	171,569	35.1(33.4–36.8)	80,326	31.8(30.2–33.4)	91,243	38.5(36.5–40.5)	66,803	41.6(39.6–43.5)	104,766	65.0(60.3–69.7)
<i>p</i> value for difference		<0.001		<0.001		<0.001		<0.001		<0.001

* CI=confidence interval.

† N=Number of participants.

§ Participants answering “don't know or refuse” were not included in the trend test.

TABLE 3. Associations between factors and awareness rate of the maximum daily salt intake and behavior of salt reduction among Chinese adults aged 18 years old and above — China, 2015.

Characteristics	Awareness of maximum daily salt intake			Behavior of salt reduction		
	OR	95% CI*	p value	OR	95% CI	p value
Age (years)						
18–29	Ref			Ref		
30–39	1.49	1.28–1.74	<0.001	1.42	1.31–1.55	<0.001
40–49	1.92	1.65–2.24	<0.001	1.61	1.48–1.76	<0.001
50–59	1.37	1.13–1.66	0.002	1.56	1.42–1.71	<0.001
60–69	1.93	1.54–2.42	<0.001	1.79	1.62–1.97	<0.001
70+	1.90	1.52–2.39	<0.001	1.59	1.36–1.86	<0.001
Sex						
Men	Ref			Ref		
Women	1.60	1.46–1.75	<0.001	1.50	1.42–1.57	<0.001
Residence						
Urban	Ref			Ref		
Rural	0.67	0.51–0.87	0.003	0.75	0.67–0.84	<0.001
Geographic location						
Eastern	Ref			Ref		
Central	0.86	0.65–1.14	0.300	0.69	0.60–0.79	<0.001
Western	0.98	0.75–1.29	0.905	0.68	0.57–0.79	<0.001
Education						
Primary or less	Ref			Ref		
Junior high	4.66	3.81–5.69	<0.001	1.47	1.39–1.56	<0.001
Senior high	11.09	8.83–13.92	<0.001	1.85	1.69–2.02	<0.001
College or above	20.41	14.99–27.79	<0.001	2.16	1.91–2.43	<0.001
Family per capita income, CNY						
Q1 (<6,000)	Ref			Ref		
Q2 (6,000–11,999)	1.17	0.97–1.40	0.097	1.07	0.98–1.17	0.129
Q3 (12,000–21,599)	1.24	0.99–1.55	0.064	1.17	1.05–1.30	0.005
Q4 (21,600+)	1.41	1.08–1.84	0.011	1.20	1.05–1.37	0.009
Don't know/refused	0.93	0.67–1.29	0.673	0.83	0.74–0.94	0.003
Employment status						
Employed	Ref			Ref		
Housework	0.58	0.48–0.70	<0.001	1.04	0.94–1.15	0.479
Retired	1.67	1.39–2.02	<0.001	1.35	1.19–1.53	<0.001
Unemployed	0.81	0.64–1.01	0.062	0.94	0.80–1.10	0.422
BMI categories						
Normal weight, BMI:18.5–23.9	Ref			Ref		
Underweight, BMI<18.5	0.77	0.55–1.07	0.120	0.73	0.57–0.95	0.019
Overweight, BMI:24–27.9	1.05	0.95–1.15	0.361	1.18	1.13–1.23	<0.001
Obesity, BMI≥28	1.13	1.00–1.27	0.055	1.22	1.14–1.31	<0.001
Hypertension						
Yes	Ref			Ref		
No	0.95	0.86–1.05	0.324	0.90	0.86–0.94	<0.001
Awareness of maximum daily salt intake						
No	–	–	–	Ref		
Yes	–	–	–	3.20	2.77–3.70	<0.001

Note: "–" means not applicable.

Abbreviations: Ref=reference

* CI=confidence interval.

level, or with high family income per capita, or who have retired, which was largely consistent with the results from the previous studies (6). Lower awareness rates in rural areas may have been due to lower levels of education, poorer development of health education, and less developed health promotion campaigns.

This study showed that about one-third of the population took measures to control their salt intake, which was lower than that in 2010 (42.2%) (7). This showed that bad habits formed in the long term are difficult to change in a short term, and salt reduction requires a long time and sustained efforts (7). This study found that the awareness rate of daily maximum salt intake and the salt reduction behavior rate among the hypertension population was significantly higher than that of the non-hypertension population, which was consistent with the result of a previous study (8). This may be because people who knew they have high blood pressure were more concerned about their health and thus controlled their salt intake or took salt reduction measures under the guidance of doctors. Previous studies showed that salt-related knowledge could affect salt reduction behaviors (8). In this study, the behavior rate of salt reduction was significantly higher in those who knew the maximum salt intake than those who did not. This study showed that improving knowledge is a critical step in behavioral changes, and indicating educational activities in nutrition may be essential for the implementation of good behavior (6).

