



A survey of Chinese consumers' knowledge, beliefs and behavioural intentions regarding salt intake and salt reduction

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Abstract

Objective: Globally, China is among the 'saltiest' nations. In order to support current nationwide salt reduction initiatives, we investigated Chinese consumers' knowledge, beliefs and behaviours related to salt intake and salt reduction.

Design: A cross-sectional face-to-face survey was carried out, focusing on salt knowledge, beliefs and behaviours related to salt intake and salt reduction, perceptions of salt reduction responsibility and support for different national strategies.

Setting: The survey was carried out in China mainland.

Participants: Consumers (n 2444) from six of seven major geographical regions in China participated in the survey. After data cleaning, a sample of 2430 was included in the final analysis.

Results: A majority of Chinese consumers believed that salt added during home cooking was the biggest contributor to their salt intake. Knowledge gaps existed in the awareness of salt hidden in certain foods and flavouring products. Chinese consumers in general were interested in lowering their salt intake. They were aware of salt reduction tools, but the adoption level was low. Consumers expressed strong support for promotion of salt-restriction spoons and public education, but not fiscal policies (e.g. salt-related tax or subsidies). In terms of individual differences, education status demonstrated a substantial impact on salt reduction knowledge and behaviour.

Conclusions: There is still big room to 'shake' Chinese consumers' salt habit. The present study provides important evidence and consumer insights to support China's efforts to meet its salt reduction targets.

Keywords
Salt
Salt reduction
China
Consumer survey
Public opinion

Deeply rooted in China's food culture and history, salt plays an essential role in Chinese people's food preparation and preservation. Globally, China is among the nations with the highest salt intake level⁽¹⁾. According to the Chinese national total diet survey in 2000, the average daily salt intake was 12 g/person⁽²⁾. The most recent national survey was carried out between 2009 and 2012. The data showed a decrease in mean daily salt intake down to 9.1 g/person, mainly due to changing dietary trends and replacement

of salt with refrigeration for food preservation⁽³⁾. However, the level is still much higher than the WHO's recommended maximum daily salt intake level (5 g/d) and the 6 g/d target that many countries (including China) have set for their populations^(1,4). In China, almost all provinces exceed this target⁽³⁾. An evaluation of the diet and public health impact across 195 countries indicates that, after age standardisation, China has the highest rates of diet-related CVD deaths and high intake of Na was the leading dietary risk for these deaths⁽⁵⁾.

Dietary salt intake is derived from different sources, with significant variations between countries. In most Western

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countries, the majority of salt intake comes from commercially manufactured foods or processed foods (e.g. breads, processed meat, sandwiches, soups, ready meals and takeaways)⁽⁶⁾. In contrast, in China, salt intake is mainly from salt or soya sauce added in home cooking (about 80%)^(7,8). However, it should be noted that, in recent years, the online catering sector has been undergoing an explosive growth in China⁽⁹⁾. Some population cohorts, especially younger generations of consumers from single-person households, increasingly use food delivery apps accessed through smartphones to deliver their daily meals⁽¹⁰⁾. It is possible that this trend has altered the salt intake pattern of this particular demographic, although the actual impact is still unknown.

Following worldwide salt reduction initiatives, China has taken actions to reduce the population's salt intake, with a primary focus on reducing salt/sodium added during cooking at home. At the national level, government-led initiatives such as the China Healthy Life for All campaign and National Nutrition Week have included salt reduction as an important message, highlighting the recommended daily maximum intake of salt and promoting salt reduction tools^(4,11). More specific to salt, the China Salt Reduction Initiative (2010–2020) and Action on Salt China (2017–2021, in collaboration with the UK) are employing a multi-sector approach to tackle the challenge of salt reduction⁽¹²⁾. In 2017, the State Council set a goal of a 20% reduction in citizens' salt intake by 2030. In response to this ambition, in April 2018, the Chinese Center for Disease Control and Prevention along with the Chinese Nutrition Society officially launched salt reduction guidelines for the food industry, providing technical suggestions on product reformulations and stage targets for different food categories⁽¹³⁾. In addition to national initiatives, Beijing and Shanghai municipal governments and Shandong provincial government have organised regional interventions⁽⁴⁾. These regional interventions involve a wide range of measures, mainly including distribution of salt-restriction spoons (i.e. spoons with a volume to hold 2 g salt), promotion of low-sodium salt and low-salt foods to consumers and food catering services, and public awareness campaigns. During the intervention, the efforts had resulted in positive influence on the intervention groups' salt reduction awareness, adoption of tools and actual salt intake levels^(4,14,15). However, consumer surveys showed a decrease in impact after the intervention and common barriers that have stopped certain people to update salt restriction tools, for instance lack of education on correct use of the tools, inconvenience, difficulty of purchase and lack of perceived health benefits^(4,15–17).

