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Prevalence of Overconsumption of Salt and its Determinants – The Case of Southwestern Rural China

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Abstract

Aim: Overconsumption of salt contributes to hypertension and increases the risks of cardiovascular diseases. Most studies that investigated salt intake by applying the Health belief model (HBM) have focused on urban settings. This study aims to identify the prevalence of salt overconsumption (>6 g per day) in a rural village in Southwestern China and to determine the association between knowledge regarding salt consumption/HBM constructs and salt overconsumption behavior among village residents.

Methods: In this cross-sectional study, 79 adults aged 18 years and above were interviewed using household-based and face-to-face questionnaires. Salt intake was measured using an electronic balance in accordance with a previous protocol.

Results: Our finding showed that the average daily salt intake is 11.19±11.14 (mean±SD) g. Moreover, 64.6% of the participants overconsumed salt. None of the participants was aware of the national recommendation for salt intake. Univariate logistic regression showed that i) knowledge about hypertension causing cardiovascular diseases (odds ratio [OR_u]=3.02), ii) perceived severity of hypertension as a serious disease (OR_u=4.92), and iii) perceived benefit of reducing salt intake to prevent hypertension (OR_u=3.52) were unexpectedly positively associated with salt overconsumption behavior. All the studied sociodemographic factors were not associated with salt overconsumption behavior.

Conclusions: A high prevalence of salt overconsumption was found among residents of rural villages in Southwestern China. HBM was unable to explain the causal relationship between its constructs and salt overconsumption behavior. The extremely low awareness of the national salt recommendation highlighted the urgent need to provide relevant health education in rural China.

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Introduction

Hypertension is one of the leading disease burdens worldwide, with a global prevalence of approximately 40% among adults aged 25 years and above[1]. The World Health Organization reported that sodium intake from more than 5 g of salt per day increases the risk of developing hypertension, which in turn, causes cardiovascular diseases, kidney diseases, and stroke. The major source of sodium is salt from our diet[2]. In China, the Dietary Guidelines for Chinese Residents recommend 6 g as the maximum amount of salt intake for adults per day[3]. Despite this clear guideline, hypertension control remains an ongoing challenge. Data from the Report of National Nutrition and Health Survey of China Residents indicate that the average salt intake in China is up to 12 g per day, which is two times higher than the national recommendation[4]. Consequently, 2.7 billion Chinese people suffer from hypertension, causing more than 2 million deaths and accounting for 24.6% of the total mortality in 2010[5, 6].

The hypertension problem is particularly evident in rural China [7]. Salt overconsumption is more serious in the rural setting than in urban areas[4]. Hypertension, diabetes, and cerebrovascular diseases among rural villagers were included in the top 10 chronic conditions in rural China, with a hypertension prevalence of 22.8% among people aged 18 years and above in 2014[8, 9].

Although salt overconsumption is an alarming health concern in rural China, minimal effort has been exerted to investigate the factors that influence salt intake behavior among this large population. Most previous studies were conducted on the basis of the knowledge, attitude, and practice (KAP) survey model[10-13]. Health belief model (HBM) is a commonly used behavioral theory for explaining health behavior. It comprises six constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action, and self-efficacy[14, 15]. HBM helps provide information about cognitive factors that affect an individual's salt intake behavior, such as threat perception, evaluation of the behavior, motivation, and ability to act. Therefore, the result provides the rationale for designing effective intervention for salt reduction in the future.

Previous studies in urban settings showed that knowledge regarding hypertension and salt consumption and five constructs of HBM (i.e., perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cue to action) are significantly associated with hypertension management and salt restriction behavior[16, 17]. Accordingly, whether these factors are also applicable to rural settings in China should be investigated. The current study aims to (I) describe the prevalence of salt overconsumption (>6 g/day) in Southwestern China and (II) investigate the association of knowledge regarding salt consumption and the aforementioned five constructs of HBM with salt overconsumption behavior. The participants are hypothesized to have (I) low perceived susceptibility of hypertension, (II) low perceived severity of hypertension, (III) high perceived barriers of salt reduction, (IV) low perceived benefits of salt reduction, (V) less cues to reduce salt intake, and (VI) less knowledge regarding hypertension. These conditions are likely to result in salt overconsumption behavior.

