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Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-056725
Article Type:	Original research
Date Submitted by the Author:	23-Sep-2021
Complete List of Authors:	Gupta, Ashish; Vital Strategies, Carroll, Tom; Vital Strategies Chen, Yu; Vital Strategies Liang, Wenzhuo; Vital Strategies Cobb, Laura; Resolve to Save Lives, An Initiative of Vital Strategies Wang, Yichao; Beijing Haisi Aide Technology Co Ltd Zhang, Juan; Chinese Academy of Medical Sciences & Peking Union Medical College Chen, Yeji; Anhui Provincial Center for Disease Control and Prevention Guo, Xiaolei; Shandong Center for Disease Control and Prevention Mullin, Sandra; Vital Strategies Murukutla, Nandita; Vital Strategies
Keywords:	Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH, NUTRITION & DIETETICS

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“Love with Less Salt”: Evaluation of a Sodium Reduction Mass Media Campaign in China

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Keywords: mass media campaigns, salt reduction, evaluations, knowledge, attitude, behavior, intentions, salt use.

Word count:

Abstract: 199

Main text: 3998

Abstract

Objective: This study examined the impact of a salt reduction campaign on knowledge, attitudes and behaviors in relation to salt consumption in two provinces of China.

Methods: In 2019, the “Love with Less Salt” campaign ran on China Central Television and on local television channels in Shandong and Anhui provinces. Data for this study come from two representative household surveys conducted among a sample of adults aged 25 to 65 years in Anhui and Shandong provinces pre-campaign (n=2,000) and post-campaign (n=2,015). Logistic regression was performed to estimate the effects of the campaign on knowledge, attitudes and behaviors.

Results: Overall, 13% of post-campaign respondents recalled seeing the campaign, and reactions toward it were highly positive. Post-campaign respondents were more likely to plan to reduce the purchase of goods high in salt than pre-campaign respondents (OR=1.45, $p<0.05$). Campaign-aware respondents were significantly more likely than campaign-unaware respondents to report higher levels of knowledge, attitudes and behaviors regarding salt reduction.

Conclusions: Findings reveal that salt reduction mass media campaigns can be an effective public health tool for encouraging positive change and reducing salt intake in China. Continued and sustained mass media investments are likely to be effective in addressing high salt consumption nationwide.

Article summary

Strengths and limitations of this study:

- Cohort design for a campaign evaluation risks sensitization bias hence repeated cross-sectional study design was used.
- Multistage probability sampling procedures and data weighting were applied to have robust samples representing the population.
- Frequency of exposure to the campaign was not measured which can inform the minimum level of exposure required for impact on behavior change.
- Assessment of campaign impact relied on self-reported measures related to sodium consumption rather than physical measures of actual sodium intake.

INTRODUCTION

High sodium intake is a risk factor for hypertension, cardiovascular disease and cerebrovascular disease, and morbidity and mortality associated with these conditions.¹⁻³ The World Health Organization recommends reducing sodium intake to less than 2 grams per day (equivalent to 5 grams per day of salt). Globally, many adults exceed recommended guidelines, resulting in nearly 1.65 million deaths from cardiovascular disease.^{4,5} Evidence shows lowering sodium intake to recommended levels can substantially reduce associated risk factors.⁶

In China, average salt intake is among the highest in the world;⁷ at 10.5 grams per day, it is more than double the amount recommended by the World Health Organization.⁷ In 2010, an estimated 441,200 cardiovascular deaths in China—10% of the total—were due to high sodium intake, of which 34,500 deaths occurred in Shandong province alone.⁸ Home cooking in China contributes to over three-quarters of sodium consumption (76%),⁹ and food preparation often involves adding salt and salty seasonings or condiments.^{10,11}

Literature on knowledge, attitudes and behaviors regarding sodium intake in China suggests that although people are aware of the links between high sodium and hypertension, people often associate high salt with better taste and greater physical strength.^{11,12} In some cases, this dietary choice also stems from the preference for “traditional cuisine.”¹¹

Mass media campaigns have proven to be an effective public health tool for addressing social norms and promoting behavior change related to, for example, tobacco use.¹³⁻¹⁵ These effects have largely resulted from graphic depiction of tobacco-related health harms in a personally relevant and engaging way, prompting quitting behavior to avoid these harms and influencing social norms to support changes in smoking behaviors.¹⁶ Undertaking formative research to pre-test communication concepts with target audiences has been key feature of effective tobacco control campaigns. While evidence reflecting the effectiveness of mass media campaigns linked to sodium reduction is limited¹⁵, it is reasonable to conclude that they have the potential to influence consumption behaviors when strategies are developed and tested through research and implemented within a comprehensive package of sodium reduction interventions.^{15,17,18}

Effective mass media campaigns convey both essential health information and persuasive, emotionally appealing stories and images.^{19,20} Research on sodium intake in China suggests that, to be effective, mass media campaigns need to show people how they consume excessive sodium and how their association of sodium with better taste and physical strength can perpetuate unhealthy eating habits.¹²

Based on this evidence, in 2019 the Centers for Disease Control and Prevention of both Shandong and Anhui provinces, with technical assistance from Vital Strategies and its initiative Resolve to Save Lives, developed and implemented an evidence-based mass media campaign targeting household salt reduction. The objectives of the campaign were to: (1) increase knowledge of the harmful effects of excessive salt intake; (2) shift social norms and attitudes about salt consumption; and (3) influence food preparers to decrease the amount of sodium added in cooking. This was a first-of-its-kind campaign to depict the dangers of the high-salt diet common in China.

METHODS

A mass media campaign in Shandong and Anhui provinces

Based on advice from provincial program team members, the primary target audience designated for the campaign were women who were primary food preparers for their household as they exerted critical influence on sodium consumption and family health. Extensive formative research was undertaken with primary food preparers (women 25-65 years) and with the secondary audience of other influencers of household cooking (men 25-55 years) in each province to test the relative effectiveness of different messages and message styles to motivate primary food preparers to reduce salt in their cooking and to encourage influencers to support this change. These communication concepts included the depiction of a happy family providing positive encouragement for cooking with less salt, demonstration of how to replace salt in cooking but still maintain taste, presentation of lower salt cooking by a celebrity chef, and a testimonial story of a man who experienced hypertension and stroke due to excessive salt consumption. The research findings indicated that while it was relatively easy to communicate information about limiting salt consumption, engaging and motivating people to recognize the serious consequences of excessive salt consumption and the importance of changing their behavior in relation to salt use in cooking, required communication at both an emotional and informational level. The findings showed that the testimonial concept was most effective in generating this engagement and motivation but lacked sufficiently clear direction about how to avoid harms from excessive salt consumption. Subsequently, the campaign strategy and production focused on a personal narrative of harm from excessive sodium consumption, complemented by expert advice about reducing sodium intake presented by a doctor. The “Love with Less Salt,” campaign 30-second television public service announcement (PSA) was produced and broadcasted on national, provincial, and local television stations through a paid media plan. It featured the story of a man who developed hypertension and suffered a stroke due to his ongoing consumption of salty food, despite his wife’s warnings. The research demonstrated that an important feature of the script’s impact for both female and male participants was the husband’s introspection and regret about the ongoing burden that he was now imposing on his family, and this was carefully embedded in the PSA. In the final script the doctor identifies excessive salt intake as the main cause of hypertension, which increases the risk of stroke and heart disease and urges limiting salt consumption to no more than 5 grams per day, stating: “For the health of your family, use less salt when you cook.” The campaign complemented the 2019 Healthy China 2030 Action Plan, which recommends the 5 grams of salt per person per day limit.

The PSA aired September-October 2019 in Shandong and Anhui provinces, with a combined population exceeding 160 million people. China Central Television also broadcast the PSA across the country throughout September 2019, coinciding with broader campaign efforts,

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3 including billboards, posters and community education activities undertaken by the provincial
4 Centers for Disease Control and Prevention.
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7 **Evaluation study design**

8 The impact of the campaign was assessed through pre- and post-campaign representative
9 cross-sectional face-to-face household surveys among the campaign's target audiences to
10 measure campaign awareness and reactions, as well as changes in knowledge, attitudes and
11 behaviors regarding salt consumption.
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14 **Sampling method and sample size**

15 A multistage probability sampling procedure was used with stage-specific sampling
16 frames to select participants for the surveys in Anhui and Shandong provinces. In each province,
17 cities were selected to ensure representation across different tiers of society; the selection of
18 districts and subdistricts corresponded accordingly. In the case of rural areas, towns were
19 selected. Finally, households and subsequently respondents within households were selected. A
20 computer-aided personal interviewing random selection program was used to select one from
21 among the multiple eligible respondents in a household. Respondents' eligibility criteria included
22 adults (1) aged 25 to 65 years, who (2) influence food preparation decisions in the home. Quotas
23 were set for 75% women who were primary food preparers in the home and 25% men who
24 influence salt use by the primary food preparer.
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27 A target sample of 1,000 per province was designed at a 95% level of confidence, 5.5%
28 margin of error and design effect of 1.2. Accordingly, a total sample of 2,000 and 2,015 eligible
29 adults was included in pre- and post-campaign surveys, respectively. The pre-campaign survey
30 was conducted in July 2019, and the post-campaign survey from November 2019 to January
31 2020.
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34 **Survey questionnaire and measures**

35 The questionnaire was administered face-to-face in Chinese using a computer-aided
36 personal interviewing device to avoid any selection biases. Questions in the survey were ordered
37 to minimize order effects and related biases.
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39 *Sociodemographic information* asking age, gender, income, occupation, education,
40 marital status and whether the respondent was a parent of children under 16 (Table 1).
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42 *Campaign awareness*: showing respondents images from the PSA. All those who recalled
43 the campaign PSA accurately were categorized as "campaign-aware." All other respondents were
44 categorized as "campaign-unaware."
45

46 *Reactions to the campaign*: asking campaign-aware respondents how strongly they
47 agreed or disagreed with a series of statements about the PSA, for example, the add "taught me
48 something new," "made me stop and think," "motivated me to discuss the ad with others" (see
49 Table 2 for complete list of statements).
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Knowledge about sodium consumption: a series of “yes” or “no” questions that probed respondents’ knowledge about the recommended daily salt intake and understanding of related health risks.