To achieve effective and sustained behavioural change, salt reduction programmes should be based on a solid understanding of consumer perceptions and behaviours^(6,18,19). While lessons can be learned from successful salt reduction campaigns from other countries, Chinese

public health practitioners should also fully consider the perceptions and behaviours of Chinese consumers specifically⁽²⁰⁾. In China, the understanding of consumer issues around salt and salt reduction is still limited. For instance, the evaluation survey of the China Healthy Lifestyles for All initiative included only three simple questions regarding salt; and regional post-intervention surveys were restricted to specific villages or cities^(4,14,21,22). Using an online panel, Newson *et al.*⁽¹⁸⁾ conducted a standard seven-country survey and found that only 34% of Chinese consumers know the recommended maximum salt intake; and while 83% were interested in salt reduction, only 30% had maintained salt reduction efforts. Using an across-country sample, the current study aimed to provide comprehensive and up-to-date insights about Chinese consumers' knowledge, interest and behaviour in relation to salt and salt reduction that can be used to support current nationwide salt reduction initiatives.

Methods

Sampling

To obtain a representative sample of the Chinese population, a multistage hierarchical sampling method was employed. Geographically, China consists of seven large areas: North, Northeast, East, Central, South, Southwest and Northwest. Due to budget limit, six out of seven geographical areas were selected for sampling. The Northwest area was not included because it is the least populated area, accounting for only 7.25% of China's total population⁽²³⁾. We believe that the exclusion of this area (rather than any other area) should result in the least compromise on the representativeness of the sample. The decision was made to recruit approximately 380 participants from each area, because a power calculation suggested that to estimate the proportion of the population that possesses a particular property, a minimum sample size of 383 was required to achieve 95% power with a significant level (α) of 0.05⁽²⁴⁾. For each of those six geographical areas, we randomly selected a provincial-level administrative division (i.e. the highest level of China's administrative structure), which is either a province or a municipality (Table 1). At the second stage, probability-proportional-to-size sampling was employed to choose one city district and one town from each municipality/province, ending with twelve (i.e. 6×2) districts and towns. At the third stage, again using probability-proportional-to-size sampling, four villages/streets were selected from each district/town and four communities were selected from each village/street. This ends with 192 sampling points (i.e. $12 \times 4 \times 4$). At the last stage, at each sampling point, twelve households were randomly selected for the interview. Professional fieldworkers based in the local Center for Disease Control and Prevention visited the households

Table 1 Characteristics of the Chinese consumers (*n* 2430) from six of seven major geographical regions in mainland China who participated in the survey, September–November 2017

	<i>n</i>	%
Gender		
Male	895	36.8
Female	1535	63.2
Age (years)		
19–30	236	9.7
31–40	558	23.0
41–50	558	23.0
51–60	615	25.3
>60	463	19.1
Provincial-level administrative division (geographical area)		
Beijing municipality (North China)	380	15.6
Liaoning province (Northeast China)	394	16.2
Shandong province (East China)	384	15.8
Hubei province (Central China)	377	15.5
Guangdong province (South China)	517	21.3
Chongqing municipality (Southwest China)	378	15.6
Education status		
No formal education/no literacy	40	1.6
Primary school	274	11.3
Junior high school	726	29.9
Senior high school/technical secondary school	633	26.0
College/vocational university	380	15.6
University bachelor's degree	335	13.8
Master's degree or higher	42	1.7
Ethnicity		
Han	2385	98.1
Minority	45	1.9
Occupation		
Students	4	0.2
Responsible persons in government agencies, party and mass organisations, enterprise and public institutions	136	5.6
Professionals and technicians	343	14.1
Clerks and administrators	207	8.5
Business people, service personnel	295	12.1
Labourers engaged in agriculture, forestry, animal husbandry, fishery and water conservancy	209	8.6
Production workers, transport workers	43	1.8
Military officers and soldiers	1	0.0
Housekeeping/housewives	212	8.7
Unemployed	166	6.8
Retired	566	23.3
Other	248	10.2

and administrated the survey face-to-face. The fieldworkers were also provided with an age quota, which was based on the 2011 census⁽²³⁾, in order to cover all age groups. The questions were displayed on a tablet computer; the fieldworker read out the question to the respondent and entered the respondent's answers. In total 2444 participants took part in the survey. The data were collected between September and November 2017. Informed written consent was obtained from each participant on site, prior to the survey.