Individuals, businesses, and governments all play an important role in reducing salt. At the national level, China has conducted policies to reduce people's salt intake, including "China Healthy Lifestyle for All" and the "National Nutrition Week". Moreover, China has carried out various regional salt reduction programs, such as the Shandong Ministry of Health Action on Salt Reduction and Hypertension (9). In China, salt intake comes mainly from added salt or soy sauce in home cooking, but salt in processed foods also makes up a large portion (10). Therefore, it is particularly important to strengthen the salt-related knowledge and salt reduction technology of families and inform residents of maximum daily intake of salt and improve awareness of hidden salt in food and to inform the public of ways to control salt in cooking. Government departments should formulate policies related to salt reduction and strengthen the assessment and evaluation of the corresponding control measures.

This study was subject to at least one limitation. The results of the survey were self-reported and may be subject to a favorable response bias, which may overestimate or underestimate their actual salt

reduction behavior, or a recall bias. Furthermore, the questionnaire did not include salt reduction attitudes, so the relationship between salt reduction attitude and behaviors could not be studied.

In conclusion, this study provides a nationwide report on population-based salt-related knowledge and behavior. This study found that the awareness rate of maximum daily salt intake and behavior rate of salt reduction of Chinese adult residents were low. Chinese residents require further nutrition education to better understand the recommended maximum daily salt intake and take further salt reduction measures, particularly in rural areas or people with low education levels, or with low incomes.

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REFERENCES

- Hu ST, Gao RL, Liu LS, Zhu ML, Wang W, Wang YJ, et al. Summary of the 2018 report on cardiovascular diseases in China. *Chin Circ J* 2019;34(3):209 – 20. <http://dx.doi.org/10.3969/j.issn.1000-3614.2019.03.001>. (In Chinese).
- Chang JL, Wang Y. Comprehensive report on nutrition and health status monitoring of Chinese residents from 2010 to 2013. Beijing: Peking University Medical Press. 2016. (In Chinese).
- D'Elia L, Galletti F, La Fata E, Sabino P, Strazzullo P. Effect of dietary sodium restriction on arterial stiffness. *J Hypertens* 2018;36(4):734-43. <https://pubmed.ncbi.nlm.nih.gov/29084085/>.
- Zhang J, Wu T, Chu HL, Feng XX, Shi JP, Zhang RJ, et al. Salt intake belief, knowledge, and behavior: a cross-sectional study of older rural Chinese adults. *Medicine* 2016;95(31):e4404. <http://dx.doi.org/10.1097/MD.0000000000004404>.
- Claro RM, Linders H, Ricardo CZ, Legetic B, Campbell NRC. Consumer attitudes, knowledge, and behavior related to salt consumption in sentinel countries of the Americas. *Rev Panam Salud Pública* 2012;32(4):265 – 73. <http://dx.doi.org/10.1590/s1020-49892012001000004>.
- Idelson PI, D'Elia L, Cairella G, Sabino P, Scalfi L, Fabbri A, et al. Salt and health: survey on knowledge and salt intake related behaviour in Italy. *Nutrients* 2020;12(2):279. <http://dx.doi.org/10.3390/nu12020279>.
- Xu JW, Yan LX, Chen XR, Cai XN, Jiang Y, Wang LM, et al. Investigation on knowledge, attitude and behavior of salt reduction in Chinese adults, 2010. *Chin J Prev Med* 2014;48(5):350-4. <http://d.wanfangdata.com.cn/periodical/zhyfyx201405004>. (In Chinese).
- Arcand J, Mendoza J, Qi Y, Henson S, Lou W, L'Abbe MR. Results of a national survey examining Canadians' concern, actions, barriers, and support for dietary sodium reduction interventions. *Can J Cardiol* 2013;29(5):628 – 31. <http://dx.doi.org/10.1016/j.cjca.2013.01.018>.
- Xu AQ, Ma JX, Guo XL, Wang LH, Wu J, Zhang JY, et al. Association of a province-wide intervention with salt intake and hypertension in Shandong province, China, 2011-2016. *JAMA Intern Med* 2020; 180(6):877 – 86. <http://dx.doi.org/10.1001/jamainternmed.2020.0904>.
- Chen S, Shan LC, Tao WT, Lu T, Regan Á, Han HW, et al. A survey of Chinese consumers' knowledge, beliefs and behavioural intentions regarding salt intake and salt reduction. *Public Health Nutr* 2020; 23(8):1450 – 9. <http://dx.doi.org/10.1017/S1368980019003689>.