A Mixed-Methods Study on Determinants of Salt-Reduction Behavior Among Residents Based on the PRECEDE Model: Postprint

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Abstract

Background: Chinese residents exhibit a high prevalence of hypertension yet a low control rate. Numerous epidemiological studies have demonstrated that reducing dietary salt intake contributes to lowering blood pressure levels. Therefore, investigating the factors influencing residents' salt reduction behavior holds significant importance for their self-health management and alleviating social burden.

Objective: Grounded in the PRECEDE model, this study examines the predisposing, reinforcing, and enabling factors of salt reduction behavior among Shandong residents, aiming to provide evidence-based recommendations for future salt reduction initiatives.

Methods: A mixed-methods approach was adopted. Employing purposive sampling, a total of 114 residents were interviewed in 2016 and 2018. The interview protocol encompassed attitudes toward salt control, difficulties encountered during the salt reduction process, and support received. Quantitative data were extracted from the questionnaire survey of the final evaluation of the 2016 Shandong Salt Reduction and Hypertension Prevention Project in eastern and central-southern Shandong. Hypertension-related survey items were selected from the database, comprising a study sample of 6,697 participants.

Results: Multinomial Logistic regression analysis revealed that, after adjusting for other variables, gender, occupation, and education level significantly influenced compliance with salt reduction behavior ($P<0.05$). After controlling for general personal characteristics, personal taste preferences, salt reduction knowledge, and attitudes toward low-salt diets significantly affected compliance with salt reduction behavior ($P<0.05$). Physician intervention served to reinforce residents'salt reduction behavior. Health education delivered by medical profession-

als not only enhanced salt reduction behavior and awareness among hypertensive patients but also strengthened family supervision, thereby improving family members' salt reduction behavior and awareness and ultimately promoting residents' salt reduction. Family reminders in daily life reinforced residents' salt control behavior. The Shandong Salt Reduction Initiative established project implementation policies, catering industry policies, food industry policies, and salt reduction health education policies, fostering a robust salt reduction environment. Among low-salt products, salt-limiting spoons exerted a substantial impact on residents, whereas the relatively low accessibility of low-salt foods and low-sodium salt limited their effectiveness in salt control. Mass media publicity constituted the primary channel through which residents obtained salt reduction information, with television and publicity in public spaces representing the currently more effective mass communication modalities.

Conclusion: Attitudes toward low-salt diets and knowledge levels constitute predisposing factors affecting residents' salt reduction behavior; physician advice and family reminders can facilitate the initiation of salt reduction and reinforce residents' salt reduction behavior, categorizing them as reinforcing factors; salt reduction-related policies and mass communication create a social atmosphere for residents' salt reduction, while salt reduction-related products provide practical conditions, classifying them as enabling factors.

Full Text

Preamble

Title: A Mixed-Methods Study on Influencing Factors of Salt-Reduction Behavior Among Residents Based on the PRECEDE Model

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Abstract

Background: The prevalence of hypertension among Chinese residents is high while the control rate remains low. Numerous epidemiological studies have

demonstrated that reducing dietary salt intake helps lower blood pressure levels. Therefore, exploring the influencing factors of salt-reduction behavior is significant for residents' self-health management and reducing social burden.

Objective: Based on the PRECEDE model, this study explores the predisposing, reinforcing, and enabling factors of salt-reduction behavior among Shandong residents to provide scientific recommendations for future salt-reduction initiatives.

Methods: This mixed-methods study employed purposive sampling to interview 114 residents in 2016 and 2018. The interview guide primarily covered attitudes toward salt control, difficulties encountered during salt control, and assistance received. Quantitative data were derived from the 2016 terminal survey questionnaire data of the Shandong Action on Salt and Hypertension (SMASH) project in eastern and central-southern Shandong. Hypertension-related survey content was selected from the database, with a total of 6,697 research samples included.