Research instrument

The survey included twenty-nine questions exploring knowledge on salt and salt reduction, consumer beliefs and behavioural intentions related to salt reduction, and consumer perspectives on strategies to reduce the population's salt intake. Survey design was informed by previous literature^(25,26), pilot studies, and consultations with public health practitioners and experts. Declarative salt knowledge – factual knowledge regarding intake of salt in the diet – was assessed using questions from previous literature, adapted to be culturally suitable^(25,26). Six questions assessed participants' understanding of dietary sources of salt intake, the maximum recommended daily salt intake (entered in grams per day or 'don't know') and the relationship between salt and health (see Table 2 for full wording of the questions). Examples of food and flavouring products were selected based on commonly consumed products in China.

Table 2 Salt beliefs and knowledge of Chinese consumers (*n* 2430) from six of seven major geographical regions in mainland China, September–November 2017

	%
Which of the following do you think is the main source of your salt intake?	
Salt added during preparation or cooking at home*	80.8
Salt in restaurant foods	14.8
Salt in processed foods	4.4
Which of the following foods contain salt? (multiple choices)	
Sliced toast bread*	31.0
Dragon beard noodles*	40.8
Preserved plum*	36.9
Yoghurt	3.9
Stewed dishes*	91.7
Cheese*	17.7
Potato crisps*	64.1
(all answers correct)	(3.2)
Which of the following flavouring products contain salt? (multiple choices)	
Chicken powder*	47.4
Peanut oil	5.2
Salad sauce*	34.6
Soya sauce*	84.6
Fermented bean curd (' <i>furū</i> ')*	81.0
(all answers correct)	(13.0)
Do you know the maximum level of salt you should consume per day?	
Yes, and correctly identified (5 or 6 grams)	35.0
Yes, but incorrectly identified	4.1
Don't know	61.0
Which of the following health risks are associated with excessive salt intake? (multiple choices)	
High blood pressure*	80.3
Liver damage	28.2
Cardiovascular diseases*	62.2
Anaemia	6.1
Don't know	10.4
(all answers correct)	(34.0)
Which element in salt causes health risks?	
Potassium	6.1
Magnesium	1.2
Sodium*	56.0
Aluminium	2.0
Don't know	34.7

*Denotes the correct answer(s) for each question.

Table 3 Salt reduction intention and behaviour of Chinese consumers (n2430) from six of seven major geographical regions in mainland China, September–November 2017

	Gender		Age (years)				Education			P < 0.001	
	%	Male	Female	19–35	36–50	51–65	>65	Low	Medium		High
How would you describe the level of your salt intake?*											
Too much/very much	21.0	23.3	18.7	22.9	20.7	19.3	19.5	20.0	22.2	19.7	P < 0.001
About right	65.1	64.2	66.0	68.6	64.7	63.1	57.5	58.2	63.2	69.9	
Too little/very little	13.9	12.5	15.3	8.5	14.5	17.6	23.0	21.8	14.6	10.4	P < 0.001
How would you describe your interest in reducing salt intake?*											
Not at all interested/not interested	11.7	13.6	9.7	9.7	11.9	13.9	12.9	16.5	11.5	10.4	P < 0.001
Very interested/interested	22.7	24.7	20.8	24.7	22.7	21.4	19.1	28.4	25.5	17.1	
Do you agree/disagree with this statement: eating less salt can make you healthier?*	65.6	61.8	69.5	65.7	65.4	64.6	68.0	55.1	63.0	72.4	P < 0.001
Totally agree/agree	83.0	81.3	84.8	82.4	84.0	83.8	80.0	77.5	80.4	88.3	
Unsure	14.5	15.9	13.1	14.7	13.8	14.1	17.8	20.8	16.8	9.4	
Totally disagree/disagree	2.4	2.8	2.1	2.9	2.2	2.1	2.2	1.8	2.8	2.2	
Have you taken measures to reduce your salt intake?											
Have always been doing so	24.4	20.7	28.2	22.1	25.1	24.9	29.3	20.4	22.0	28.9	P < 0.001
Have tried before	33.9	31.2	36.6	34.5	34.3	35.4	26.7	23.6	34.8	35.9	
Never tried	41.7	48.2	35.2	43.4	40.7	39.7	44.0	56.0	43.2	35.2	

*For these questions, to reduce the complexity of result interpretation, five answering options were merged into three categories.