Attitudes toward sodium consumption: measuring respondents’ agreement (on five-point Likert scales) with a series of statements, such as: It is very important to reduce salt in cooking; or making efforts to use salt alternatives is worthwhile given the health benefits (see Table 3 for the complete list of statements).

Behavior regarding sodium consumption: using a series of “yes” or “no” questions related to cooking, eating and recognizing “too much” salt.

Considerations and intentions related to salt consumption: through a series of “yes” or “no” questions and Likert-scale responses.

Barriers to salt reduction: asking respondents to indicate agreement (using a five-point Likert scale) to a list of potential barriers for reducing salt (see Table 4 for the complete list of statements).

Data analysis

Data obtained from the face-to-face surveys were analyzed using SPSS V25. Comparisons between proportions were conducted using chi-square tests. Logistic regression was performed to examine the association between respondents’ awareness of the campaign and their knowledge, attitudes, and behaviors regarding salt reduction. Covariates included gender, age, primary care giver status, marital status, education, occupation, income, frequency of watching television and frequency of internet use.

Ethical approval

The study was approved under applicable U.S. regulations about human-subjects research by the Vital Strategies Human Protections Administrator. Researchers explained purpose of the study and obtained their informed consent.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Demographic characteristics of respondents

Table 1 presents demographic characteristics of the pre- and post-campaign samples. There were significant differences between pre- and post-campaign respondents across several measures of demographic characteristics. Respondents in the pre-campaign survey were significantly older, less educated, and more likely to be retired. Post-campaign respondents were significantly less likely to watch television or use the internet than those in the pre-campaign survey.

Campaign awareness and recall

A significantly higher proportion of those who were aware of the campaign had completed high school, college, or higher education (57%). Those who were aware of the campaign were more likely to watch television every day (51% versus 42%). The top three messages recalled were: “Reducing salt consumption is good for health” (78%); “Excess salt intake leads to hypertension/heart attack/stroke” (53%); “Limit salt intake to 5 grams or less per day per person” (32%). The campaign slogan “Too much salt will lead to stroke and even death” was recalled by 53% of the campaign-aware participants.

Reactions to the campaign

The majority of respondents who recalled the campaign agreed the PSA was believable (93%), relevant (93%), taught them something new (88%), and made them stop and think about excessive salt intake (82%; see Table 2). The majority of campaign-aware respondents reported it made them feel concerned about the effects of eating too much salt on their family’s health (92%) and on their own health (90%). In addition, 80% agreed the campaign made them feel concerned about too much salt being used in household cooking. Almost all campaign-aware respondents (95%) reported it made them more confident to cook with less salt and encourage less salt in home cooking, and to want to use less salt in cooking and eat less salt. Almost all of those aware of the campaign agreed it made them more supportive of government action to reduce salt consumption nationwide (96%) and that it’s useful for public education (97%).

Knowledge and attitudes about salt intake

Changes from the pre- to the post-campaign period

There were significant differences in key measures of knowledge and attitudes regarding salt intake between pre- and post-campaign (see Table 3). A higher proportion of post-campaign respondents agreed the “recommended daily salt intake should be less than 5 grams per day” (40%) than pre-campaign respondents (34%). Nearly nine in ten (89%) post-campaign respondents “worried that too much salt consumption in their family can have very serious consequences,” compared with 85% of pre-campaign respondents. And the proportion considering the health risks of too much salt was significantly higher in the post-campaign survey compared with the pre-campaign survey (54% versus 45%). Similarly, a greater proportion of post-campaign respondents (43%) considered how to reduce family salt consumption, compared to pre-campaign respondents (38%). Certain parameters were lower in post-campaign survey, such as, knowledge about ‘eating high salt/salty seasoning is harmful’, ‘sauces like soy, fish sauces, oyster sauces being high in salt’; and perception about ‘Use of salt alternatives is a safe way of reducing sodium intake’, however, these were significantly higher among campaign-aware respondents

Impact of Campaign Awareness within the Post-Campaign Period

Awareness of the health consequences of excessive salt intake were significantly higher amongst those aware of the campaign. As described in Table 3, the proportion agreeing that the “recommended daily salt intake should be less than 5 grams per day” was significantly higher among campaign-aware (49%) respondents compared with campaign-unaware (39%). While the perception that “eating high levels of salt or salty seasoning will be very harmful for health” was significantly higher amongst campaign-aware respondents, it is surprising that these perceptions were generally lower in the post-campaign survey (38% versus 44%). Campaign-aware respondents were significantly more likely to agree that consuming high levels of salt has negative health consequences, including hypertension (93% versus 85%), heart attack (69% versus 60%), stroke (65% versus 58%), and bone health (51% versus 39%). Post-campaign respondents who recalled the campaign were significantly more likely to believe that “it’s very important to reduce salt in cooking” compared with those who did not recall (72% versus 53%), and that “using salt alternatives is a safe way to reduce sodium intake” (30% versus 25%). Similarly, among post-campaign respondents, the belief that using salt alternatives has positive health benefits was higher among those who recalled the campaign (84% versus 77%).

Intentions, behaviors, and barriers:

Changes from the pre- to the post-campaign period

Table 4 presents findings on behaviors and barriers to salt reduction. Immediate intentions to reduce high-salt food purchases were higher among post-campaign respondents (86% versus 80%). However, the level of confidence in one’s ability ‘to control salt consumption while maintaining the appealing taste of food’ was lower among post-campaign respondents (80% versus 85%). While the proportion that reported “measuring the amount of salt added while cooking” was significantly higher in the post-campaign survey than in the pre-campaign survey (50% versus 46%), the proportion that reported ‘adding less salty processed foods now than three months ago’ was lower in post-campaign survey (16% versus 26%).

The most cited barrier to salt reduction—a greater concern for the negative health consequences of ingredients such as fat, carbohydrates, or sugar rather than that of salt— was reported by fewer respondents in the post-campaign survey than in the pre-campaign survey (61% versus 70%). Over two-fifths of pre- and post-campaign survey respondents reported that not knowing how much salt on a food label is too much” (41% versus 44%) and limited low-salt food options while shopping or dining (44% versus 45%). The proportion of respondents who said their doctor advised against reducing salt was lower in the post-campaign versus the pre-campaign survey (29% versus 38%), potentially reflecting differences in respondent age profiles

of the two surveys. Other barriers to salt reduction reported by respondents were limited time (31% versus 29%) and the high cost of low-salt foods (24% in both surveys).

Impact of Campaign Awareness within the Post-Campaign Period

As described in Table 4, intentions to reduce high-salt food purchases were higher among respondents who recalled the campaign compared with those who did not (90% versus 85%). A significantly higher proportion of campaign-aware respondents reported confidence in reducing salt during food preparation to limit family consumption (88% versus 82%) and confidence in preserving taste while reducing salt (86% versus 79%). Considerably more campaign-aware respondents (28%) reported that they had decreased their overall salt consumption in the previous three months than unaware respondents (18%).

Significantly more campaign-aware respondents reported “measuring the amount of salt added while cooking” (63% versus 48%). Almost two-thirds of campaign-aware respondents reported limiting consumption of processed food and avoiding eating outside foods (64% and 65%) compared with a little more than half of those not aware of the campaign (55% and 59%). A significantly higher proportion of respondents who recalled the campaign reported looking for salt content on food labels (36% versus 23%), buying low-salt alternatives (43% versus 20%), and buying low-sodium salt (54% versus 32%) compared with those not aware of the campaign. Over two-thirds of respondents unaware of the campaign reported they couldn’t tell how much salt is in the foods they like to eat, compared with only one-half of respondents who recalled the campaign (68% versus 49%). Similarly, reporting not knowing how much salt on a food label is too much was significantly lower among respondents who were aware of the campaign compared with those who were unaware (35% versus 45%).

DISCUSSION

A systematic review of global progress toward salt reduction targets found that consumer education and awareness are essential components of sodium reduction strategies around the world.²¹ This paper describes the first comprehensive study to evaluate the impact of a mass media campaign on changes in knowledge, attitudes and behaviors regarding salt consumption in China, where an excessively salty diet is a major public health challenge and contributor to significant morbidity and mortality. The study evaluated the impact of the “Love with Less Salt” campaign in China’s Shandong and Anhui provinces, where salt consumption is particularly high.