Results: Multinomial Logistic regression results showed that, after controlling for other variables, gender, occupation, and education level significantly influenced salt-reduction behavior compliance ($P<0.05$). After controlling for general personal conditions, personal taste, salt-reduction knowledge, and attitudes toward low-salt diet also significantly impacted compliance ($P<0.05$). Physician intervention could reinforce residents' salt-reduction behavior. Health education from medical personnel not only enhanced salt-reduction behavior and awareness among hypertensive patients but also strengthened family supervision, thereby improving family members' salt-reduction behavior and awareness, ultimately promoting salt reduction among residents. Family supervision in daily life could also strengthen residents' salt-control behavior. The Shandong Salt-Reduction Action formulated policies for project promotion, catering industry, food industry, and salt-reduction health education, creating a strong salt-reduction environment. Among low-salt products, the salt-restriction spoon had the greatest impact on residents, while the relatively low accessibility of low-salt foods and low-sodium salt affected their effectiveness in salt control. Mass media promotion was the primary channel for residents to obtain salt-reduction information, with television and public place promotions being the most visible forms of mass communication.

Conclusion: Attitudes toward low-salt diet and knowledge levels are predisposing factors affecting residents' salt-reduction behavior. Doctors' advice and family reminders serve as reinforcing factors that help residents initiate and maintain salt-reduction behavior. Salt-reduction policies and mass communication create a social atmosphere for salt reduction, while related products provide practical conditions—these are enabling factors.

Keywords: Hypertension; Diet, sodium-restricted; Mixed methods research; PRECEDE model; Root cause analysis

Introduction

The China Nutrition and Chronic Disease Status Report (2020) indicates that the prevalence of hypertension among adults aged 18 and above nationwide is 27.5%, five percentage points higher than the global level, yet the hypertension control rate is only 13.8% [1]. Improving hypertension control rates has become an urgent public health issue in China. Epidemiological studies have shown that reducing dietary salt intake helps lower blood pressure levels, improve the efficacy of antihypertensive medications, and enhance non-pharmacological treatment outcomes [2], thereby reducing cardiovascular disease incidence [3]. The World Health Organization (WHO) recommends that adult salt intake should not exceed 5 g/d [4]. However, surveys show that Chinese adult residents consume 9.3 g/d of salt [5], significantly exceeding WHO recommendations. Therefore, exploring the influencing factors of residents' salt-reduction behavior is crucial for personal health management and reducing social burden.

The PRECEDE-PROCEED model is one of the most effective and widely used frameworks for community health promotion and public health intervention, offering the most comprehensive evaluation in the health field [6]. Given the complex and diverse influencing factors of residents' salt-reduction behavior, the multi-perspective, multi-dimensional PRECEDE model can effectively address such complex research questions. The PRECEDE model (Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis and Evaluation) is the first half of the Green model, suitable for exploring behavioral influencing factors. Developed by American scholars GREEN et al. [7] based on community-based group intervention practices for health behavior change, drawing on previous theoretical models and perspectives of health behavior change, and integrating various psychological, cognitive, and external social environmental factors, this health education model divides factors influencing human health behaviors into three categories: predisposing, enabling, and reinforcing factors. Predisposing factors are motivations, desires, or triggers for a behavior; enabling factors are those that facilitate the realization of behavioral motivations or desires, namely the necessary skills and resources; reinforcing factors are those that incentivize behavior maintenance, development, or weakening. This study applies the PRECEDE model to explore the predisposing, reinforcing, and enabling factors influencing residents' salt-reduction behavior in the Shandong Action on Salt and Hypertension (SMASH) project, providing scientific recommendations for subsequent salt-reduction work.

1.2 Research Methods

This study employed a mixed-methods design, using both quantitative and qualitative methods within a single study [11-12] to maximize their respective advantages [13] and balance breadth and depth of analysis. Since quantitative and qualitative components were conducted simultaneously, this represents a parallel convergent design. Based on the PRECEDE model and literature review [14-15], researchers conceptualized residents'salt-reduction behavior as influenced by gen-

eral personal conditions, predisposing factors, reinforcing factors, and enabling factors. General personal conditions include age, urban/rural residence, gender, occupation, taste preferences, and hypertension status. Predisposing factors include salt-reduction knowledge and attitudes toward salt reduction. Reinforcing factors include family supervision and physician intervention. Enabling factors include salt-restriction spoons, low-sodium salt, low-salt foods, salt-reduction policy support, and mass media promotion. Factors difficult to quantify (such as salt-reduction policies) were primarily obtained through qualitative methods, while data like salt-reduction knowledge, which would be inefficient to collect qualitatively, were obtained only through quantitative methods. Some factors used both methods. The analytical framework for this study is shown in Figure 1 [Figure 1: see original paper].