Table 4 Reasons behind salt reduction behaviour stated by Chinese consumers (n2430) from six of seven major geographical regions in mainland China, September–November 2017

	n	%
What motivated you to reduce the salt intake? (multiple choices)	1454	
Health concerns		83.9
Family influence (e.g. family members prefer 'light' taste, having children at home, etc.)		53.7
Friend influence		13.4
Other/don't know		6.9
What prevents you from reducing your salt intake? (multiple choices)	976	
Influence on taste		62.3
High salt intake is not a big problem		11.3
High price associated with some low-salt products		3.2
Don't know which foods are high/low in salt		22.5
Don't know how to check the salt content		21.7
Change requires too much effort		29.6
Lack of family support		4.7
Other/don't know		12.7

Note: participants were divided based on their answers to the previous question, 'Have you taken measures to reduce your salt intake?' (see Table 3). Those who answered 'have always been doing so' or 'have tried before' were presented with a follow-up question, 'What motivated you to reduce the salt intake?'; those who answered 'never tried' were presented the question, 'What prevents you from reducing your salt intake?'

Participants' beliefs and behaviours related to salt intake and salt reduction were also assessed with culturally adapted questions from previous literature^(25,26). Participants were asked about their salt intake behaviours and their interest in and motivations for reducing salt intake (see Tables 3 and 4 for full wording). The multiple-choice options included in the survey for the motivations and barriers for taking salt reduction action were developed based on a qualitative pilot exercise undertaken with non-academic staff at the first author's affiliation, such as administrators, cleaners and security guards.

To measure consumer awareness and adoption of salt reduction strategies, three questions (Table 5) were included. Salt-restriction spoons and low-sodium salt have been strongly promoted in previous Chinese national or regional salt reduction initiatives; thus, questions asked about both the awareness and the actual adoption of these strategies. The third question asked about salt-reduction cooking skills and was designed in consultation with internal nutrition experts at the first author's affiliation. Multiple-choice options for this question included correct practices, as well as improper practices that commonly occur in Chinese families.

The last section in the survey related to perceptions of salt reduction responsibility and effectiveness of different national salt reduction strategies. Participants were asked to rate how responsible they thought different parties (themselves, food producers, restaurants/caterers, governments, family and friends) were for salt reduction, using a five-option scale (total responsibility, a lot of responsibility, unsure, a little responsibility, no responsibility). They were

Table 5 Awareness of and adoption of salt reduction tools by Chinese consumers (n=2430) from six of seven major geographical regions in mainland China, September–November 2017

	Gender		Age (years)				Education			P	
	%	Male	Female	19–35	36–50	51–65	>65	Low	Medium		High
Have you ever heard of salt-restriction spoons?											
Have never heard of or seen it	29.2	33.3	25.0	25.9	33.7	27.6	30.4	42.1	34.1	18.6	P < 0.001
Have heard of it, but never seen it	30.3	31.4	29.2	36.4	29.7	25.0	23.2	24.9	29.4	33.1	
Have seen it, but never used it	20.4	17.1	23.8	19.9	18.9	23.7	19.2	16.5	18.4	24.3	
Have used it	20.1	18.2	22.0	17.9	17.7	23.7	27.2	16.5	18.1	24.0	
Have you ever heard of low-sodium salt?											
Have never heard of or seen it	15.0	16.7	13.2	11.8	14.7	16.8	24.0	26.7	17.8	7.6	P < 0.001
Have heard of it, but never seen it	25.9	28.2	23.7	27.1	26.0	26.2	20.9	25.6	27.4	23.9	
Have seen it, but never used it	22.5	22.8	22.3	24.7	22.2	20.9	19.1	14.7	20.7	27.4	
Have used it	36.5	32.3	40.8	36.4	37.1	36.1	36.0	33.0	34.0	41.1	
Which cooking skills can help salt reduction without compromising on taste? (multiple choices)											
Taste the dish before adding salt*	52.0	52.2	51.7	59.2	49.1	47.1	46.4	41.9	50.7	56.9	P < 0.001
Add salt first, then check the taste of the dish	17.0	17.4	16.7	12.8	18.6	20.2	19.6	28.8	18.2	11.7	
Use soyabean paste to add flavour	14.1	17.0	11.1	15.5	14.0	11.3	16.0	15.4	13.2	14.9	P < 0.001
Use soya sauce to replace salt	28.5	29.1	27.8	31.5	27.2	25.3	29.8	24.6	25.6	33.7	
Add salt at a late stage of cooking*	52.9	48.3	57.6	53.7	53.5	51.4	51.6	36.3	53.2	57.8	P < 0.001
Add salt at an early stage of cooking	6.7	7.8	5.5	7.9	5.8	6.4	5.3	7.4	6.3	6.8	

