Postprint: A Survey of Community Residents' Health Behaviors and Optimization Strategies Based on the Behavior Change Wheel Theory

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Abstract

Background With the increasing burden of chronic diseases, promoting healthy behaviors among residents has become a key public health objective. Despite gradual improvements in health literacy and management awareness, a significant gap persists between knowledge and behavior. The Behavior Change Wheel (BCW) theory, as a tool for systematically identifying behavioral influences and designing intervention strategies, has been widely applied internationally. However, empirical research in the field of community residents' health behaviors in our country remains relatively limited. Objective To understand the current status of health behaviors among community residents in Shanghai and analyze their influencing factors, and to propose optimized strategies for improving residents' health behaviors based on the BCW theoretical framework. Methods From February to May 2023, a stratified sampling method was employed, considering the permanent population size and number of community health service centers in each district of Shanghai, to randomly select 1–4 street/town community health service centers per district, totaling 28 centers. The research team conducted questionnaire surveys among 50 community residents seeking medical care at each center to collect information related to their health behaviors. The questionnaire content was based on BCW theory, utilizing the Health Literacy Management Scale (HeLMS) to assess health literacy levels, with self-designed items evaluating health management behaviors, health management beliefs, and participation in health management programs. To control for confounding factors, propensity score matching (PSM) based on general individual characteristics was employed for data balancing, and the main factors influencing health behaviors were analyzed. Results A total of 1,436 community residents were included. The results showed that the health management belief dimension had the highest score rate (mean score 2.58, score rate 86.0%), followed by health literacy level (mean score 95.40, score rate 79.5%), while health management

behavior scores were relatively low (mean score 4.24, score rate 60.6%), and scores for implementing health management programs were the lowest (mean score 4.00, score rate 33.3%). Based on health management behavior scores, residents with scores $ $5 were classified into the good behavior group (n=412), and those with scores $ $4 into the poor behavior group (n=1,024). Using a 1:1 PSM method to control for confounding variables including gender, age, education level, residential area, medical expense source, monthly income, and marital/childbearing status, the comparison of health literacy and health management belief scores between the two groups after matching showed statistically significant differences (P<0.05). Furthermore, based on the research findings, optimized strategies for community residents' health behaviors were proposed based on the BCW: improving residents' health literacy levels and health management beliefs. Conclusion Community residents in Shanghai possess relatively good health management beliefs and health literacy levels, but health behavior implementation and participation in health management programs still need improvement. Based on BCW theory, this study proposes multidimensional intervention strategies encompassing health education, capability empowerment, incentive mechanisms, and environmental support, targeting optimization of core behavioral elements such as capability and motivation, aiming to improve residents' health behavior levels and provide theoretical guidance and practical pathways for systematic intervention in community health management.

Full Text

Assessment and Optimization of Community Health Behaviors Guided by the Behaviour Change Wheel Theory

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Abstract

Background

With the increasing burden of chronic diseases, promoting health behaviors among residents has become a key public health priority. Although health literacy and awareness of health management have gradually improved, a significant gap remains between knowledge and actual behavioral change. The Behavior Change Wheel (BCW) theory, as a systematic framework for identifying behavioral determinants and designing targeted interventions, has been widely applied internationally. However, empirical research applying this model to the health behaviors of community residents in China remains limited.

Objective

To assess the current status of health behaviors among community residents in Shanghai, identify their influencing factors, and propose optimization strategies to improve health behaviors based on the Behavior Change Wheel framework.

Methods

From February to May 2023, a stratified sampling method was employed. Based on the permanent population and the number of community health service centers (CHSCs) in each administrative district of Shanghai, 1 to 4 CHSCs were randomly selected from each district, resulting in a total of 28 centers. At each site, 50 community residents attending outpatient services were invited to complete a structured questionnaire assessing their health behaviors. The questionnaire was developed based on the Behavior Change Wheel (BCW) framework. Health literacy was assessed using the Health Literacy Management Scale (HeLMS), while health management behaviors, health management beliefs, and participation in health management programs were evaluated using self-designed items. To control for confounding, propensity score matching (PSM) based on general individual characteristics was applied to balance baseline variables, and key influencing factors of health behaviors were subsequently analyzed.