The study findings demonstrated that the “Love with Less Salt” campaign performed as intended. Awareness of the campaign was evident among 13% of the sample in the post-campaign survey; about 16% and of the sample in Shandong and in 11% in Anhui reported they recalled seeing the campaign. This represents campaign recall by approximately 8.8 million people in Shandong and 3.8 million people in Anhui. Three-quarters of these respondents

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3 reported that seeing the campaign motivated them to discuss it with others, potentially and
4 significantly expanding its reach and influence. Reactions to seeing the campaign indicated that
5 it was effective in communicating and motivating some viewers to lower their salt consumption,
6 or at least to try to do so.
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9 Despite modest recall of the campaign, significant improvements across several
10 indicators of change (knowledge, attitudes and behaviors) were observed between the pre- and
11 post-campaign surveys. The higher levels of knowledge of the recommended daily salt intake,
12 the increased recognition that too much salt consumption can have serious family consequences,
13 and the heightened awareness that reducing salt consumption is a positive way to maintain good
14 health were consistent with a positive campaign impact, as were the observed improvements in
15 considerations, intentions and behavior regarding lower salt consumption.
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18 While the changes between the pre- and post-campaign surveys may have been
19 influenced to some degree by concurrent activities beyond the campaign, the comparison of
20 campaign-aware and campaign-unaware respondents in the post-campaign period suggests an
21 independent impact of the campaign. After controlling for potential confounders, the data
22 showed that those who were aware of the campaign were significantly more likely than those
23 who were unaware to demonstrate higher levels of knowledge, more positive attitudes and
24 improved considerations, intentions and behaviors related to reducing sodium consumption. In
25 line with specific campaign objectives, campaign-aware respondents were significantly more
26 likely than unaware respondents to understand the harms of high salt intake, to recognize the
27 importance of reducing salt in cooking and dining, and to understand effective approaches for
28 doing so.
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31 limiting purchases of food high in salt, looking for salt content on food labels, and buying
32 low-salt alternatives and low-sodium options. Campaign-aware respondents had significantly
33 higher levels of confidence in controlling salt intake in cooking and were more likely to report
34 changing their purchasing, cooking and eating behaviors compared with those who were
35 unaware. The campaign's high effectiveness ratings and its positive impact on sodium reduction
36 knowledge and intentions among campaign-aware respondents validate the rigorous formative
37 research process undertaken to guide future campaign communication strategy and PSA
38 production.
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41 Finally, this study identified some key barriers to behavior change in reducing salt intake.
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43 A majority of respondents in pre- and post-campaign surveys reported they were more concerned
44 about other ingredients, such as sugar and fat, than they were about salt. However, this reported
45 barrier was significantly higher among pre-campaign respondents, which suggests the campaign
46 was effective in raising concerns about salt. Future sodium reduction campaigns should continue
47 to highlight the harms of high salt consumption in comparison with other food ingredients that
48 affect health.
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51 A large majority of respondents in the campaign surveys reported they couldn't tell how
52 much salt is in the foods they like to eat. Just as a mass media campaign like "Love with Less
53 Salt" can educate and motivate behavior change, there is a clear role within a comprehensive
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sodium reduction strategy for food policy measures to facilitate that behavior change, including enacting food policies that ensure labeling can be easily understood by consumers and products available for purchase are lower in salt.

This study builds on literature showing the effectiveness of mass media campaigns in addressing behavioral risk factors, including high salt intake, that can lead to disease and even death.¹⁴ It shows that mass media campaigns can play a crucial role in improving awareness and changing knowledge, attitudes, preferences and behaviors regarding nutrition and diet.^{14,22-25} The study replicates findings from other countries by demonstrating that the salt consumption campaign performed as intended,²⁶ and contributes to emerging literature in China about reducing salt consumption¹² and also in designing of future such campaigns.

Study Limitations

While the repeated cross-sectional survey design of the evaluation precluded the assessment of individual-level change resulting from the intervention and can represent a study limitation, adopting a cohort design for a campaign evaluation risks sensitization bias. Respondents for the two surveys were selected randomly to represent the overall target population of each province; however, significant demographic differences were evident between the two samples and needed to be controlled for in data analysis. There are also limitations to the quasi-experimental study design which was necessitated since the campaign exposure was across whole provincial populations and no control group comparison was possible.

Secondly, the study did not measure frequency of exposure to the campaign. Estimating the relationship between frequency of exposure to the campaign and behavior change can inform the minimum level of exposure required for impact, which can be useful for developing cost-effective campaigns, especially in low-income countries with limited resources. Thirdly, this assessment of campaign impact relied on self-reported measures related to sodium consumption rather than physical measures of actual sodium intake. Some studies have found that despite seeing changes in knowledge, attitudes and practices, no changes in actual sodium intake were seen.²⁷ Physical measures like urine levels can be used to assess longer term change in the population's sodium consumption in line with China's sodium reduction goals.

CONCLUSION

Findings from this study suggest a mass media salt reduction campaign can be an effective public health tool to encourage reduced salt consumption in China. The higher levels of sodium reduction knowledge, attitudes and behaviors related to reducing salt intake observed amongst those who recalled the campaign reflects the campaign effectiveness. Repeated public education campaigns will be required to consolidate these gains across the population

In China, typical high-salt diet is a major public health challenge that must be addressed with comprehensive, evidence-based interventions and policies. While the findings from this campaign evaluation are very encouraging, sustained mass media campaigns will be required to consolidate these gains across Chinese households. Thorough research to develop effective

campaign communication strategies and materials, careful targeting of mass media broadcasts, and adequate funding to reach wide audiences will be essential to maximize the impact of such campaigns.

Acknowledgments

The authors gratefully acknowledge the Chinese Center for Disease Control and Prevention; the research teams from the Chinese Academy of Medical Sciences and Peking Union Medical College who undertook fieldwork and preliminary data analysis for the surveys; Jun Cai, MD and Chief of Hypertension Center, Fu Wai Hospital, who kindly provided a shooting venue for the PSA and portrayed a doctor in it. The authors also thank colleagues at Vital Strategies for their reviews and edits to this paper, including Julia Berenson, PhD; Genine Babakian and Karen Schmidt, MPH.

Contributors

AKG: Study and questionnaire design; oversight of evaluation field activities; design and direction of data analysis; data interpretation; literature review; writing of this article. TEC: Inputs to questionnaire design; oversight of the field activities; help in writing and analysis; data interpretation; technical assistance for the campaign; literature review; contribution to questionnaire development and writing; coordination with stakeholders. YC, WL: Review and overall local guidance of this evaluation. LKC: input into questionnaire, overall input into media campaign strategy including implementation and evaluation. YW: Survey coordination and conduct of the analysis. JZ: Supervision of conduct of survey and analysis. YC, XG: Strategic planning and implementation of mass media and implications of evaluation findings. SM: Review and overall guidance of this evaluation. NM: Conception, study design and direction of data analysis; data interpretation; supervision in writing this article. All authors contributed to manuscript revision and read and approved the submitted version.

Funding

This analysis was conducted on behalf of Resolve to Save Lives, an initiative of Vital Strategies. Resolve to Save Lives is funded by grants from Bloomberg Philanthropies (50732 (DAF) and 50731.01 (BFF)); the Bill and Melinda Gates Foundation/Gates Philanthropy Partners/Chan Zuckerberg Initiative (OPP1175906). The authors have not received any additional remuneration to write this article.

Conflict of interest

None.

Ethical approval

The study was approved under applicable U.S. regulations about human-subjects research by the Vital Strategies Human Protections Administrator (approval number 2019/15).

Patient consent for publication

Not required.

Data sharing statement

The data can be made available to other researchers following publication and after the researchers sign a contract with Vital Strategies about data use.

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Table 1. Demographic characteristics of respondents in pre- and post-campaign (%)

	Pre-campaign		Post-campaign	
	Total (n=2,000)	Total (n=2,015)	Unaware (n=1,744)	Aware (n=271)
Location				
Tier 2 city	40	40	43a	23b
Tier 3 city	30	30	27a	48b
Tier 4 city	30	30	30	29
Women (primary food preparers)	75	75	75	74
Men (influencers)	25	25	25	26
Age in completed years (mean)	41.6a	48.6b	48.7	48.3
Education				
Middle school and below	42a	55b	57a	43b
High school	23a	19b	31a	39b
College and higher	36a	26b	12a	18b
Occupation				
Employed	58a	52b	52	56
Homemaker	24a	20b	20	19
Retired	10a	20b	21	16
Unemployed	7a	7b	7	9
Student	0.5a	1.1b	1	1
Household income (annual)				
Up to 30K RMB	27a	23b	23	25
31K to 70K RMB	28a	34b	35a	27b
71K to 110K RMB	22	21	21a	26b
Above 110K RMB	13	12	12	16
Parent of children below 16 years	45a	30b	28a	40b
Married/living together	90a	87b	87a	91b
Watch television every day	48a	43b	42a	51b
Use internet many times a day	50a	44b	44	44
<i>Values in the same row with different subscript "a" and "b" are significantly different at p<.05 in the two-sided test of equality for column proportions.</i>				

Table 2. Reactions to the campaign among post-campaign, campaign-aware respondents (%)

Self-reported reactions to PSA	% agree (n=271)
Was believable	93
Was relevant to me	93
Taught me something new	88
Made me stop and think	82
Made me feel uncomfortable	22
Made me concerned about too much salt being used in cooking in my household	80
Made me feel concerned about effects of eating too much salt on my health	90
Made me feel concerned about effects of eating too much salt on my family's health	92
Made me want to use less salt in my cooking	95
Made me want to eat less salt	95
Made me more confident to cook with less salt/encourage less salt in cooking in my family home	95
Made me more supportive of government action to reduce salt consumption in my country	96
Is useful for public education	97
Intended interpersonal communication	
Motivated me to discuss the ad with others	73
I would like others to see this ad	97
I would like my family members to see this ad	96