*Denotes the correct answers.

also asked about perceived effectiveness of different salt reduction strategies as listed in Table 6. Among these strategies, four strategies have already been implemented in China or some regions in China (i.e. salt-restriction spoons, low-sodium salt, indication of salt content and public education)^(4,20). The rest were inspired by salt reduction initiatives undertaken in other countries. The questionnaire ended with standard demographic questions.

Statistical analysis

Prior to data analysis, data cleaning was carried out. Fourteen respondents did not answer at least two key questions and were excluded, resulting in a sample of 2430 participants. The data analyst found an error in the survey’s logic path. Participants who answered ‘never’ to the question, ‘Q13. Have you taken any measures to reduce your salt intake?’, were supposed to skip the next question, ‘Q14. What motivated you to reduce the salt intake?’ The data showed that three participants answered ‘never’ to Q13, but also left answers on Q14. This indicated the ‘skip’ function did not work properly for these three participants. The data analyst thus manually removed their answers to Q14. This procedure did not lead to deletion of any participants. Data analyses were conducted using the statistical software package IBM SPSS Statistics version 24. To minimise the bias caused by multistage hierarchical sampling, we applied post-stratification weights by age, gender and geographical area, based on statistics from the most recent national census data⁽¹⁹⁾. We performed this procedure using SPSS Complex Sample module, which helps make more statistically valid inferences by incorporating the sample design into survey analysis. To enable cross-group comparison, age was recoded into four categories; and education status was merged into three categories: low (no education, primary school education); medium (junior or senior high school education, technical secondary school education); and high (college education, university degrees). A series of χ^2 tests was carried out to compare population groups across knowledge, beliefs and behavioural intentions regarding salt intake and salt reduction.

Results

Salt beliefs and knowledge

A majority of Chinese consumers (80.8 %) believed that the main source of their salt intake was from foods prepared at home (Table 2). Interestingly, 22.2 % of young consumers (aged 19–35 years) and 22.8 % well-educated consumers selected ‘restaurant foods’ as their main source of salt intake, which is significantly higher than the average percentage (14.8 %).

Knowledge gaps exist in the awareness of high/medium salt hidden in certain food items and flavouring products. For instance, over half of Chinese consumers were not

Table 6 Beliefs about responsibilities and strategies for reducing the population's salt intake of Chinese consumers (n=2430) from six of seven major geographical regions in mainland China, September–November 2017