Results

A total of 1,436 community residents were included in the study. Among the four dimensions evaluated, the highest score rate was observed in health management beliefs (mean score: 2.58; score rate: 86.0%), followed by health literacy (mean score: 95.40; score rate: 79.5%). In contrast, health management behaviors showed a lower score (mean: 4.24; score rate: 60.6%), and participation in health management programs was the lowest (mean: 4.00; score rate: 33.3%). Based on health management behavior scores, residents scoring $ $5 were categorized as the good behavior group (n=412), and those scoring $ $4 as the poor behavior group (n=1,024). Propensity score matching (1:1) was applied to control for potential confounding variables including gender, age, education level, residential area, source of medical payment, monthly income, and marital/childbearing status. After matching, significant differences remained between the two groups in health literacy and health management belief scores ($P<0.05$). Targeted optimization strategies were subsequently proposed based

on the Behavior Change Wheel framework: improving residents' health literacy and health management beliefs.

Conclusion
Community residents in Shanghai demonstrated relatively strong health management beliefs and health literacy. However, the execution of health-related behaviors and participation in health management programs remain suboptimal. Guided by the Behavior Change Wheel framework, this study proposed a set of multi-dimensional intervention strategies encompassing health education, capacity building, incentive mechanisms, and environmental support. These strategies target core behavioral determinants such as capability and motivation, aiming to enhance residents' health behavior performance and provide theoretical and practical guidance for systematic community health management interventions.

Keywords: Health behavior; Health management; Community residents; Active health; Behavior change wheel

Introduction

Health management plays a central role in achieving universal health goals, extending beyond clinical diagnosis and treatment to encompass disease prevention, health literacy promotion, and public health environment improvement. As society progresses and demographic structures evolve, chronic noncommunicable diseases have become the focal point of health management, prompting a paradigm shift from a "treatment-centered" model to a "prevention-oriented" approach that emphasizes health promotion and disease prevention. In this transformation, community residents serve as the primary agents of change. Enhancing residents' health literacy—their ability to access, process, and understand essential health information and services—is crucial for enabling informed health decisions. Improved health literacy empowers residents to manage their health status more effectively, understand disease prevention, and seek appropriate medical assistance when necessary.

Encouraging residents to adopt active lifestyles, including regular exercise, balanced nutrition, adequate sleep, and avoidance of harmful habits, represents an effective approach to significantly reducing chronic disease risk, improving quality of life, and decreasing healthcare expenditures. These health behaviors not only improve individual well-being but also generate positive impacts on the public health system by reducing chronic disease incidence. For patients with chronic conditions, proactive health management can improve quality of life, reduce disease impact on daily activities, and enhance disease control while decreasing complications and medical costs. Therefore, strengthening residents' health management capacity through education, resource provision, and environmental support benefits both individual health and reduces economic burden for society.

In 2011, MICHIE first proposed the Behavior Change Wheel (BCW) theory, a framework for analyzing and planning behavior change interventions. The BCW model consists of three concentric layers: a core, middle layer, and outer layer. The core contains three essential elements—capability, opportunity, and motivation (COM-B system)—identified as key drivers of behavior. The middle layer comprises nine intervention functions designed to change one or more COM-B elements: education, persuasion, incentivization, coercion, enablement, modeling, restriction, environmental restructuring, and training. The outer layer encompasses policy categories that provide implementation methods for intervention strategies. The BCW framework helps identify determinants of target behaviors and develop effective, sustainable health behavior change strategies by selecting appropriate intervention functions and policies. Currently, BCW theory is widely applied in community health behavior optimization research to promote healthier lifestyles and improve public health outcomes.

Understanding and analyzing residents' current health behaviors and their influencing factors is essential for developing optimization strategies. This study employs questionnaire surveys to examine health behavior changes, analyzing the relationships between capability, opportunity, motivation, and behavior based on BCW theory to provide a theoretical foundation for subsequent optimization 方案.

Methods

Study Design and Participants

From February to May 2023, we employed a stratified sampling method. Based on the permanent population and number of community health service centers in each Shanghai administrative district, we randomly selected 1-4 street/town community health service centers from each district, totaling 28 centers. At each center, 50 community residents attending outpatient services were invited to participate in the survey. According to Kendall' s principle, sample size for questionnaire research should be 5-10 times the number of items. Considering a 10-20% attrition rate, the minimum required sample was 672 residents, and ultimately 1,436 community residents were enrolled.