Table 3. Knowledge and attitudes about salt intake, pre- and post-campaign (%)

	Pre-campaign	Post-campaign	Post-campaign		
	Total (n=2,000)	Total (n=2,015)	Unaware* (n=1,744)	Aware* (n=271)	Adjusted OR ^
Knowledge					
Recommended daily salt intake should be <5 grams/day	34.0 _a	40.1 _b	38.8 _a	48.8 _b	1.58**
Eating high salt/salty seasoning will be very harmful	43.6 _a	38.3 _b	36.2 _a	51.7 _b	1.69*
Consuming high levels of salt lead to: (% yes)					
Hypertension	87.6	85.7	84.6 _a	92.5 _b	1.87*
Heart attack	59.6	60.8	59.5 _a	69.3 _b	1.51*
Stroke	59.9	58.9	57.9 _a	65.2 _b	1.32
Harmful for bones	45.5 _a	40.4 _b	38.7 _a	50.6 _b	1.64*
Knowledge about foods high in salt: (% definitely)					
Seasoning like stock cubes and powders	18.7 _a	22.8 _b	21.3 _a	32.1 _b	1.72*
Sauces like soy, fish sauce, oyster sauce, etc.	62.2 _a	58.0 _b	55.7 _a	72.3 _b	2.01*
Attitudes					
About salt reduction:					

It is very important to reduce salt in cooking (% yes)	64.1a	55.6b	53.2a	71.6b	1.96*
Use of salt alternatives is a safe way of reducing sodium intake (% definitely)	29.2 _a	25.6 _b	24.9a	30.3b	1.43**
<i>(% Strongly agree and somewhat agree)</i>					
Making efforts to use salt alternatives is worthwhile for the health benefits	76.5	77.9	76.9a	83.8b	1.43**
I am worried that too much salt consumption in my family can have very serious consequences	84.8a	89.3b	88.7a	93.4b	1.32
It's very difficult to control salt consumed in a day	61.3	61.8	63.4a	51.7b	0.67*
I am worried reducing salt in cooking may have negative effects on family's health	30.7a	34.0b	33.8	35.8	1.11
Reducing salt in cooking is not a priority for me	35.8a	49.5b	49.8	48	0.98
Reducing salt in cooking is something I support	93.3a	95.5b	95.2	97.4	1.81
Reducing salt consumption in my family is a positive way to maintain good health	94.0a	96.0b	95.8	97.4	1.62
Considered following in last 3 months:	(n=2,000)	(n=2,015)	(n=1,633)	(n=257)	
<i>(% always /often)</i>					
Amount of salt/salty sauces added while cooking	12.6a	22.4b	21.4a	28.8b	1.36**
Amount of salt added to food before eating	7.9a	15.9b	14.4a	25.8b	2.08*
Health harms from consuming high salt	45.2a	54.0b	52.0a	66.8b	1.82*
Ways to reduce salt the family consumes	37.7a	43.0b	41.2a	54.6b	1.64*

Values in same row with different subscript "a" and "b" are significantly different at $p < 0.05$ in two-sided test of equality for column proportions.

** Comparisons are currently based on bivariate analysis alone and do not control for potential confounders. Hence, any significant differences between "aware" and "unaware" groups must be interpreted with caution. *significance at 0.01, **significance at 0.05*

^ Adjusted for gender, age, primary care giver, marital status, education, occupation, income, television watching frequency and internet use frequency.

Table 4. Intentions, behavior and barriers related to salt intake, pre- and post-campaign (%)

	Pre-campaign		Post-campaign		
	Total (n=2,000)	Total (n=2,015)	Unaware* (n=1,744)	Aware* (n=271)	Adjusted OR [^]
Immediate intentions <i>(% strongly/somewhat agree)</i>			(n=1,633)	(n=257)	
To reduce purchase of foods very high in salt	79.6a	85.8b	85.1a	90.0b	1.45*
Confidence in controlling salt use <i>(% confident)</i>			(n=1,633)	(n=257)	
Reduce salt in cooking to avoid family's salt intake exceeding the recommended levels	82.2	82.9	82.1a	87.9b	1.59**
Maintain appealing taste for food for my family with reduced salt in cooking	84.7a	80.3b	79.1a	87.5b	2.07*
Behavior related to purchase <i>(% yes)</i>			(n=1,633)	(n=257)	
Look for salt content on food labels	23.5	24.6	22.8a	36.2b	1.8*
Buy low-salt alternatives	21.0	22.9	19.8a	42.8b	2.88*
Buy low-sodium salt	33.8	35.1	32.2a	53.5b	2.35*
Behavior while cooking <i>(% yes)</i>			(n=1,633)	(n=257)	

1						
2						
3	Measure amount of salt	45.7a	49.9b	47.8a	63.4b	1.84*
4	Use salt reduction measuring spoon	32.4	31.4	29.1a	45.5b	2.01*
5	Replace salt using onions, garlic, ginger	17.1a	23.2b	22.6	27.2	1.30
6	Add less salt than 3 months ago	20.5	19.3	18.0 _a	27.2 _b	1.56*
7	Add less salty processed foods than 3 months ago	26.3a	16.1b	14.3 _a	27.2 _b	1.94*
8	Add less sauce or seasoning than 3 months ago	17.7	15.8	14.1 _a	26.5 _b	2.01*
9						
10	Behavior while eating			(n=1,633)	(n=257)	
11	(% yes)					
12	Limit consumption of processed foods	40.1a	56.1b	54.9a	63.8b	1.44*
13	Avoid eating outside foods	43.7a	59.7b	58.8	65.3	1.27
14	Consume less salt overall	17.5	18.9	17.5 _a	27.7 _b	1.65*
15	Barriers to salt reduction					
16	(% strongly agree/agree)					
17	I am more concerned about other ingredients	70.3a	61.4b	61.8	58.7	0.88
18	Can't tell how much salt is in the foods I like to eat	58.2a	65.2b	67.7a	49.1b	0.48*
19	Can't tell how much salt on food label is too much	41.4	43.7	45.0a	35.1b	0.79
20	My doctor suggested not to reduce my salt intake	38.1a	28.6b	27.7a	34.7b	1.4**
21	due to my certain disease or current treatment					
22	<i>Values in same row with different subscript "a" and "b" are significantly different at p<0.05 in the two-sided test of equality for column proportions.</i>					
23	<i>* Comparisons are currently based on bivariate analysis alone and do not control for potential confounders. Hence, any significant differences between "aware" and "unaware" groups must be interpreted with caution.</i>					
24	<i>^ Adjusted for gender, age, primary care giver, marital status, education, occupation, income, television watching frequency and internet use frequency.</i>					
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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	2,5,11
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	NN/A
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-9

		(b) Report category boundaries when continuous variables were categorized	7-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	7-9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7-9
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

"Love with Less Salt": Evaluation of a Sodium Reduction Mass Media Campaign in China

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-056725.R1
Article Type:	Original research
Date Submitted by the Author:	11-May-2022
Complete List of Authors:	Gupta, Ashish; Vital Strategies, Carroll, Tom; Vital Strategies Chen, Yu; Vital Strategies Liang, Wenzhuo; Vital Strategies Cobb, Laura; Resolve to Save Lives, An Initiative of Vital Strategies Wang, Yichao; Beijing Haisi Aide Technology Co Ltd Zhang, Juan; Chinese Academy of Medical Sciences & Peking Union Medical College Chen, Yeji; Anhui Provincial Center for Disease Control and Prevention Guo, Xiaolei; Shandong Center for Disease Control and Prevention Mullin, Sandra; Vital Strategies Murukutla, Nandita; Vital Strategies
Primary Subject Heading:	Public health
Secondary Subject Heading:	Public health
Keywords:	Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH, NUTRITION & DIETETICS

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1 “Love with Less Salt”: Evaluation of a Sodium Reduction Mass Media 2 Campaign in China 3

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29
30 **Keywords:** mass media campaigns, salt reduction, evaluations, knowledge, attitude, behavior,
31 intentions, salt use.

32
33 **Word count:**

34 **Abstract:** 207

35 **Main text:** 4397

36

37

Abstract

Objective: This study examines the impact of a salt reduction campaign on knowledge, attitudes, intentions, behaviors and barriers to behavior change relating to salt consumption in two provinces of China.

Methods: In 2019, the “Love with Less Salt” campaign ran on China Central Television and on local television channels in Shandong and Anhui provinces. Data for this study come from two representative household surveys conducted among a sample of adults aged 25 to 65 years in Shandong and Anhui provinces: pre-campaign (n=2,000) and post-campaign (n=2,015). Logistic regression was performed to estimate the effects of the campaign on knowledge, attitudes, intentions, behaviors and barriers to behavior change.

Results: Overall, 13% of post-campaign respondents recalled seeing the campaign, and reactions toward the campaign were positive. Post-campaign respondents were more likely to plan to reduce their purchase of foods high in salt than pre-campaign respondents (OR=1.45, $p<0.05$). Campaign-aware respondents were significantly more likely than campaign-unaware respondents to report higher levels of knowledge, attitudes and behaviors regarding salt reduction.

Conclusions: Findings reveal that salt reduction mass media campaigns can be an effective public health tool to support efforts to reduce salt consumption in China. Continued and sustained mass media investments are likely to be effective in addressing high salt consumption nationwide.