How much responsibility do you think ___ should have for salt reduction?*	Gender		Age (years)				Education				
	%	Male	Female	19–35	36–50	51–65	>65	Low	Medium	High	
											P < 0.001
Myself	67.4	63.1	71.8	66.4	63.4	73.2	70.5	63.2	66.2	70.6	P < 0.001
Food producers	53.5	50.9	56.2	60.6	49.4	51.1	46.2	41.5	48.1	64.7	P < 0.001
Restaurants and the catering business	52.0	52.1	51.8	62.0	45.7	49.0	42.5	38.2	48.5	61.1	P < 0.001
Governments	45.2	46.6	43.8	48.8	44.5	42.7	40.4	31.6	40.5	56.0	P < 0.001
Family and friends	13.8	13.1	14.4	16.5	10.9	13.9	12.4	9.5	11.6	18.1	P < 0.01
To reduce the population's salt intake, which measure(s) do you think would be most effective? (multiple choice)											
Promote the use of salt-restriction spoons	63.8	61.7	66.1	70.7	62.4	59.3	54.2	52.5	62.6	69.1	P < 0.001
Promote the use of low-sodium salt	37.1	41.7	32.4	41.7	35.8	34.0	32.1	33.3	33.0	44.0	P < 0.001
Clear symbols to signal the level of salt (i.e. low/medium/high) on food packaging	41.2	42.0	40.4	46.3	41.7	37.2	30.2	24.9	38.0	50.7	P < 0.001
Clear indication of salt content in food labelling	38.9	37.7	40.2	42.9	40.0	35.9	28.0	26.0	37.9	44.6	P < 0.001
Enforce salt reduction in restaurants and food catering business	29.5	31.3	27.6	33.6	30.2	26.5	18.7	22.5	25.2	37.4	P < 0.001
Provide price subsidy to low-salt food products	24.8	26.9	22.6	28.6	22.4	22.6	23.1	19.6	22.2	29.9	P < 0.001
Put a tax on high-salt food products	16.0	17.6	14.4	20.1	15.2	13.4	9.3	8.8	12.9	22.6	P < 0.001
Government-led salt reduction public education	50.3	49.2	51.3	49.7	48.3	52.3	54.2	46.8	49.1	52.9	P < 0.001
Set a maximum amount of salt on children's food products	35.6	36.2	35.0	42.2	35.2	30.7	24.4	22.5	35.6	39.8	P < 0.001

*For this question, the five answering options were 'total responsibility', 'some responsibility', 'unsure', 'little responsibility' and 'no responsibility'. The percentages indicate the proportion of those who selected 'total responsibility' or 'some responsibility'.

aware of salt in dragon beard noodles, preserved plum and certain Western foods that have been introduced to China (i.e. toast bread and cheese). A large proportion of consumers did not know chicken powder (52.6%) and salad sauce (65.4%) contain salt. Consumers with higher education and younger age profiles were relatively more knowledgeable on 'invisible' salt in foods and flavourings.

Slightly over one-third of Chinese consumers correctly identified the recommended maximum salt intake level (Table 2). In relation to health risks associated with salt intake, consumers had high awareness of hypertension and moderate awareness of CVD. Of participants, 56.0% were aware that 'sodium' was the element in salt which caused health risks. Better-educated participants demonstrated a much higher knowledge level on these questions.

Salt reduction beliefs and behaviour

A majority of Chinese consumers did not perceive they were consuming excessive salt (Table 3). Despite this, 65.6% of consumers expressed interest in lowering their salt intake and 83.0% believed that eating less salt would benefit their health. At the behavioural level, only a quarter of consumers claimed that they made an ongoing effort to reduce salt and 33.9% indicated that they had tried in the past to reduce salt intake. Females and better-educated people were more interested in and more active on salt reduction.

For those who had been making/ever made salt reduction efforts, they were mainly triggered by health concerns and family influence (Table 4). For those who had not tried salt reduction, taste concern was the major barrier. A perception that change would require too much effort, and a lack of knowledge on which foods contain high salt and how to check salt content, also explained some participants' lack of motivation on salt reduction. The answering patterns were similar across different sociodemographic groups.

Awareness and adoption of salt reduction tools

The results showed a general pattern of high awareness but low adoption of salt-restriction spoons and low-sodium salt (Table 5). Between these two tools, low-sodium salt was relatively more popular, with 85.0% of consumers at least having heard of it and 36.5% of consumers having (ever) used it. In comparison, 70.8% of consumers had heard of salt-restriction spoons and only 20.1% had (ever) adopted them. People with third-level education had a higher awareness and usage of these tools. Middle-aged and elderly people were more likely to have used salt-restriction spoons than other age groups, while females used low-sodium salt more than males. Availability of these tools in the market seems to be an issue: correspondingly 30.3 and 25.9% of consumers had heard of salt-restriction spoons and low-sodium salt, but never saw them.

In relation to cooking skills that can help salt reduction, 52.0 and 52.9 % of consumers were aware of the correct practices (taste the dish before adding salt and add salt at a late stage of cooking, respectively). Better-educated people, females and young people were more knowledgeable about these salt reduction tips. It should be noted that 28.5 % of consumers incorrectly believed that replacement of salt with soya sauce can help salt reduction.