Methods

A cross-sectional questionnaire survey was conducted in March 2017 in Xingguang Village, Yushan Township, Pengshui Miao and Tujia Autonomous County, Chongqing Province. The village comprises 9 subgroups, 520 households, and approximately 2000 residents from diverse ethnic groups, including Han, Miao, and Du Jia. Inclusion criteria of the present study include those who are permanent residence of the village. Only those who are 18-year-old or above would be invited to this study. The inclusion criterion of 18-year-old was selected in accordance with the settings of similar studies[10-13]. Exclusion criteria include those with communication difficulties including but not limited to hearing or speech impairment, as well as villager who speaks a language that could not be understood by both the interviewer and the translator. Informed consent was obtained from all the participants before the interview commenced. Ethical approval was approved by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong. A total of 81 villagers were interviewed. Among which, 2 were excluded from data analysis due to incomplete questionnaires. Therefore, 79 valid questionnaires were obtained for data analysis.

A face-to-face structured questionnaire was

administered by the interviewers. They were responsible for reading questions, and the interviewees would select their answers with the help of translators in case of language barriers. Prior to data collection, a pilot test was conducted among village heads who had never participated in an interview. All the interviewers and translators were briefed before data collection to ensure that the questions would not be misinterpreted. The measurement method for the interviewees' daily salt intake amount was taught in detail to minimize errors. Each interview was completed for 15–20 min.

The sociodemographic characteristics of the interviewees were recorded. These characteristics included gender, age, ethnic group, marital status, educational level, occupation, household annual income, number of family members living together, and hypertension status. The estimated individual annual income was calculated by dividing the interviewee's household annual income by the number of family members living together.

The independent variables in this research are (I) knowledge regarding hypertension and salt consumption and (II) determinants derived from the five constructs of HBM asked using close-ended yes/no questions. Likert scale questions were not used because the education level in the village was low and might affect the validity of the result. Response options included "yes," "no," "do not know," and "refuse to answer."

Salt consumption - and hypertension-related knowledge included four questions, namely, (1) "Does high salt intake cause hypertension?" (2) "Does hypertension cause kidney diseases?" (3) "Does hypertension cause cerebrovascular diseases such as stroke and heart diseases?" and (4) "Do you know the national recommendation level for adult daily salt intake?" For the question regarding the national recommendation level, additional options, including "12 g," "10 g," "6 g," "3 g," "do not know," and "refuse to answer," were provided to test whether the interviewee really knew the answer. A "yes" answer and a correct answer of "6 g" were categorized as having knowledge of the national recommendation, whereas "no" and "do not know" were categorized as having no knowledge of this item.

For the five constructs of HBM, perceived susceptibility to having hypertension or worsening their hypertension was assessed using two items. The first is "Do you agree that you have a high chance of developing hypertension in the future?" for villagers without hypertension. The second is for villagers with hypertension who were asked, "Do you agree that your hypertension has a high chance of worsening in the future?" The item "Do you agree that hypertension is a serious disease?" was used to measure the perceived severity of hypertension. The perceived benefit of salt intake reduction was measured using the item "Do you agree that reducing salt intake can prevent hyperten-sion?" For the perceived barriers to salt reduction, the two items used were "Do you agree that reduced salt intake will weaken your physical strength?" and "Do you agree that reduced salt intake will negatively affect the taste of food?" Lastly, cues to the action of salt reduction were measured using two items: "Have you ever been advised to reduce your salt intake by medical personnel?" and "Have you ever been advised to reduce your salt intake by nonmedical personnel, such as your friends or family members?" A "yes" answer was categorized as having perception, whereas "no" and "do not know" were categorized as having no perception of that item.

The dependent variable in this study is the daily salt intake of the participants. Measurement was modified from the methods used in previous studies[11, 18] as follows:

(Use of salt per meal per family × daily number of family meals prepared with salt)/Number of household members

The number of household members of the interviewees was determined in the demographic section of the questionnaire. Interviewers provided the interviewees with a pack of salt and then asked them to pour the amount of salt they would use to prepare a meal for their household into a measuring cup on an electronic balance. The standard question asked was "If you have to prepare a meal for your entire family, how much salt would you use?" The electronic balance was set to zero before the salt was weighed. In case the interviewee was not responsible for cooking in his/her household, the interviewers would invite the corresponding family member to do the salt-weighing

activity. The interviewee could agree or disagree with the amount and add or reduce the amount accordingly. Eventually, the amount of salt used by the family per meal was determined. The number of meals that involved salt use was determined by asking the question "How many meals in your family are prepared with salt?" The interviewee's daily salt intake amount was calculated and categorized into normal (≤6 g/person/day) and overconsumption (>6 g/person/day).