Article summary

Strengths and limitations of this study:

- For this study, a repeated “cross-sectional” survey design was used rather than a cohort design, which risks sensitization bias for a mass media campaign evaluation.
- Multistage probability sampling procedures and data weighting were applied to have robust samples representing the population.
- Frequency of exposure to the campaign was not measured, which can inform the minimum level of exposure required for impact on behavior change.
- Assessment of campaign impact relied on self-reported measures related to sodium consumption rather than physical measures of actual sodium intake.

1 INTRODUCTION

2 High sodium intake is a risk factor for hypertension, cardiovascular disease and cerebrovascular
3 disease, and morbidity and mortality associated with these conditions.¹⁻³ The World Health
4 Organization recommends reducing sodium intake to less than 2 grams per day (equivalent to 5 grams
5 per day of salt). Globally, many adults exceed recommended guidelines, resulting in nearly 1.65 million
6 deaths from cardiovascular disease annually.^{4,5} Evidence shows lowering sodium intake to
7 recommended levels can substantially reduce associated risks.⁶

8 Salt is the main source of sodium in diets.⁷ In China, average salt intake is among the highest in
9 the world; at 10.5 grams per day, it is more than double the amount recommended by the World Health
10 Organization.⁸ In 2010, an estimated 441,200 cardiovascular deaths in China—12.8% of the total—
11 were due to high sodium intake, of which 34,500 deaths occurred in Shandong province alone.⁹ Home
12 cooking in China contributes to more than three-quarters of sodium consumption (76%),¹⁰ since food
13 preparation often involves adding salt and salty seasonings or condiments.^{11,12} Women are the primary
14 preparers of homecooked meals in China and are often the household's nutritional gatekeepers, while
15 men also exert an influence over food purchase and preparation.¹³⁻¹⁵ Due to factors such as differences
16 in eating patterns, men consume more salt than women and experience linked diseases at higher rates.¹⁶
17 Understanding and addressing these gender norms and patterns as they relate to salt intake is important
18 for salt reduction efforts.

19 Literature on knowledge, attitudes and behaviors regarding sodium intake in China suggests
20 that although people are aware of the links between high sodium and hypertension, people often
21 associate the use of salt with better tasting food and believe it makes them physically stronger.^{12,17} In
22 some cases, this dietary choice also stems from preference for regional cuisine, which in some regions
23 may contain more salt than in others. Shandong's cuisine, for example, is famous for containing more
24 salt and soy sauce than other regional cuisine.¹²

25 Mass media campaigns have proven to be an effective public health tool for promoting
26 behavior change and addressing social norms.¹⁸⁻²⁰ For example, campaigns addressing tobacco use that
27 graphically depict tobacco-related health harms in a personally relevant and engaging way, have been
28 found to effectively prompt quitting behavior to avoid these harms and influence social norms to
29 support changes in smoking behavior²¹. Undertaking formative research to pre-test communication
30 concepts with target audiences has been a key feature of effective tobacco control campaigns. While
31 evidence reflecting the effectiveness of mass media campaigns aimed at reducing salt consumption is
32 limited²⁰, it is reasonable to conclude that they have the potential to influence consumption behaviors
33 when strategies are developed and tested through research and implemented within a comprehensive
34 package of sodium reduction interventions.^{20,22,23}

35 Effective mass media campaigns convey both essential health information and persuasive,
36 emotionally appealing stories and images.^{24,25} Research on sodium intake in China suggests that, to be
37 effective, mass media campaigns need to show people how they consume excessive sodium (e.g., salt
38 added during home cooking) and how their association of salt with better taste and physical strength can
39 perpetuate unhealthy eating habits.¹⁷

40 Based on this evidence, in 2019 the Centers for Disease Control and Prevention of both
41 Shandong and Anhui provinces, with technical assistance from Vital Strategies, a global public health
42 organization, and the Resolve to Save Lives initiative, which supports governments in both provinces in
43 sodium reduction efforts, developed and implemented an evidence-based mass media campaign
44 targeting household salt reduction. This was a first-of-its-kind research-based mass media campaign to
45 target salt consumption in China and complemented the 2019 Healthy China 2030 Action Plan, which
46 recommends the 5 grams of salt per person per day limit. The objective of this study was to determine

1 whether the campaign led to changes in knowledge, attitudes, intentions and behaviors around salt use
2 in Shandong and Anhui provinces by conducting pre- and post-campaign cross-sectional surveys.

3 4 **METHODS**

5 6 **A mass media campaign in Shandong and Anhui provinces**

7 **Campaign development**

8 Based on advice from provincial program team members, the primary target audience
9 designated for the campaign were women who were primary food preparers for their household as they
10 exerted critical influence on sodium consumption and family health. From August to September 2018,
11 thirteen focus groups adopting a methodology of quantitative ratings and group discussions were
12 undertaken with primary food preparers (nine groups of women 25-65 years) and with the secondary
13 audience of other influencers of household cooking (four groups of men 25-55 years) in each province.
14 Participants were recruited according to age, gender and geographical specifications in line with the
15 campaign target audience by an independent market research agency, which conducted the focus
16 groups. The objective of this formative research was to test the relative effectiveness of different
17 messages and message styles to motivate primary food preparers to reduce salt in their cooking and to
18 encourage influencers to support this change. These communication concepts were presented in
19 animatic videos and included the depiction of a happy family providing positive encouragement for
20 cooking with less salt, demonstration of how to replace salt in cooking but still maintain taste,
21 presentation of lower salt cooking by a celebrity chef, and a testimonial story of a man who experienced
22 hypertension and stroke due to excessive salt consumption.

23 The research findings indicated that while it was relatively easy to communicate information
24 about limiting salt consumption, engaging and motivating people to recognize the serious consequences
25 of excessive salt consumption and the importance of changing their behavior in relation to salt use in
26 cooking required communication at both an emotional and informational level. The findings showed
27 that the testimonial concept was most effective in generating this engagement and motivation but lacked
28 sufficiently clear direction about how to avoid harms from excessive salt consumption. Informed by
29 these findings, the campaign strategy and production of the campaign public service announcement
30 (PSA) for television broadcast focused on a personal narrative of harm from excessive salt
31 consumption, complemented by expert advice about reducing salt intake presented by a medical doctor.
32 The “Love with Less Salt” campaign’s 30-second PSA featured the story of a man who developed
33 hypertension and suffered a stroke due to his ongoing consumption of salty food, despite his wife’s
34 warnings. The formative research demonstrated that an important feature of the script’s impact for both
35 female and male participants was the husband’s introspection and regret about the ongoing burden that
36 he was now imposing on his family, and this was carefully embedded in the PSA. In the final script of
37 the PSA the doctor identifies excessive salt intake as the main cause of hypertension which increases
38 the risk of stroke and heart disease, and urges limiting salt consumption to no more than 5 grams per
39 day, stating: “For the health of your family, use less salt when you cook.”

40 41 **Campaign dissemination**

42 The “Love with Less Salt” PSA was broadcast on national, provincial and local television
43 stations through a paid media plan. The PSA aired September-October 2019 in Shandong and Anhui
44 provinces, with a combined population exceeding 160 million people, supporting broader campaign
45 efforts in the two target provinces, including billboards, posters and community education activities

1 undertaken by the provincial Centers for Disease Control and Prevention. China Central Television also
2 broadcast the PSA across the country throughout September 2019.

3 4 **Evaluation study design**

5 To evaluate campaign effectiveness, pre- and post-campaign cross-sectional representative
6 household surveys were undertaken. Surveys were conducted in-person by an independent research
7 agency hired by Vital Strategies. The pre-campaign survey was conducted leading up to the campaign
8 in July 2019; the post-campaign survey was conducted following the campaign from November 2019 to
9 January 2020.

10 11 **Sampling method and sample size**

12 A multistage probability sampling procedure was used with stage-specific sampling frames to
13 select participants for the surveys in Anhui and Shandong provinces. In each province, cities were
14 selected to ensure representation across different city tiers; the selection of districts and subdistricts
15 corresponded accordingly. In the case of rural areas, towns were selected. Finally, households and
16 respondents within households were selected. A computer-aided personal interviewing random
17 selection program was used to select one respondent from among the multiple eligible respondents in a
18 household. Reflecting the campaign target audience, respondents' eligibility criteria included being
19 adults aged 25 to 65 years who influence food preparation decisions in the home. Quotas were set for
20 75% women who were primary food preparers in the home and 25% men who influence food
21 preparation, including salt use by the primary food preparer.

22 A target sample of 1,000 people per province was designed at a 95% level of confidence, 5.5%
23 margin of error and design effect of 1.2. Accordingly, a total sample of 2,000 and 2,015 eligible adults
24 was included in pre- and post-campaign surveys, respectively.

25 26 **Survey questionnaire and measures**

27 A pre-tested questionnaire was administered in-person in Chinese using a computer-aided
28 personal interviewing device to avoid any selection biases. Questions in the survey were ordered to
29 minimize order effects and related biases. The duration of the interviews was approximately 30
30 minutes. The key measures that were used in the survey are described below.

31 *Sociodemographic information:* asking age, gender, income, occupation, education, marital
32 status, media consumption habits, location and whether the respondent was a parent of children under
33 16 (Table 1).

34 *Campaign awareness:* showing respondents still images depicting key scenes from the
35 television PSA and asking whether the respondent had seen the PSA before. Those who recalled seeing
36 the campaign PSA were categorized as “campaign aware.” All other respondents were categorized as
37 “campaign unaware.”