1.2.1 Qualitative Research

This study employed purposive sampling in qualitative research, selecting individuals or small groups with specific characteristics who could provide maximum information or most valuable information as research subjects to theoretically obtain representativeness of the study population [8]. The sample size was determined by information saturation, where respondent data began to repeat and no new themes emerged during analysis [9]. Yantai Fushan District (eastern Shandong) and Weifang Gaomi City (central-southern Shandong) were pilot intervention sites for Shandong' s salt-reduction work, and residents in these areas, as key informants, had greater knowledge about salt-reduction efforts. Therefore, qualitative study subjects were selected from these two locations.

In September 2016, purposive sampling was used to select 31 residents for interviews. After preliminary analysis, it was found that interviews on some factors could be more in-depth and information was not sufficiently saturated, so 83 additional residents were interviewed in June-July 2018. Interviews were stopped when no new thematic content emerged, totaling 114 residents.

1.2.1.1 Interview Guide The interview guide was designed by researchers and finalized after multiple discussions with relevant experts. Questions included: (1) Do you have hypertension? How long have you had it? How do you usually control your blood pressure? (2) Discuss salt usage in home cooking. (3) Where have you seen salt-reduction promotions or received help from others? Which promotions were most effective? Whose help was most valuable? What suggestions do you have for salt-reduction promotion? (4) Discuss your views on salt reduction.

1.2.1.2 Data Organization and Analysis After interviews, audio recordings were transcribed verbatim, and interviewers conducted word-by-word verification. Qualitative data were organized and analyzed using NVivo 11.0 software from QSR. Before formal analysis, study subjects were coded, and personal privacy information was removed. Codes were suffixed with Y/G and numbered

according to entry into the study. For example, the 8th interview subject from Gaomi was coded as G08. All group interview transcripts were split into individual interview transcripts by interviewee and imported into NVivo together with individual interview transcripts for coding, theme extraction, and analysis.

1.2.2 Quantitative Research

Quantitative data were obtained through questionnaire surveys from the 2016 terminal survey of the Shandong Provincial and Ministry of Health Joint Action on Salt and Hypertension. After excluding samples missing key information such as sociodemographic characteristics, 6,697 residents were included to analyze the impact of sociodemographic characteristics, attitudes toward salt reduction, taste preferences, and hypertension status on salt-reduction behavior.

1.2.2.1 Questionnaire The questionnaire consisted of five sections: sociodemographic characteristics, hypertension status, salt-reduction knowledge, taste preferences, and attitudes toward low-salt diet. Sociodemographic characteristics included age, gender, education level, ethnicity, marital status, occupation, and urban/rural residence. Hypertension status assessed whether subjects had hypertension. The salt-reduction knowledge section included 7 questions, such as diseases that may be caused by hypertension and risk factors for hypertension. One point was awarded for each correct answer, with no points for incorrect or missing items (total score: 7). Taste preferences were categorized as light, moderate, or salty. Attitudes toward low-salt diet were categorized as opposed, supportive, or indifferent.

1.2.2.2 Quality Control All survey personnel underwent rigorous training. Each survey site had supervisors who conducted daily questionnaire checks. All forms were entered into PADs. Data were checked for quality by a data management team. For questionable data, investigators were responsible for verification and cleaning, and if necessary, re-contacted subjects to verify data and ensure accuracy. Quantitative data were double-entered to establish the database.