Measurements

General Information Questionnaire

Designed by the researchers based on literature review, this questionnaire included: gender, age, education level, residential district, medical payment source, monthly income, marital status, and childbearing status.

Behavior Change Wheel Elements

In this study, target behavior was defined as community residents' health behaviors, with core elements operationalized as follows:

- **Behavior** was converted to health behavior level, assessed through multiple-choice items where each selected item accumulated 1 point (score range: 1-7). Based on McNerney' s health behavior content, the "Healthy China 2030" 规划纲要, and characteristics of the study population, health behavior items were organized into three dimensions: (1) physiological: "paying attention to physical abnormalities and actively seeking professional advice," "proactively reading health information," "developing exercise plans and exercising appropriately," "maintaining regular meals and nutritional balance" ; (2) psychological: "self-relaxation and stress regulation to maintain emotional well-being" ; (3) social: "maintaining harmonious interpersonal relationships."
- **Capability** was operationalized as health literacy level using the Health Literacy Management Scale (HeLMS), developed by Professor JORDAN at the University of Melbourne in 2010. This 24-item scale uses 1-5 scoring per item (total score range: 24-120), with higher scores indicating better health literacy. The scale demonstrates good internal consistency (Cronbach' s α: 0.857-0.947).
- **Motivation** was converted to health management beliefs, assessed by the item: "Do you believe health management is necessary for yourself?" Scoring: "always necessary" = 3 points, "necessary when ill" = 2 points, "not necessary" = 1 point (range: 1-3), with higher scores indicating stronger beliefs.
- **Opportunity** was converted to participation in health management programs, assessed by asking "Which community health management or clinical services have you received?" with 12 multiple-choice items, each scored 1 point (range: 0-12).

Statistical Analysis

Data were entered using Excel and analyzed with SPSS 26.0. Continuous variables were expressed as mean ± standard deviation, with between-group comparisons using independent samples t-tests. Categorical data were expressed as percentages, with between-group comparisons using ^{2} tests. To control for confounding factors, propensity score matching (PSM) was applied using gender, age, education level, residential area, medical payment source, monthly income, and marital/childbearing status as covariates, with a caliper value of 0.02 and 1:1 nearest neighbor matching to pair the good behavior and poor behavior groups. Post-matching comparisons were conducted to examine differences in health literacy, health management beliefs, and program participation. All tests were two-tailed, with $P<0.05$ considered statistically significant.

Results

Participant Characteristics

Among the 1,436 community residents, 44.8% (n=643) were male and 55.2% (n=793) were female. Age distribution was: 22.2% (n=319) aged 44 or younger, 49.0% (n=704) aged 45-59, and 28.8% (n=413) aged 60 or older. Education lev-

els included: 38.9% (n=558) with junior high school or below, 41.0% (n=589) with high school or vocational education, and 20.1% (n=289) with bachelor' s degree or higher. Regarding residential area, 35.0% (n=502) lived in urban districts while 65.0% (n=934) lived in suburban areas. Medical payment sources were: 50.0% (n=718) employee insurance, 33.3% (n=478) resident insurance (including rural cooperative medical schemes), and 16.7% (n=240) other forms. Monthly income distribution showed 40.3% (n=578) earning $ $5,000 yuan and 59.7% (n=858) earning >5,001 yuan. The majority were married (88.7%, n=1,274) and had children (91.5%, n=1,314).

Health Management Behavior Levels

Residents scored highest in health management beliefs (mean score: 2.58; score rate: 86.0%), followed by health literacy (mean: 95.40; score rate: 79.5%). Health management behaviors scored relatively lower (mean: 4.24; score rate: 60.6%), while participation in health management programs was lowest (mean: 4.00; score rate: 33.3%). The score rate reflects the ratio of actual score to maximum possible score, indicating performance level in each behavioral dimension. Detailed scores are presented in Table 1 .

Based on health management behavior scores, residents scoring $ $5 points were classified as the good behavior group (n=412), while those scoring $ $4 points were classified as the poor behavior group (n=1,024).