38 *Reactions to the campaign:* using a 5-point Likert scale to measure levels of agreement among
39 campaign-aware respondents on a battery of 16 statements about responses to the PSA, for example, the
40 ad “taught me something new,” “made me stop and think,” and “motivated me to discuss the ad with
41 others” (see Table 2 for the complete list of statements).

42 *Knowledge about salt consumption:* asking a series of “yes” or “no” questions that probed
43 respondents' knowledge about the recommended daily salt intake and understanding of related health
44 risks.

45 *Attitudes toward salt consumption:* measuring respondents' agreement (on five-point Likert
46 scales) with a series of statements, such as: “It is very important to reduce salt in cooking” or “making

1
2
3 1 efforts to use salt alternatives is worthwhile given the health benefits” (see Table 3 for the complete list
4 of statements).

5 3 *Behavior* related to salt consumption: using a series of “yes” or “no” questions related to
6 4 cooking, eating and recognizing “too much” salt.

7 5 *Behavioral intentions* related to salt consumption: using a series of “yes” or “no” questions and
8 6 Likert-scale responses such as intention to reduce purchase of foods very high in salt.

9 7 *Barriers* to salt reduction: asking respondents to indicate agreement (using a five-point Likert
10 8 scale) to a list of potential barriers for reducing salt such as being more concerned about other
11 9 ingredients (see Table 4 for the complete list of statements).

11 **Data analysis**

12 12 Data were analyzed using SPSS V25. The proportion of respondents indicating “agree” and
13 13 “strongly agree” on the 5-point Likert scale were aggregated for analysis and reporting. Comparisons
14 14 between proportions in the pre- and post-campaign surveys and between respondents who were aware
15 15 and unaware of the campaign were conducted using chi-square tests. Logistic regression was performed
16 16 to examine the association between respondents’ awareness of the campaign and their knowledge,
17 17 attitudes, behavioral intentions and behaviors regarding salt reduction, as well as barriers to changing
18 18 behavior. Covariates included gender, age, primary care giver status, marital status, education,
19 19 occupation, income and media consumption habits (frequency of watching television and frequency of
20 20 internet use).

22 **Ethical approval**

23 23 The study was approved under applicable U.S. regulations about human-subjects research by
24 24 the Vital Strategies Human Protections Administrator. Researchers explained the purpose of the study
25 25 to participants and obtained their informed consent.

27 **Patient and public involvement**

28 28 Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of our
29 29 research.

31 **RESULTS**

33 **Demographic characteristics of respondents**

34 34 Table 1 presents demographic characteristics of the pre- and post-campaign samples. There
35 35 were significant differences between pre- and post-campaign respondents across several measures.
36 36 Respondents to the post-campaign survey were significantly older (48.6 years old versus 41.6 years
37 37 old), less educated (26% versus 36% attended college and higher), and more likely to be retired (20%
38 38 versus 10%) than those to the pre-campaign survey. Post-campaign respondents were significantly less
39 39 likely to watch television (43% versus 48%) or use the internet (44% versus 50%) than those in the pre-
40 40 campaign survey.

42 **Campaign awareness and recall**

43 43 A significantly higher proportion of those who were aware of the campaign had completed high
44 44 school, college, or higher education (57%) than those who were unaware (43%). Those who were aware
45 45 of the campaign were also more likely to watch television every day (51% versus 42%). The top three
46 46 messages recalled were: “Reducing salt consumption is good for health” (78%); “Excess salt intake

1 leads to hypertension/heart attack/stroke” (53%); “Limit salt intake to 5 grams or less per day per
2 person” (32%). The campaign slogan “Too much salt will lead to stroke and even death” was recalled
3 by 53% of campaign-aware respondents.

4 5 **Reactions to the campaign**

6 The majority of respondents who recalled the campaign agreed it was believable (93%),
7 relevant (93%), taught them something new (88%), and made them stop and think about excessive salt
8 intake (82%; see Table 2). The majority of campaign-aware respondents reported it made them feel
9 concerned about the effects of eating too much salt on their family’s health (92%) and on their own
10 health (90%). In addition, 80% agreed the campaign made them feel concerned about too much salt
11 being used in household cooking. Almost all campaign-aware respondents (95%) reported it made them
12 more confident to cook with less salt and encourage less salt in home cooking, and to want to use less
13 salt in cooking and eat less salt. Similarly, almost all campaign-aware respondents agreed it made them
14 more supportive of government action to reduce salt consumption nationwide (96%) and that it’s useful
15 for public education (97%). Further, almost three-quarters of campaign-aware respondents agreed that
16 they would discuss the campaign with others (73%).

17 18 **Knowledge and attitudes about salt intake**

19 20 *Changes between the pre- to the post-campaign surveys*

21
22 There were significant differences in key measures of knowledge and attitudes regarding salt
23 intake between the pre- and post-campaign surveys (see Table 3). A higher proportion of post-campaign
24 respondents agreed the “recommended daily salt intake should be less than 5 grams per day” (40%)
25 than pre-campaign respondents (34%). Nearly nine in ten (89%) post-campaign respondents “worried
26 that too much salt consumption in their family can have very serious consequences,” compared with
27 85% of pre-campaign respondents. The proportion of respondents considering the health risks of too
28 much salt was significantly higher in the post-campaign survey compared with the pre-campaign survey
29 (54% versus 45%). Similarly, a greater proportion of post-campaign respondents (43%) considered how
30 to reduce family salt consumption, compared to pre-campaign respondents (38%). Certain parameters
31 were lower in the post-campaign survey, such as, knowledge that “eating high salt/salty seasoning is
32 harmful,” and “sauces like soy, fish sauces, oyster sauces being high in salt”; and perception that the
33 “use of salt alternatives is a safe way of reducing sodium intake,” however, these were significantly
34 higher among campaign-aware respondents than campaign-unaware respondents.

35 36 *Impact of campaign awareness within the post-campaign survey*

37
38 Knowledge of the health consequences of excessive salt intake was significantly higher among
39 those aware of the campaign. As described in Table 3, the proportion agreeing that the “recommended
40 daily salt intake should be less than 5 grams per day” was significantly higher among campaign-aware
41 respondents (49%) compared with campaign-unaware respondents (39%). While the perception that
42 “eating high levels of salt or salty seasoning will be very harmful for health” was significantly higher
43 among campaign-aware respondents, these perceptions were generally lower in the post-campaign
44 survey (38% versus 44%). Campaign-aware respondents were significantly more likely to agree that
45 consuming high levels of salt has negative health consequences, including hypertension (93% versus
46 85%), heart attack (69% versus 60%), stroke (65% versus 58%), and bone health (51% versus 39%).

1 Post-campaign respondents who recalled the campaign were significantly more likely to believe that
 2 “it’s very important to reduce salt in cooking” compared with those who did not recall the campaign
 3 (72% versus 53%), and that “use of salt alternatives is a safe way of reducing sodium intake” (30%
 4 versus 25%). Similarly, among post-campaign respondents, the belief that using salt alternatives have
 5 positive health benefits was higher among those who recalled the campaign (84% versus 77%).

7 **Intentions, behaviors, and barriers related to reducing salt consumption:**

9 *Changes between the pre- and the post-campaign surveys*

11 Table 4 presents findings on intentions and behaviors related to reducing salt use, as well as
 12 barriers to doing so. Immediate intentions to reduce high-salt food purchases were higher among post-
 13 campaign respondents than pre-campaign respondents (86% versus 80%). However, the level of
 14 confidence in one’s ability “to control salt consumption while maintaining the appealing taste of food”
 15 was lower among post-campaign respondents (80% versus 85%). While the proportion that reported
 16 “measuring the amount of salt added while cooking” was significantly higher in the post-campaign
 17 survey than in the pre-campaign survey (50% versus 46%), the proportion that reported “adding less
 18 salty processed foods now than three months ago” was lower in the post-campaign survey (16% versus
 19 26%).

20 The most cited barrier to salt reduction—a greater concern for the negative health consequences
 21 of ingredients such as fat, carbohydrates, or sugar rather than that of salt—was reported by fewer
 22 respondents in the post-campaign survey than in the pre-campaign survey (61% versus 70%). More
 23 than two-fifths of pre- and post-campaign survey respondents reported not knowing how much salt on a
 24 food label is too much (41% versus 44%) and limited low-salt food options while shopping or dining
 25 (44% versus 45%). The proportion of respondents who said their doctor advised against reducing salt
 26 was lower in the post-campaign survey compared with the pre-campaign survey (29% versus 38%).

28 *Impact of campaign awareness within the post-campaign survey*

30 As shown in Table 4, intentions to reduce high-salt food purchases were higher among
 31 respondents who recalled the campaign compared with those who did not (90% versus 85%). A
 32 significantly higher proportion of campaign-aware respondents reported confidence in reducing salt
 33 during food preparation to limit family consumption (88% versus 82%) and confidence in preserving
 34 taste while reducing salt (86% versus 79%). Considerably more campaign-aware respondents reported
 35 that they had decreased their overall salt consumption in the previous three months than unaware
 36 respondents (28% versus 18%).