1.2.2.3 Data Analysis In qualitative research, residents' daily salt-reduction behaviors mainly included: cooking with less salt, using salt-restriction spoons, consuming low-sodium salt, eating less pickled vegetables, and using less soy sauce. Therefore, in quantitative analysis, the variable "salt-reduction compliance" was introduced to quantify residents' salt-reduction behavior. Specifically, scores were assigned to these five daily salt-reduction methods: 1 point for each behavior practiced, with a maximum of 5 points and minimum of 0. Residents' salt-reduction behavior was divided into three levels: poor compliance (0-1 points), moderate compliance (2-3 points), and good compliance (4-5 points).

2.1 Basic Information of Study Subjects

The quantitative component included 6,697 study samples, while the qualitative component included 114 interview subjects.

2.1.1 Basic Information of Quantitative Subjects

The quantitative study included 6,697 subjects with a mean age of $(47.2\$\pm10.1)years; 53.7\pm\$1.1)$.

2.1.2 Basic Information of Qualitative Subjects

The qualitative study included 114 subjects, with 64.9% aged $ $60 years, 75.4% (86/114) female and 24.6% (28/114) male; 55.3% (63/114) were from Gaomi City and 44.7% (51/114) from Yantai City; 34.2% (39/114) had primary school education, 23.7% (27/114) had junior high school education, 22.8% (26/114) had missing data, 16.7% (19/114) had high school or technical secondary school education, 1.8% (2/114) were illiterate/semi-illiterate, and 0.9% (1/114) had college education or higher; 57.9% (66/114) were urban residents and 42.1% (48/114) were rural residents; 61.4% (70/114) were hypertensive patients and 38.6% (44/114) were non-hypertensive; 78.1% (89/114) cooked at home while 21.9% (25/114) did not; 77.2% (88/114) practiced salt reduction while 22.8% (26/114) did not.

2.2 Analysis of Predisposing Factors

2.2.1 Univariate Analysis Results of Salt-Reduction Behavior Characteristics

There were no statistically significant differences in marital status or ethnicity distribution among residents with different levels of salt-reduction compliance ($P>0.05$). However, statistically significant differences were found in age, gender, education level, urban/rural residence, taste preference, occupation, knowledge level, attitudes toward low-salt diet, and hypertension status among residents with different compliance levels ($P<0.05$). See Table 1 .

2.2.2 Logistic Regression Analysis of Salt-Reduction Behavior Characteristics

Before conducting Logistic regression analysis, collinearity diagnosis indicated no multicollinearity among variables. Since the study sample did not meet the parallel lines assumption and the dependent variable was not strictly ordinal, unordered multinomial Logistic regression analysis was performed. Based on univariate analysis results, with salt-reduction behavior compliance as the dependent variable and age group, gender, education level, urban/rural residence, taste preference, occupation, knowledge level, attitude toward low-salt diet, and hypertension status as independent variables, unordered multinomial Logistic regression analysis was conducted. Results showed: females had better

salt-reduction compliance than males (P<0.05); residents with light or moderate taste preferences tended to have better compliance compared to those with salty taste preferences (P<0.05); residents with higher salt-reduction knowledge levels tended to have better compliance (P<0.05); residents who were heads of state organs, party organizations, enterprises, or institutions tended to have better compliance compared to unemployed residents (P<0.05); residents who opposed or were indifferent to low-salt diet tended to have poorer compliance compared to those who supported it (P<0.05); residents aged 30-39 tended to have poorer compliance compared to those aged 60-69 (P<0.05); residents with lower education levels tended to have poorer compliance (P<0.05). See Table 2 for details.

2.2.3 Impact of General Personal Conditions on Salt-Reduction Behavior

The impact of age group, gender, education level, urban/rural residence, and occupation on residents' salt-reduction compliance has been presented in the previous univariate and multivariate Logistic analyses and will not be repeated here. In qualitative research, findings on hypertension status, personal taste, and age variables either corroborated or contradicted quantitative results, so these three variables are explained here.