Double data entry and data cleaning were performed before data analysis to ensure the high quality of data. The association between sociodemographic characteristics and salt overconsumption behavior was determined via univariate logistic regression analysis. The univariate odds ratios (OR_u) and respective 95% confidence interval (CI) were reported. Statistically significant sociodemographic ($p < 0.05$) in the univariate analysis would be adjusted in the final model between knowledge/HBM constructs and salt overconsumption behavior. IBM SPSS Statistics 22 software was used for data analyses. Statistical significance was taken at the 0.05 level.

Results

The majority of the 79 valid interviewees were male (74.1%), with Han ethnicity (86.4%), married (84.0%), farmers or fishermen (70.4%), suffer from hypertension (66.7%), and have 4 to 6 family members (64.6%). Other sociodemographic factors (educational level, age, and income) are distributed evenly (Table 1). The average daily intake of salt is 11.19 ±11.14 (mean ±SD) g. The prevalence of salt overconsumption (>6 g/day) among the participants was 64.6%.

Regarding knowledge about hypertension, one-fifth (20.3%) of the participants correctly pointed out that high salt intake causes hypertension. Moreover, 32.9% of the participants knew that hypertension causes kidney diseases. More than half (50.6%) of the participants acknowledged that hypertension causes cardiovascular diseases. However, none of the participants answered the question about the national recommendation on daily salt intake correctly.

For the HBM constructs, in terms of perceived severity, 79.7% of the participants agreed that hypertension is a serious disease. However, many participants (62.0%) did not agree that reducing salt intake prevents hypertension (perceived benefits). With regard to perceived barriers, a substantial number of respondents had the misconception that reducing salt intake weakens their physical strength (51.9%) and makes food bland (78.5%). In terms of perceived susceptibility, only 13.9% of the participants agree that their chance of developing hypertension is high or that their hypertension will worsen in the future. Lastly, regarding cues to action, most participants had not been previously advised to reduce their salt intake, and 86.1% and 83.5% of the respondents had never been advised to reduce their salt intake by medical and nonmedical personnel, respectively (Table 2).

Univariate logistic regression analysis was run between all the sociodemographic factors and salt overconsumption behavior. None of the sociodemographic factors was associated with salt intake (Table 3). Thus, no adjustment was made for sociodemographic factors in the final model between knowledge and the determinants derived from HBM and salt overconsumption behavior (Table 4).

Univariate logistic regression was used to test the association of the independent variables, including knowledge regarding hypertension and salt consumption, and HBM constructs, with salt overconsumption behavior. A significant positive association exists between participant's knowledge regarding hypertension as a cause of cardiovascular diseases and salt overconsumption behavior (OR_u = 3.02, 95% CI = 1.14–7.95). Moreover, the perceived severity of hypertension as a serious disease (OR_u = 4.92, 95% CI = 1.03–23.51) and the perceived benefits of reducing salt intake to prevent hypertension (OR_u = 3.52, 95% CI = 1.34–9.28) were positively associated with participant's salt overconsumption behavior. Other factors were found to be statistically insignificant (Table 4).

Discussion

In the current study, the prevalence of salt overconsumption was determined to be 64.6%. This figure was higher than the general salt overconsumption prevalence in Mainland China, i.e., 50%[19]. This high prevalence indicates an urgent need for salt reduction intervention in rural Southwestern China. Given that

Table 1. Background characteristics of participants (n = 79)

	n	%
Gender		
Male	58	73.4
Female	21	26.6
Education Level		
Below Primary Education	20	25.3
Primary Education	27	34.2
Secondary Education and above	32	40.5
Age		
18-24	6	7.6
25-44	28	35.4
45-64	27	34.2
≧65	18	22.8
Ethnic Groups		
Han	68	86.1
Miao	10	12.7
Others	1	1.3
Marital Status		
Unmarried	9	11.4
Married	66	83.5
Divorced	1	1.3
Bereaved	3	3.8
Occupation		
Farmer/ fisherman	56	70.9
Miner	1	1.3
Worker	3	3.8

Housewife	8	10.1
Unemployed	7	8.9
Others	4	5.1
Annual Household Income (RMB$)		
$<10,000	13	25
$10,000 – 19,999	9	17.3
$20,000 – 29,999	17	32.7
$≧30,000	13	25
Annual Individual Income (RMB$)		
$<1000	6	11.5
$1000 – 2499	9	17.3
$2500 – 4999	18	34.6
$5000 or above	19	36.5
Hypertension		
Yes	53	67.1
No	15	19
Don't know	11	13.9
Number of family members		
1-3	13	16.5
4-6	51	64.6
7-10	15	19

Table 2. Frequency distribution of participant's knowledge and HBM constructs (n=79)