37 Significantly more campaign-aware respondents reported “measuring the amount of salt added
 38 while cooking” (63% versus 48%). Almost two-thirds of campaign-aware respondents reported limiting
 39 consumption of processed food and avoiding eating outside foods (64% and 65%) compared with a
 40 little more than half of those not aware of the campaign (55% and 59%). A significantly higher
 41 proportion of respondents who recalled the campaign reported looking for salt content on food labels
 42 (36% versus 23%), buying low-salt alternatives (43% versus 20%), and buying low-sodium salt (54%
 43 versus 32%) compared with those not aware of the campaign. More than two-thirds of respondents
 44 unaware of the campaign reported they couldn’t tell how much salt is in the foods they like to eat,
 45 compared with only one-half of respondents who recalled the campaign (68% versus 49%). Similarly,
 46 reporting not knowing how much salt on a food label is too much was significantly lower among

1 respondents who were aware of the campaign compared with those who were unaware (35% versus
2 45%).

3 4 **DISCUSSION**

5 Consumer education and awareness are essential components of sodium reduction strategies
6 around the world.²⁶ This paper describes the first comprehensive study to evaluate the effect of a mass
7 media campaign on changes in knowledge, attitudes, intentions, behaviors and barriers regarding
8 reducing salt consumption in China, where an excessively salty diet is a major public health challenge
9 and contributor to significant morbidity and mortality. The “Love with Less Salt” campaign described
10 in the paper was conducted in China’s Shandong and Anhui provinces, where salt consumption is
11 particularly high.

12 The study findings demonstrated that the “Love with Less Salt” campaign performed as
13 intended. Though overall awareness of the campaign may appear relatively modest (13% overall;
14 Shandong 16%, Anhui 11%), the campaign reached approximately 12.6 million people in Shandong
15 and Anhui provinces, based on campaign recall findings. The observed lower levels of watching
16 television and internet use among post-campaign respondents may have resulted in lower recall
17 findings. Among those who recalled the campaign it was very well-received; respondents found it
18 believable, relevant and that it made them stop and think about excessive salt use. Almost all campaign-
19 aware respondents (95%) reported it made them more confident to cook with less salt and encourage
20 less salt in home cooking. Approximately three-quarters of respondents reported that seeing the
21 campaign motivated them to discuss it with others, potentially expanding the campaign’s reach and
22 influence.¹⁹ Despite modest recall of the campaign, significant improvements across several indicators
23 of change (knowledge and attitudes) were observed between the pre- and post-campaign surveys. The
24 higher levels of knowledge of the recommended daily salt intake, the increased recognition that too
25 much salt consumption can have serious consequences on one’s family, and the heightened awareness
26 that reducing salt consumption is a positive way to maintain good health were consistent with a positive
27 campaign impact, as were the observed improvements in intentions, behaviors and barriers regarding
28 lower salt consumption.

29 While the changes between the pre- and post-campaign surveys may have been influenced to
30 some degree by concurrent activities beyond the campaign, the comparison of campaign-aware and
31 campaign-unaware respondents in the post-campaign survey suggests an independent impact of the
32 campaign. After controlling for potential confounders, the data showed that those who were aware of
33 the campaign were significantly more likely than those who were unaware to demonstrate higher levels
34 of knowledge, more positive attitudes and improved intentions and behaviors related to reducing salt
35 consumption. In line with specific campaign objectives, campaign-aware respondents were significantly
36 more likely than unaware respondents to understand the harms of excess salt intake, to recognize the
37 importance of reducing salt in cooking and dining, and to understand effective approaches for doing so,
38 such as limiting purchases of food high in salt, looking for salt content on food labels, and buying low-
39 salt alternatives and low-sodium options. Campaign-aware respondents had significantly higher levels
40 of confidence in controlling salt intake in cooking and were more likely to report changing their
41 purchasing, cooking and eating behaviors compared with those who were unaware. The campaign’s
42 high effectiveness ratings and its positive impact on sodium reduction knowledge and intentions among
43 campaign-aware respondents validate the rigorous formative research process undertaken to guide the
44 campaign communication strategy and PSA production.

45 Finally, this study identified some key barriers to behavior change in reducing salt intake. In
46 both the pre- and post-campaign surveys a majority of respondents reported they were more concerned

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1 about other ingredients in foods, such as sugar and fat, than they were about salt. However, this
2 reported barrier was significantly higher among pre-campaign respondents, which suggests the
3 campaign was effective in raising concerns about salt. Future sodium reduction campaigns should
4 continue to highlight the harms of high salt consumption in comparison with other food ingredients that
5 affect health.

6 In both surveys a large majority of respondents reported they couldn't tell how much salt is in
7 the foods they like to eat. Just as a mass media campaign like "Love with Less Salt" can educate and
8 motivate behavior change, there is a clear role within a comprehensive sodium reduction strategy for
9 food policy measures to facilitate that behavior change, including enacting food policies that ensure
10 labeling can be easily understood by consumers and products available for purchase are lower in salt.

11 This study builds on literature showing the effectiveness of mass media campaigns in
12 addressing behavioral risk factors, including high salt intake, that can lead to disease and premature
13 death.¹⁹ It shows that mass media campaigns can play a crucial role in improving awareness and
14 changing knowledge, attitudes, preferences and behaviors regarding nutrition and diet.^{19,27-30} The study
15 replicates findings from other countries by demonstrating that the salt consumption campaign
16 performed as intended,³¹ and contributes to emerging literature in China about reducing salt
17 consumption¹⁷ and designing future such campaigns.

18 **Study Limitations**

19 While the repeated cross-sectional survey design of the evaluation precluded the assessment of
20 individual-level change resulting from the intervention and can represent a study limitation, adopting a
21 cohort design for a campaign evaluation risks sensitization bias. Respondents for the two surveys were
22 selected randomly to represent the overall target population of each province; however, significant
23 demographic differences were evident between the two samples and needed to be controlled for in data
24 analysis. There are also limitations to the quasi-experimental study design which was necessitated since
25 the campaign exposure was across whole provincial populations and no control group comparison was
26 possible.

27 The study did not measure frequency of exposure to the campaign. Estimating the relationship
28 between frequency of exposure to the campaign and behavior change can inform the minimum level of
29 exposure required for impact, which can be useful for developing cost-effective campaigns, especially
30 in low-income countries with limited resources. It is also possible that respondents who were already
31 interested in reducing salt consumption may have been more likely to recall the campaign.

32 This assessment of campaign impact relied on self-reported measures related to sodium
33 consumption rather than physical measures of actual sodium intake. Some studies have found that
34 despite seeing changes in knowledge, attitudes and practices, no changes in actual sodium intake were
35 seen.³² Physical measures like urine levels can be used to assess longer term change in the population's
36 sodium consumption in line with China's sodium reduction goals.

38 **CONCLUSION**

39 In China, a typical high-salt diet is a major public health challenge that must be addressed with
40 comprehensive, evidence-based interventions and policies. Findings from this study suggest a mass
41 media salt reduction campaign can be an effective public health tool to encourage reduced salt
42 consumption in China. The improved levels of salt reduction knowledge, attitudes, intentions and
43 behaviors, and reduced barriers to limiting salt consumption observed among those who recalled the
44 campaign reflects the campaign effectiveness.

1 While the findings from this campaign evaluation are very encouraging, sustained mass media
2 campaigns will be required to consolidate these gains across Chinese households. Applying best
3 practice principles of conducting thorough research to develop effective campaign communication
4 strategies and materials, careful targeting of mass media broadcasts, and adequate funding to reach wide
5 audiences will be essential to maximize the impact of such campaigns.

6 **Acknowledgments**

7 The authors gratefully acknowledge the Shandong and Anhui Centers for Disease Control and
8 Prevention; the research teams from the Chinese Academy of Medical Sciences and Peking Union
9 Medical College who undertook fieldwork and preliminary data analysis for the surveys; Jun Cai, MD
10 and Chief of Hypertension Center, Fu Wai Hospital, who kindly provided a shooting venue for the PSA
11 and portrayed a doctor in it. The authors also thank colleagues at Vital Strategies for their reviews and
12 edits to this paper, including Julia Berenson, PhD; Genine Babakian, Karen Schmidt, MPH and Hana
13 Raskin, M.S.

14 **Contributors**

15 AKG: Study and questionnaire design; oversight of evaluation field activities; design and direction of
16 data analysis; data interpretation; literature review; writing of this article. TEC: Inputs to questionnaire
17 design; oversight of the field activities; help in writing and analysis; data interpretation; technical
18 assistance for the campaign; literature review; contribution to questionnaire development and writing;
19 coordination with stakeholders. YC, WL: Review and overall local guidance of this evaluation. LKC:
20 input into questionnaire, overall input into media campaign strategy including implementation and
21 evaluation. YW: Survey coordination and conduct of the analysis. JZ: Supervision of conduct of survey
22 and analysis. YC, XG: Strategic planning and implementation of mass media and implications of
23 evaluation findings. SM: Review and overall guidance of this evaluation. NM: Conception, study
24 design and direction of data analysis; data interpretation; supervision in writing this article. All authors
25 contributed to manuscript revision and read and approved the submitted version.

26 **Funding**

27 This analysis was conducted on behalf of Resolve to Save Lives. Resolve to Save Lives is funded by
28 grants from Bloomberg Philanthropies (50732 (DAF) and 50731.01 (BFF)); the Bill and Melinda Gates
29 Foundation/Gates Philanthropy Partners/Chan Zuckerberg Initiative (OPP1175906). The authors have
30 not received any additional remuneration to write this article.

31 **Conflict of interest**

32 None.

33 **Ethical approval**

34 The study was approved under applicable U.S. regulations about human-subjects research by the Vital
35 Strategies Human Protections Administrator (approval number 2019/15).