2.2.3.1 Hypertension Status Interviews revealed that hypertension status affected motivation or awareness for salt-reduction behavior. Residents with hypertension or with hypertensive family members had higher salt-reduction awareness than those without hypertension. One non-hypertensive resident stated: "I reduced salt for my husband' s sake; he has hypertension." —Y24, female, 68 years, non-hypertensive. A hypertensive patient mentioned: "I started reducing salt after being diagnosed with hypertension." —G30, male, 59 years, 10-year hypertension patient. "I' ve been using less salt since developing hypertension." —Y28, female, 76 years, 10-year hypertension patient.

Additionally, many residents reported that hypertension symptoms improved after reducing salt intake, which increased their compliance: "I used to have high blood pressure. After controlling salt for several months, my blood pressure stabilized. I' ve been controlling salt intake ever since, and my blood pressure has been fine." —Y12, female, 60 years, former hypertension patient.

However, multivariate analysis showed no statistically significant association between hypertension status and salt-reduction compliance. Moreover, only 21.3% of hypertensive patients adopted salt-reduction measures to control hypertension.

2.2.3.2 Age Multivariate Logistic regression results (Table 2) showed that residents aged 30-39 tended to have poorer salt-reduction compliance compared to those aged 60-69 (OR=0.801, 95%CI=0.646-0.993). This was corroborated in qualitative interviews. Elderly residents mentioned: "Salt reduction was

advocated before, but I didn' t pay attention, thinking I was young and this wasn' t a disease. But as I got older and felt weaker, I started reducing salt." —G40, female, 66 years, 30-year hypertension patient.

Younger residents paid less attention to salt control, did not actively seek salt-reduction information, did not participate in salt-reduction health education activities, did not use salt-restriction spoons, and were even unaware of the benefits: "I remembered everything well during the doctor' s lecture, but forgot after a while." —Y31, female, 37 years, non-hypertensive.

2.2.3.3 Personal Taste Logistic regression analysis showed that personal taste preference significantly impacted salt-reduction behavior (Table 2), with residents preferring lighter tastes tending to have better compliance. Interviews revealed that "poor taste after reducing salt" was the main reason for poor compliance. Many residents could reduce salt usage but did not control other salty seasonings, increasing soy sauce usage to enhance flavor, which ultimately hindered salt reduction: "Sometimes I put very little salt and basically don' t eat pickled vegetables, but I use quite a lot of soy sauce." —G21, 34 years, male, non-hypertensive.

2.2.4 Impact of Predisposing Factors on Salt-Reduction Behavior

2.2.4.1 Attitude In quantitative research, 91.9% of residents planned to reduce salt intake after learning about the harms of high-salt diets, 96.4% supported low-salt diets, 0.7% opposed low-salt diets, and 2.9% were indifferent. Logistic regression analysis of attitudes toward low-salt diet (Table 2) showed that residents who opposed or were indifferent to low-salt diets tended to have poorer compliance compared to supporters. Interviews found that most residents had good compliance. Despite poor taste of low-salt diets, they persisted for health benefits: "I have health problems (hypertension), and doctors advise eating less salt. It' s all for health, so I try to eat as little as possible." —Y29, female, 72 years, hypertension patient.

2.2.4.2 Knowledge The impact of salt-reduction knowledge on compliance has been presented in the previous Logistic regression analysis and will not be repeated here.

2.3 Reinforcing Factors

2.3.1 Physician Advice and Reminders

Both quantitative and qualitative surveys showed that physician advice was the main reason for hypertensive patients and their families to start reducing salt. Quantitative surveys found that medical personnel (43.0%) were the second most influential source of salt-reduction education for residents after mass media (43.1%). Qualitative interviews revealed that when residents were diagnosed with hypertension, doctors prescribed medication and provided lifestyle

interventions, including salt reduction: "Since my blood pressure increased, the clinic doctor told me to eat less salt and control it, which could help lower blood pressure." —Y27, female, 41 years, hypertension patient.

This action effectively motivated hypertensive patients and their families to start salt reduction. When asked to rank the effectiveness of perceived salt-reduction interventions, many subjects (39.0%, 16/41) considered doctors' advice the most effective control measure.