Consumer beliefs about national salt reduction strategies

In relation to salt reduction, Chinese consumers believed that they themselves should take the most responsibility (67.4 %), with stakeholders such as food producers (53.5 %), restaurants and caterers (52.0 %) and governments (45.2 %) also viewed as having an important role (Table 6). Young consumers (aged 19–35 years) and consumers with high education expressed more emphasis on other stakeholders' responsibilities in salt reduction.

Among a list of measures that can be taken to help to reduce the population's salt intake, Chinese consumers expressed strong beliefs in the effectiveness of salt-restriction spoons and public education. About 40 % of consumers also expressed confidence in strategies related to food labelling, such as clear symbols to signal the level of salt and clear indication of salt content. Salt tax was considered as least effective. Well-educated consumers and young people, in comparison to their counterparts, were more confident in the effectiveness of the strategies listed.

Discussion

The present study mapped Chinese consumers' knowledge on salt intake and salt reduction, their beliefs and behaviour, and their support for different salt reduction strategies. Using a large sample of participants recruited across China, the study provided a comprehensive picture to inform this country's ongoing nationwide salt reduction initiatives. According to our results, in general, participants' belief about their main source of salt intake was in line with the estimation from published dietary studies^(7,8). The finding that young consumers and well-educated people were relatively more likely to consider restaurant foods as their main source of salt may reflect a social phenomenon: in China, young unmarried white-collar workers increasingly rely on restaurant foods and online delivery of their meals^(10,27,28). Regarding food items, Chinese consumers were well aware of salt in traditional salty foods, but less aware of salt in certain staple foods, snacks and flavourings that do not carry a typical 'salty' taste. Public health education should improve consumers' knowledge on 'hidden' salt content in commonly consumed food products. Our findings also showed large room to improve consumers' knowledge on the salt intake threshold and the relationship

between sodium and salt. This is particularly pertinent given the emphasis placed on low-sodium salt as a strategy in current salt reduction campaigns in China.

Despite excessive salt intake as a common problem in China⁽³⁾, our data showed that almost 80 % Chinese consumers perceived their salt intake was about right or too little. This resonates with an international study showing that consumers largely underestimate their salt intake across countries⁽¹⁸⁾. One explanation is many Chinese consumers may not be aware of the severity and prevalence of the salt intake problem in this country. Another possible explanation is the 'optimism bias' or 'it won't be me' effect. Optimism bias is a cognitive bias that causes a person to believe him/herself is less likely to experience a negative event. Such bias has been observed in the public's health risk perception⁽²⁹⁾. Underneath this phenomenon is a key question: how easy it is for consumers to evaluate their salt intake? Food diary-based salt intake measurement requires significant effort (e.g. inspection of nutrition labels, weighing/recording of all items containing salt), so do urine test-based methods. More practically, consumers can be empowered with digital tools. For instance, there has been an online/mobile phone-based 'sodium calculator' assisting consumers to quickly estimate their salt intake level^(30,31). The validity and reliability of this calculator are yet to be confirmed; however, it shows the potential of digital tools in self-evaluation of salt intake.

In relation to salt reduction intentions, according to our study, a majority of Chinese consumers expressed interest in and believed in the health benefits of eating less salt. They were aware of salt reduction tools that had been promoted in national or regional health campaigns. However, over 40 % of consumers had never tried salt reduction, and many consumers had never used salt reduction tools and maintained the efforts. A big challenge in public health intervention is to bridge the gap between motivation and behaviour. The Theory of Planned Behaviour and the Transtheoretical Model and Stages of Change suggest that behaviour change can be complex and is influenced by factors beyond personal interest, such as decisional balance (i.e. relative weighing of the pros and cons of changing), self-efficacy and environmental factors^(32,33). Regarding salt reduction behaviour, as reflected from our data, lack of willingness to compromise on taste is a huge barrier. However, certain salt reduction strategies (e.g. salt substitutes and cooking skills) will not significantly influence the taste and positively phrased messages (e.g. 'same great taste, less salt and more herbs') will help to result in equal sensory satisfaction as for the regular product^(6,34,35). Public health initiatives should address this perception that salt reduction will necessarily lead to taste reduction. Apart from this, salt reduction tools should be made widely available to consumers, and market promotional activities can be introduced to gain people's attention and to increase the accessibility to these tools.