Propensity Score Matching Analysis

Before matching, significant differences existed between groups in gender, age, education level, residential area, medical payment source, and childbearing status ($P<0.05$), indicating baseline imbalance. Using 1:1 PSM to control these confounding variables, 391 matched pairs were successfully created. After matching, no significant differences remained in general characteristics between groups ($P>0.05$), achieving balanced individual characteristics, as shown in Table 2 .

Factors Associated with Health Management Behaviors

After PSM, the good behavior group demonstrated significantly higher scores in health literacy and health management beliefs compared to the poor behavior group ($P<0.05$). However, no significant difference was found in participation in health management programs between groups ($P>0.05$), as detailed in Table 3 .

Optimization Strategies Based on the Behavior Change Wheel

In developing optimization strategies, we followed BCW' s three main stages: understanding the target behavior, identifying intervention options, and deter-

mining intervention content and implementation.

Understanding the Target Behavior

This stage involved four specific steps: (1) defining the behavioral problem, (2) selecting target behaviors, (3) specifying target behaviors, and (4) identifying what needs to change. Our study aimed to improve community residents' health management behaviors. Based on our findings, we identified capability and motivation as key elements influencing community health behaviors, providing a theoretical basis for subsequent optimization 方案.

Identifying Intervention Options

Determining Intervention Functions

According to the relationship matrix between COM-B elements and BCW intervention functions, and applying the APEASE criteria (affordability, practicability, effectiveness and cost-effectiveness, acceptability, side-effect/safety, equity), we identified suitable intervention functions. Diagnosis of capability elements indicated education, training, and enablement as appropriate functions. Mapping motivation elements to intervention functions suggested persuasion, incentivization, coercion, environmental restructuring, modeling, and enablement.

Selecting Policy Categories

Using the relationship matrix between BCW intervention functions and policy categories, we identified policy categories matching the above intervention functions.

Determining Optimization Strategies

Based on preliminary survey results and literature review, we developed initial optimization strategies for improving community residents' health behaviors grounded in BCW theory. Considering that coercion did not meet APEASE criteria for feasibility, practicability, and acceptability, this function was excluded.

Comprehensive Optimization Strategies for Community Health Behaviors

Improving Residents'Health Literacy Levels Policy Support and System Establishment

Develop and disseminate comprehensive health management guidance manuals with specific indicators and steps for disease prevention and healthy lifestyles. Promote formulation of relevant health regulations to ensure public places such as schools, parks, and workplaces provide guidance on healthy lifestyles. Establish community-level rules mandating regular health check-ups and requiring or encouraging participation in health education and training activities. Provide subsidies or rewards for residents participating in health management training,

and offer financial support for purchasing health management tools such as blood pressure monitors and pedometers to facilitate self-monitoring.

Health Education and Training
Organize regular health education lectures and seminars focusing on chronic disease prevention, management, and cultivation of daily health habits. Produce and widely distribute easy-to-understand health education materials, particularly for key populations including older adults, chronic disease patients, and children. Conduct regular health management training courses for chronic disease patients and community residents covering basic knowledge of healthy diets, regular exercise, and disease self-management. Provide health monitoring skills training for groups with specific needs, such as blood glucose and blood pressure monitoring techniques. Establish health consultation windows in communities to offer personalized health management plans and counseling. Disseminate health information widely through social media, community broadcasting, and online platforms, including health management apps and online courses.

Resource Provision and Infrastructure Improvement
Provide residents with necessary health monitoring equipment and teach proper usage for daily health management. Establish walking paths and fitness areas to encourage physical activity. Collaborate with schools, senior centers, and other community organizations to conduct joint health education and activities. Optimize community health facilities by establishing more public walking paths and fitness areas. Organize various health activities such as walking groups and health knowledge competitions to increase residents' engagement and interest in health behaviors.

Enablement Interventions
Offer one-on-one communication with residents to provide personalized health management recommendations tailored to their health status and lifestyle. Publicly recognize residents with significant health management achievements during community activities as positive examples to motivate others. Provide health advisory services including disease management recommendations and regular follow-up assessments. Offer online health training resources through web platforms for residents to access anytime and apply in daily life. Establish community health support networks to encourage mutual support and sharing of health management experiences among residents.

Improving Residents' Health Management Beliefs Education
Regularly organize lectures and seminars inviting health experts to explain the benefits of healthy lifestyles, enhancing residents' awareness of health management importance. Widely use posters and flyers in communities to disseminate health knowledge, emphasizing the long-term benefits of healthy behaviors.