Physicians not only triggered residents' initial salt-reduction behavior but also played a crucial role in maintaining and reinforcing daily salt-reduction awareness and behavior. When examining factors influencing sustained salt-reduction behavior, many hypertensive patients mentioned that doctors' reminders were their main reason for persistence: "My hypertension is severe, and he (the doctor) always patiently explains things to make me pay attention, telling me what to eat and what not to eat, and my blood pressure has improved significantly." —G40, 66 years, female, 30-year hypertension patient.

2.3.2 Family Advice and Help

Quantitative surveys found that 12.0% of residents obtained salt-reduction information from family members. In interviews, when asked when they started reducing salt intake, some residents answered that they changed under family supervision. Interviews also found that most residents primarily ate at home, with outside dining mainly at wedding banquets. Family help occurred through two main pathways: verbal advice from children and spouses, and consuming salt-reduced meals prepared by family members. For non-cooking residents, family help was an important pathway to salt reduction.

2.4 Enabling Factors

2.4.1 Salt-Reduction Policies

In the SMASH project, the Shandong Provincial Government and former Health and Family Planning Commission collaborated with 16 departments including the Education Department, Propaganda Department, and Food and Drug Administration, creating extensive impact. Shandong integrated salt-reduction work into the "Healthy Shandong Action" evaluation system, included salt-reduction food counters, healthy demonstration restaurants, and guidance for food enterprise salt reduction as demonstration zone assessment indicators, and created comprehensive salt-reduction intervention demonstration townships. The Provincial Quality Supervision Bureau specified salt and edible oil usage standards in 31 newly issued "Shandong Cuisine" standards. Food industry salt-reduction policies guided food processing enterprises to include salt content standards when filing enterprise standards for salty foods. The province advocated for and promoted labeling salt content on salty food packaging and low-salt diet health tips. The "Shandong Province Salt-Reduction

and Hypertension Prevention Comprehensive Intervention Project Primary Healthcare Institution Service Standards" was issued, integrating comprehensive salt-reduction intervention into basic public health service projects.

2.4.2 Low-Salt Products

Low-salt products are important tools to help residents achieve salt-reduction goals, effectively controlling salt intake at the food source. Currently, products influencing residents' salt-reduction behavior mainly include salt-restriction spoons, low-sodium salt, and low-salt foods.

2.4.2.1 Salt-Restriction Spoons Research results showed that salt-restriction spoons play a crucial role in promoting salt-reduction behavior among "family cooks." Residents reported that after learning to reduce salt, they could not determine whether they had actually reduced intake: "Without this spoon, who knows how many grams of salt they' re eating?" —G11, 76 years, male, 10-year hypertension patient. Salt-restriction spoons provided a measurement scale, helping residents move away from "pinching with fingers or scooping with large spoons" and overcome the obstacle of unquantifiable salt intake, providing significant assistance in scientific salt reduction.

However, quantitative data showed that only 37.2% of residents had used salt-restriction spoons. Considering their importance, efforts are needed to increase usage rates. Many residents (65.9%, 27/41) affirmed the helpfulness of salt-restriction spoons, ranking their effectiveness second only to doctors' advice (31.7%, 13/41) among salt-reduction interventions, indicating their important role in reinforcing salt-reduction behavior.

Two factors hindered the effectiveness of salt-restriction spoons. First, low practicality reduced usage rates: "The spoon handle is too short; when the salt is almost gone, I can't reach it."—G54, 54 years, female, non-hypertensive. Second, residents lacked usage skills. Residents received two specifications of spoons: 2 g and 6 g. Interviews revealed that many residents believed using the spoon controlled salt intake, but upon further questioning, some didn' t even know the specifications, with some believing one spoon held 25 g. These misconceptions weakened salt-reduction effectiveness. Correct usage is essential for functionality. Quantitative data showed only 29.1% of residents reported knowing how to correctly use salt-restriction spoons, and only 24.7% believed they could use them properly, indicating that teaching correct usage is crucial.