	Yes (%)
Knowledge	
High salt intake causes hypertension	20.3
Hypertension causes kidney diseases	30.9
Hypertension causes cardiovascular diseases such as stroke	50.6
Correct description of national recommendation on daily salt intake	0
Perceived Severity	
Hypertension is a serious disease	79.7
Perceived benefit	
Reduction of salt intake prevents hypertension	38
Perceived Barriers	
Reduction of salt intake reduces physical strength	51.9
Reduction of salt usage makes foods less tasty	78.5
Perceived Susceptibility	
High chance to develop / worsen of hypertension in the future	13.9
Cues to Action	
Advised by medical staff to reduce salt intake	13.9
Advised by non-medical staffs to reduce salt intake	16.5

Table 3. Association between socio-demographic factors with salt over-consumption behavior

	#OR_u (95% CI)	*p-value*
Gender		
Female	0.48 (0.15 - 1.48)	0.2
Education Level		
Secondary Education and above	1.0 (Reference)	
Below Primary Education	1.36 (0.44 – 4.24)	0.59
Primary Education	0.58 (0.19 - 1.79)	0.35
Age		
25-44	1.0 (Reference)	
18-24	0	0.99
45-64	0.90 (0.30 – 2.74)	0.85
≧65	1.80 (0.54 – 6.00)	0.34
Ethnic Groups		
Han	1.0 (Reference)	
Miao	3.14 (0.80 – 12.26)	0.1
Others	0	1
Marital Status		
Married	1.0 (Reference)	
Unmarried	0.21 (0.02 – 1.74)	0.15
Divorced	0	1
Bereaved	3.28 (0.28 - 38.06)	0.34

Annual Household Income (RMB$)		
$20,000 – 29,999	1.0 (Reference)	
$<10,000	0.48 (0.12 – 1.98)	0.31
$10,000 – 19,999	0.45 (0.08 – 2.45)	0.36
$≧30,000	1.36 (0.39 – 4.74)	0.63
Annual Individual Income (RMB$)		
$5000 or above	1.0 (Reference)	
$<1000	0	0.99
$1000 – 2499	0.56 (0.11 – 2.90)	0.49
$2500 – 4999	0.56 (0.15 – 2.10)	0.39
Hypertension		
Yes	1.0 (Reference)	
No	1.21 (0.36 – 4.06)	0.76
Don't know	0.75 (0.14 – 4.13)	0.74
Number of family members		
4-6	1.0 (Reference)	
1-3	1.88 (0.54 – 6.48)	0.32
7-10	1.46 (0.44 – 4.80)	0.53

[#]OR_u: Odds ratios of univariate logistic regression model.

Table 4. Association between knowledge and HBM constructs and salt over-consumption behavior

	#OR_u (95% CI)	*p-value*
Knowledge		
High salt intake causes hypertension	0.79 (0.24 - 2.56)	0.7
Hypertension causes kidney diseases	0.95 (0.35 – 2.53)	0.91
Hypertension causes cardiovascular diseases such as stroke	**3.02 (1.14 – 7.95)**	**0.03**
National recommendation level on daily salt intake	NA	NA
Perceived Severity		
Hypertension is a serious disease	**4.92 (1.03 - 23.51)**	**0.05**
Perceived benefit		
Reduce salt intake can prevent hypertension	**3.52 (1.34 – 9.28)**	**0.01**
Perceived Barriers		
Reduce salt intake will reduce your physical strength	1.74 (0.68 – 4.44)	0.25
Reduce salt usage will make the food taste less good	2.05 (0.60 – 7.03)	0.25
Perceived Susceptibility		
High chance to develop / worsen of hypertension in the future	1.05 (0.28 – 3.94)	0.95
Cues to Action		
Advised by medical staff to reduce salt intake	0.65 (0.16 – 2.66)	0.54
Advised by non-medical staff to reduce salt intake	1.17 (0.34 – 3.99)	0.8

#OR_u: Odds ratios of univariate logistic regression models; NA: Not applicable

food tradition and salt use vary considerably in different parts of China, our results provide a basis for other comparison studies to determine the accurate behavior of Chinese people across the country in terms of salt intake. Our results also found that none of the participants know the national recommended daily salt intake. This finding is alarming because it indicates that the Chinese government must exert considerable effort to promote this information to rural villagers. By doing so, villagers can be aware of the maximum intake level and limit their intake accordingly. However, such promotion should be in accordance with the cultural context of a rural setting and should consider the daily living of the people. For example, the villagers should be taught the daily salt limit by using teaspoons rather than conveying the abstract concept of 6 g per day. This nutrition education can be accompanied by the distribution of salt-restriction spoons for standardizing the amount of salt use and facilitating the commencement of salt restriction behavior.