Persuasion
Publish success stories and case studies of residents' health management through media and social platforms as motivational tools to encourage participation in

health activities.

Incentivization and Reward Mechanisms
Organize regular health challenge activities such as walking competitions or healthy eating challenges with rewards for active participants. Establish a health points system where residents earn points through health activities or achieving health goals, redeemable for small gifts or services. Provide bonuses or discounts to encourage active participation in health management activities.

Environmental Restructuring
Simplify health management service processes to make services more convenient and reduce barriers to accessing medical care. Improve the accessibility and quality of community medical services to ensure residents can easily obtain necessary healthcare and health consultations.

Modeling
Medical personnel should model healthy behaviors to inspire residents to follow suit. Showcase successful residents practicing healthy lifestyles in community activities, media, or social networks as role models to encourage emulation.

Enablement
Engage in one-on-one communication with residents to provide personalized health management advice tailored to their specific health conditions and habits. Publicly commend residents with notable health management achievements during community events as positive demonstrations to motivate others.

Discussion

Our findings indicate that while community residents may possess certain health management motivation, substantial room for improvement exists in translating this motivation into actual practice. Particularly in implementing specific health management programs, significant challenges remain, possibly due to lack of effective management plans, insufficient resources, or inadequate understanding of health management.

Complexity of Community Health Behaviors

Health management behaviors are influenced not only by individual knowledge and beliefs but also by community environments, social structures, and policy contexts. Analysis of multi-dimensional influencing factors reveals that personal health literacy and health beliefs collectively shape residents'behavioral patterns. Therefore, strategies to improve health behaviors must comprehensively consider these factors rather than merely increasing health knowledge or changing beliefs.

Although community residents may possess basic health management knowledge and beliefs, these do not always translate effectively into concrete actions. This disconnect may result from various causes such as lack of necessary health

resources, insufficient social support, or weak motivation for behavior change. Residents with stronger health literacy demonstrate better health management behaviors, indicating that high-level health literacy enables individuals to more effectively understand and use health information to make beneficial health decisions. This underscores the critical role of improving public health literacy in enhancing health behaviors and promoting overall health. Residents with strong health management beliefs are more likely to adopt good health management practices. These beliefs not only promote regular health check-ups and active health information seeking but also increase acceptance of and participation in health interventions.

Strategic Health Interventions for Improving Health Behaviors

Enhancing community residents' health behavior levels requires a multi-level, multi-strategy comprehensive approach. These methods include policy integration, environmental support, community empowerment, and technology application, aiming to build an ecosystem that promotes health behaviors and fundamentally improves residents' health literacy and behavioral performance. Therefore, continuous monitoring and evaluation of these strategies' implementation effects is crucial for adjusting and optimizing health interventions.

Policy and system establishment requires sustainability and adaptability. Health management guidance manuals and related health regulations must be regularly updated to reflect the latest medical research and practical advances. Ensuring effective communication of the most current information to every community member is key to improving policy implementation effectiveness. Given the diversity of community residents' health needs, providing personalized health management plans is essential. Additionally, applying big data and artificial intelligence technology to analyze residents' health data and provide tailored health recommendations and education represents an important future direction. While financial incentives can increase participation in the short term, their long-term effectiveness and sustainability present challenges, requiring joint efforts from government and community organizations to identify continuous funding sources and effective management models.

Community environment optimization extends beyond physical spaces to include cultural and social interaction pattern changes. Therefore, designing environments that encourage healthy behaviors—such as adding walking and cycling paths and optimizing parks and recreational areas—can promote daily outdoor activities. Environmental improvements require cross-sector collaboration involving urban planning, public health, and community development.

Establishing health support networks can be achieved through organizing health volunteer teams and health buddy programs, thereby enhancing mutual assistance and resource sharing among residents. Such networks not only provide real-time health assistance and information exchange but also strengthen community cohesion and residents' collective capacity to address health challenges.

This study systematically analyzed the current status and influencing factors of community residents' health behaviors based on BCW theory and proposed targeted intervention optimization strategies. These comprehensive interventions aim to enhance community residents' health management capacity, providing theoretical and practical guidance for continuous optimization of community health management.

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Note: Figure translations are in progress. See original paper for figures.