2.4.2.2 Low-Sodium Salt The study found statistically significant differences in low-sodium salt usage between urban and rural residents (^{2}=222.623, P<0.001, see Table 3). More rural residents had never consumed low-sodium salt. The main reasons for not consuming low-sodium salt were "it doesn' t matter whether I consume low-sodium salt or not" (42.5%) and "difficult to purchase low-sodium salt" (26.3%). Qualitative interviews corroborated this, with many residents reporting they had never seen low-sodium salt: "I' ve never seen

this low-sodium salt. What they sell in the village (small shops) probably isn' t low-sodium salt; you can only buy it in supermarkets." —Y12, female, 60 years, non-hypertensive.

2.4.2.3 Low-Salt Foods Low-salt foods in the market include packaged low-salt products (e.g., low-salt biscuits), low-salt condiments (e.g., low-salt soy sauce), low-salt dishes in catering units, and low-salt processed foods (e.g., marinated meat products). However, interviews showed low-salt foods had minimal impact on residents' salt-reduction behavior, with many reporting they had never seen low-salt foods or dishes. Quantitative surveys found only 23.1% of residents actively chose low-salt processed foods.

2.4.3 Mass Communication

Mass media promotion was the primary channel for residents to obtain salt-reduction information. Quantitative results showed 43.1% of residents received salt-reduction education and promotion through mass media, with television having the greatest impact (34.1%). Interviews revealed that residents most frequently watched health programs like "Health Hall" and "Path to Health," and had high trust in CCTV channels. Television health programs influenced salt-reduction behavior by: (1) reinforcing salt-reduction awareness in daily life and prompting salt-reduction actions; and (2) strengthening salt-reduction behavior.

One resident noted: "After developing hypertension, even before the SMASH project, I had some awareness (of salt reduction) from reading newspapers, news, and watching TV health programs." —G07, male, 68 years, 18-year hypertension patient.

In addition to television, promotional brochures and posters in public places were important carriers for salt-reduction education. Some residents had strong impressions of promotional materials from the project, which greatly helped improve salt-reduction awareness. Quantitative surveys showed 20.1% of residents learned about salt reduction through brochures and 12.5% through public place bulletin boards, ranking third and fourth among information sources. Many interviewees found the project' s promotional materials most impressive: "The salt-reduction signs posted along the riverfront square—people who like exercising can all see them and understand the salt-reduction information at a glance. This is the most effective." —Y04, male, 73 years, over 20-year hypertension patient.

This study found that the internet had minimal impact on residents' salt-reduction behavior, possibly because the study population was older with lower internet literacy. However, with rapid information technology development, using the internet and new media to intervene in salt-reduction behavior among younger residents holds significant potential.

Discussion

According to the PRECEDE model, among factors influencing residents' salt-reduction behavior, some sociodemographic characteristics affect compliance; attitudes toward salt reduction and salt-reduction knowledge affect compliance —these are predisposing factors. Doctors' advice and family reminders effectively enhance salt-reduction awareness and serve as reinforcing factors. Salt-reduction policies create an important social atmosphere, low-salt products like salt-restriction spoons are essential tools, and mass communication is an important information channel—these are enabling factors. Based on these predisposing, reinforcing, and enabling factors, targeted salt-reduction measures can be developed. Results suggest that policy support and health education should be priorities in "Three Reductions and Three Health" initiatives.

This study has limitations. The quantitative sample had a mean age of (47.2$±$10.1) years and was predominantly rural, so caution is needed when generalizing findings to populations with more balanced characteristics. Additionally, due to uncontrollable factors in field surveys, the qualitative follow-up was conducted later, creating a time gap with quantitative data and initial qualitative interviews that may introduce recall bias and affect comparability.

Author Contributions: ZHANG Xing and SUN Xinying conceived and designed the study and conducted feasibility analysis. DONG Jing, XU Jianwei, BAI Yamin, LIU Min, ZHANG Xiaochang, GUO Xiaolei, and MA Jixiang coordinated field surveys and collected data. GUO Yi assisted with data organization and manuscript revision. SUN Xinying reviewed and quality-controlled the manuscript and provided supervision.

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