36 **Patient consent for publication**

37 Not required.

38 **Data sharing statement**

39 The data can be made available to other researchers following publication and after the researchers sign
40 a contract with Vital Strategies about data use.

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Table 1. Demographic characteristics of respondents to the pre- and post-campaign surveys (%)

	Pre-campaign		Post-campaign	
	Total (n=2,000)	Total (n=2,015)	Unaware (n=1,744)	Aware (n=271)
Location				
Tier 2 city	40	40	43a	23b
Tier 3 city	30	30	27a	48b
Tier 4 city	30	30	30	29
Women (primary food preparers)	75	75	75	74
Men (influencers)	25	25	25	26
Age in completed years (mean)	41.6a	48.6b	48.7	48.3
Education				
Middle school and below	42a	55b	57a	43b
High school	23a	19b	31a	39b
College and higher	36a	26b	12a	18b
Occupation				
Employed	58a	52b	52	56
Homemaker	24a	20b	20	19
Retired	10a	20b	21	16
Unemployed	7a	7b	7	9
Student	0.5a	1.1b	1	1
Household income (annual)				
Up to 30K RMB	27a	23b	23	25
31K to 70K RMB	28a	34b	35a	27b
71K to 110K RMB	22	21	21a	26b
Above 110K RMB	13	12	12	16
Parent of children below 16 years	45a	30b	28a	40b
Married/living together	90a	87b	87a	91b
Watch television every day	48a	43b	42a	51b
Use internet many times a day	50a	44b	44	44
<i>Values in the same row with different subscript "a" and "b" are significantly different at p<.05 in the two-sided test of equality for column proportions.</i>				

Table 2. Reactions to the campaign among campaign-aware respondents in post-campaign survey (%)

Self-reported reactions to PSA	% agree (n=271)
Was believable	93
Was relevant to me	93
Taught me something new	88
Made me stop and think	82
Made me feel uncomfortable	22
Made me concerned about too much salt being used in cooking in my household	80
Made me feel concerned about effects of eating too much salt on my health	90
Made me feel concerned about effects of eating too much salt on my family's health	92
Made me want to use less salt in my cooking	95
Made me want to eat less salt	95
Made me more confident to cook with less salt/encourage less salt in cooking in my family home	95
Made me more supportive of government action to reduce salt consumption in my country	96
Is useful for public education	97
Intended interpersonal communication	
Motivated me to discuss the ad with others	73
I would like others to see this ad	97
I would like my family members to see this ad	96

Table 3. Knowledge and attitudes about salt intake, pre- and post-campaign (%)

	Pre-campaign	Post-campaign	Post-campaign		
	Total (n=2,000)	Total (n=2,015)	Unaware* (n=1,744)	Aware* (n=271)	Adjusted OR [^]
Knowledge					
Recommended daily salt intake should be <5 grams/day	34.0 _a	40.1 _b	38.8 _a	48.8 _b	1.58**
Eating high salt/salty seasoning will be very harmful	43.6 _a	38.3 _b	36.2 _a	51.7 _b	1.69*
Consuming high levels of salt lead to: (% yes)					
Hypertension	87.6	85.7	84.6 _a	92.5 _b	1.87*
Heart attack	59.6	60.8	59.5 _a	69.3 _b	1.51*
Stroke	59.9	58.9	57.9 _a	65.2 _b	1.32
Harmful for bones	45.5 _a	40.4 _b	38.7 _a	50.6 _b	1.64*
Knowledge about foods high in salt: (% definitely)					
Seasoning like stock cubes and powders	18.7 _a	22.8 _b	21.3 _a	32.1 _b	1.72*
Sauces like soy, fish sauce, oyster sauce, etc.	62.2 _a	58.0 _b	55.7 _a	72.3 _b	2.01*
Attitudes					
About salt reduction:					
It is very important to reduce salt in cooking (% yes)	64.1 _a	55.6 _b	53.2 _a	71.6 _b	1.96*

Use of salt alternatives is a safe way of reducing sodium intake (% definitely)	29.2 _a	25.6 _b	24.9 _a	30.3 _b	1.43**
<i>(% Strongly agree and somewhat agree)</i>					
Making efforts to use salt alternatives is worthwhile for the health benefits	76.5	77.9	76.9 _a	83.8 _b	1.43**
I am worried that too much salt consumption in my family can have very serious consequences	84.8 _a	89.3 _b	88.7 _a	93.4 _b	1.32
It's very difficult to control salt consumed in a day	61.3	61.8	63.4 _a	51.7 _b	0.67*
I am worried reducing salt in cooking may have negative effects on family's health	30.7 _a	34.0 _b	33.8	35.8	1.11
Reducing salt in cooking is not a priority for me	35.8 _a	49.5 _b	49.8	48	0.98
Reducing salt in cooking is something I support	93.3 _a	95.5 _b	95.2	97.4	1.81
Reducing salt consumption in my family is a positive way to maintain good health	94.0 _a	96.0 _b	95.8	97.4	1.62
Considered following in last 3 months: <i>(% always /often)</i>	(n=2,000)	(n=2,015)	(n=1,633)	(n=257)	
Amount of salt/salty sauces added while cooking	12.6 _a	22.4 _b	21.4 _a	28.8 _b	1.36**
Amount of salt added to food before eating	7.9 _a	15.9 _b	14.4 _a	25.8 _b	2.08*
Health harms from consuming high salt	45.2 _a	54.0 _b	52.0 _a	66.8 _b	1.82*
Ways to reduce salt the family consumes	37.7 _a	43.0 _b	41.2 _a	54.6 _b	1.64*

*Values in same row with different subscript "a" and "b" are significantly different at p<0.05 in two-sided test of equality for column proportions.
* Comparisons are currently based on bivariate analysis alone and do not control for potential confounders. Hence, any significant differences between "aware" and "unaware" groups must be interpreted with caution. *significance at 0.01, **significance at 0.05
^ Adjusted for gender, age, primary care giver, marital status, education, occupation, income, television watching frequency and internet use frequency.*

Table 4. Intentions, behavior and barriers related to reducing salt consumption, pre- and post-campaign (%)

	Pre-campaign		Post-campaign		
	Total (n=2,000)	Total (n=2,015)	Unaware* (n=1,744)	Aware* (n=271)	Adjusted OR [^]
Immediate intentions <i>(% strongly/somewhat agree)</i>			(n=1,633)	(n=257)	
To reduce purchase of foods very high in salt	79.6 _a	85.8 _b	85.1 _a	90.0 _b	1.45*
Confidence in controlling salt use <i>(% confident)</i>			(n=1,633)	(n=257)	
Reduce salt in cooking to avoid family's salt intake exceeding the recommended levels	82.2	82.9	82.1 _a	87.9 _b	1.59**
Maintain appealing taste for food for my family with reduced salt in cooking	84.7 _a	80.3 _b	79.1 _a	87.5 _b	2.07*
Behavior related to purchase <i>(% yes)</i>			(n=1,633)	(n=257)	
Look for salt content on food labels	23.5	24.6	22.8 _a	36.2 _b	1.8*
Buy low-salt alternatives	21.0	22.9	19.8 _a	42.8 _b	2.88*
Buy low-sodium salt	33.8	35.1	32.2 _a	53.5 _b	2.35*
Behavior while cooking <i>(% yes)</i>			(n=1,633)	(n=257)	
Measure amount of salt	45.7 _a	49.9 _b	47.8 _a	63.4 _b	1.84*
Use salt reduction measuring spoon	32.4	31.4	29.1 _a	45.5 _b	2.01*
Replace salt using onions, garlic, ginger	17.1 _a	23.2 _b	22.6	27.2	1.30
Add less salt than 3 months ago	20.5	19.3	18.0 _a	27.2 _b	1.56*
Add less salty processed foods than 3 months ago	26.3 _a	16.1 _b	14.3 _a	27.2 _b	1.94*
Add less sauce or seasoning than 3 months ago	17.7	15.8	14.1 _a	26.5 _b	2.01*

			(n=1,633)	(n=257)	
Behavior while eating					
<i>(% yes)</i>					
Limit consumption of processed foods	40.1a	56.1b	54.9a	63.8b	1.44*
Avoid eating outside foods	43.7a	59.7b	58.8	65.3	1.27
Consume less salt overall	17.5	18.9	17.5 _a	27.7 _b	1.65*
Barriers to salt reduction					
<i>(% strongly agree/agree)</i>					
I am more concerned about other ingredients	70.3a	61.4b	61.8	58.7	0.88
Can't tell how much salt is in the foods I like to eat	58.2a	65.2b	67.7a	49.1b	0.48*
Can't tell how much salt on food label is too much	41.4	43.7	45.0a	35.1b	0.79
My doctor suggested not to reduce my salt intake due to my certain disease or current treatment	38.1a	28.6b	27.7a	34.7b	1.4**
<i>Values in same row with different subscript "a" and "b" are significantly different at p<0.05 in the two-sided test of equality for column proportions.</i>					
<i>* Comparisons are currently based on bivariate analysis alone and do not control for potential confounders. Hence, any significant differences between "aware" and "unaware" groups must be interpreted with caution.</i>					
<i>^ Adjusted for gender, age, primary care giver, marital status, education, occupation, income, television watching frequency and internet use frequency.</i>					

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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5,6
Bias	9	Describe any efforts to address potential sources of bias	5,10
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	NN/A
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-8

		(b) Report category boundaries when continuous variables were categorized	6-8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	6-8
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	6-8
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.