To the best of the authors' knowledge, this study is the first to apply HBM as a theoretical framework to investigate salt overconsumption behavior in rural China. Similar to previous relevant studies on hypertension management and salt restriction behavior[16, 17], the current work found that knowledge regarding hypertension, perceived severity of hypertension as a serious disease, and perceived benefit of salt reduction in preventing hypertension were significantly associated with salt overconsumption behavior. Nevertheless, a strong positive association was observed between the three factors and salt overconsumption behavior in contrast with the expected negative association as stated in the study hypotheses. Such unexpected association might be due to the causality issue that was relevant to the cross-sectional nature of this study. A similar reversed association was reported when HBM was applied to other cross-sectional studies[20]. People who exhibit salt overconsumption behavior may already be aware of the strong taste of their daily diet; thus, they are likely to be aware of their problem, research on this issue, and eventually increase their knowledge and insights regarding salt intake and hypertension. Similarly, people who overconsume salt may perceive hypertension as a serious disease because of the guilt associated with high salt intake. Moreover, they believe that reducing their salt intake can prevent hypertension (i.e. perceived benefit).

This study may help in formulating evidence-based health intervention for salt reduction in rural settings with similar cultural background and dietary habits. A high proportion of the participants believe that reducing salt use makes food bland. Moreover, many participants did not consider themselves susceptible to the negative effects, e.g., hypertension, of salt overconsumption and had never been previously advised to reduce salt intake. This finding partly explained why salt overconsumption is highly prevalent in the studied village. Therefore, future health intervention should focus on educating rural villagers on how to use salt substitutes in their diet. For example, the use of inexpensive and healthy herbs, such as garlic, chili, chives, coriander, star anise, and ginger, as salt alternatives can be introduced. This measure can provide subjects with a cue to commence salt reduction. Future health intervention can also focus on educating rural villagers about the current prevalence of hypertension in rural China and providing immediate blood pressure measurement to the participants. Consequently, their awareness and perceived susceptibility toward hypertension will improve.

This survey paved the way for a new research direction for future studies. Given the high prevalence of salt overconsumption behavior and that HBM constructs cannot explain the causal relationship with this behavior, future studies with a larger sample size should be conducted. A longitudinal design should be used to confirm the relationship among various HBM constructs. Moreover, a similar study that uses other behavioral theoretical frameworks can be conducted to check their applicability to explaining salt intake. Performing cluster analysis to investigate the effects of factors, such as hypertension status and education level, on salt overconsumption behavior may be also feasible in studies with a large sample size.

The present study exhibits several limitations. First, the cross-sectional nature of this work prevents the establishment of causal relationships between the studied factors and the salt overconsumption behavior of the subjects. Second, the sample size of this study is relatively small. This study used household survey, that is only one questionnaire was collected for one village

house irrespective of total number of household members. This limits the eventual number of finished questionnaire. Also, the geographical restriction of scattered households across hills hinders effective data collection. Moreover, many inhabitants of the village are migrant workers who moved to the cities during the data collection period. Thus, this needs to be taken into account when applying this study's finding for future reference. Third, language barrier exists. A number of old villagers speak only the rural Chongqing dialect. The research team employed translators for the interviews but information loss was possible during translation. Lastly, the salt measurement method in this study relies on the villagers' self-reported amounts. Underestimation or overestimation of the actual salt intake is possible. Also, although home cooking is the major way of dining in rural village there may be likelihood that the participants in this study consume foods away from their home. Thus, other dietary salt assessment tools, such as food frequency questionnaire, which is widely used in measuring salt intake in Chinese nutrition surveys [21], can be used in future investigations to validate the collected results.

To conclude, the prevalence of salt overconsumption was high among residents of rural villages in Southwestern China. HBM cannot explain the causal relationship between its constructs and salt overconsumption behavior. A positive association between perceived severity and benefit remains unsolved, but its understanding can help in formulating interventions for salt reduction. The findings of this study highlight that the current status of health education in China is insufficient to improve awareness of the national recommended salt intake and the health risks associated with high salt intake. Health intervention based on the local context of rural settings should be urgently developed.

Authorship Declaration

Tony Yung's works include formation of research idea / supervise data collection / manuscript preparation. Rainbow Mok's works include data collection / manuscript preparation. All authors are in agreement with the manuscript and declare that the content has not been published elsewhere.

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Conflicts of Interest

The authors declare no conflicts of interest.

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