Regarding different strategies for population-level salt reduction, Chinese consumers wished to be empowered to control their own salt intake: they viewed themselves as having the most responsibility and they mostly favoured strategies like salt-restriction spoons and public education. This is possibly because they already knew their major source of salt intake is from their own cooking. There have been explorations of the best educational strategies regarding hypertensive risk and salt intake in China. Evidence shows that interactive education workshops (e.g. using visual tools, cartoons/animations, demonstration of the use of salt spoons, etc.) are more effective than strategies based on lectures or self-reading⁽³⁶⁾; and the inclusion of salt reduction education in children's curriculum can help to lower their families' salt intake⁽³⁷⁾.

About 40 % of consumers expressed strong confidence in labelling strategies such as clear symbols to highlight salt levels on food packaging and clear indication of salt content. In China, under the current rules of food labelling (GB 28050-2011), salt content is indicated by sodium content and its percentage in relation to Nutrient Reference Value. Our study showed 42.5 % of consumers did not associate sodium with salt. Another study suggests that only 20 % of Chinese consumers have a good objective understanding of Nutrient Reference Values⁽³⁸⁾. This line of evidence highlights the need for more user-friendly food labelling and effective public education. One possibility is the implementation of front-of-pack labelling, in order to enable quick and easier evaluations of nutrition profiles including salt content. Globally, colour-coded labelling (e.g. the government-endorsed UK traffic light labels), 'high in...' warning statements in South America and the Health Star Rating system in Australia and New Zealand are good examples⁽³⁹⁾. If China decides to implement front-of-pack labels, it should carry out rigorous consumer tests to inform the design and provide technical supports and robust guidance for food companies. Such efforts should be accompanied by public communication to encourage proper use of the labels among consumers.

Furthermore, the Chinese government can engage the food industry to reduce the population's high salt intake. In April 2018, China, for the first time, officially launched salt reduction guidelines for the food industry⁽¹³⁾. This is in line with the global trend of including industry engagement and food product reformulation as a pillar of national salt reduction strategies⁽¹⁹⁾. Such efforts should be carefully balanced with those strategies focusing on consumers' cooking behaviour, given that for a majority of Chinese consumers, salt from processed and restaurant foods is still a small contributor to their salt intake^(7,8). In addition, our survey showed relatively less public interest in setting salt limits for children's foods and restaurant foods. Lastly, fiscal policies (i.e. salt subsidies and tax) were least favoured by Chinese consumers, which is similar to Regan *et al.*'s⁽²⁶⁾ finding with a Western cohort.

The current study examined individual differences across age, gender and education. Education demonstrated a substantial impact: knowledge regarding salt and salt reduction, salt reduction intention and efforts, and the support on salt reduction strategies strongly decreased along with educational attainment. In addition, older consumers were more interested in and active on salt reduction, but their declarative salt knowledge was lower than younger people's. Previous research indicates that Chinese women are more likely than men to modify their salt reduction⁽²¹⁾; while from our research, overall, the gender differences were moderate. Due to restriction on survey length, the present study did not explore how other demographic variables (e.g. marital status, presence of children, social economic status, urban/rural divide), lifestyle factors (e.g. the frequencies of eating out/consuming ready-to-eat meals/self-cooking) and psychological factors (e.g. health concerns and beliefs, food choice motivations, attitudes) may have influenced participants' knowledge, interest and behaviour in relation to salt reduction. Previous studies suggest that the residential place (i.e. urban/rural) is a determinant of the adoption of salt-restriction spoons in Beijing⁽⁴⁰⁾, and individual attitudes and beliefs related to health and salt are strong predictors of support for government-led salt reduction policies⁽¹⁹⁾. Future research can explore variations between individuals in detail, by including more demographic and socio-psychological factors and using more complicated statistical analysis. It will help to design targeted salt reduction initiatives for different subgroups of the Chinese population.

Conclusion

The present study provides an insight into Chinese consumers' declarative knowledge, beliefs and behaviours in relation to salt intake and salt reduction. In the past number of years, at the national and regional level, China has made efforts to promote healthy eating and lower its population's salt intake. Our study shows that there is still room for improvement. There are key knowledge gaps to fill, and the adoption levels of salt reduction tools, especially among less educated consumers, is still low. Our study also illustrates consumer confidence in different strategies regarding salt reduction, which can be of value to policy makers and decision makers when developing and implementing public health strategies.

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