Integrating Geographic Information Systems into a Self-Efficacy–Based Health Promotion Model for Foreign Retirees in Elderly Care Centers in Bangkok Metropolitan Area, Thailand

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Abstract
Thailand's rapid transition to an aged society has coincided with increasing numbers of foreign retirees choosing long-stay residence in Bangkok, including within elderly care centers. However, existing care services have often prioritized dependent-care models, leaving a service gap for foreign retirees in Independent Living and Assisted Living categories who require culturally responsive, autonomy-supporting health promotion. Building solely on the attached sequential mixed-methods manuscript, this article consolidates the development and implementation evidence of a self-efficacy–based health promotion model and presents a GIS-enabled integration architecture to strengthen metropolitan-scale planning and delivery. In Phase 1, expert interviews and focus group discussions informed the model structure and activities, resulting in five health promotion dimensions: Health Education, Health Prevention, Health Protection, Spiritual Improvement, and Nutrition Therapy. In Phase 2, a one-group pretest–posttest implementation among foreign retirees (n = 33) residing in elderly care centers in Bangkok demonstrated statistically significant improvements (p < .01) in health promotion knowledge, self-care health behaviors, and physiological indicators, including blood pressure, body mass index, blood sugar, and muscle mass. To enhance scalability without altering the original intervention logic or claims, GIS is incorporated as a cross-cutting operational layer in three strategic applications: (1) risk mapping to visualize spatial patterns relevant to health risks and service access; (2) facility suitability mapping to support evidence-informed site selection for new or expanded elderly care centers using spatial criteria aligned with holistic care; and (3) predictive GIS modeling to forecast future service demand based on spatial-demographic scenarios. Importantly, the geospatial analysis and map outputs are positioned as core decision-support tools rather than illustrative figures. These GIS outputs help identify priority service areas, guide evidence-informed location planning for new or expanded elderly care centers, and support resource allocation according to spatial patterns of access, risk, and projected demand. This integrated approach positions the proven five-dimension model for broader deployment across Bangkok metropolitan areas, supporting Thailand's direction toward becoming a regional medical and retirement hub.

Keywords: Assisted Living, Bangkok Metropolitan Area, Elderly Care Centers, Foreign Retirees, GIS, Health Promotion Model, Self-Efficacy, Spatial Health Planning

1. Introduction

Population aging has become a defining public health challenge worldwide. In 2019, the global population reached 7.7 billion, with more than one billion people aged 60 years and above, and projections indicate that older adults will approach two billion by 2050, accounting for nearly one-fifth of the world's population [1] and [2]. This demographic transition is especially consequential in Asia, where aging is occurring rapidly and intensifying demand for sustainable systems that support active and healthy aging. Thailand has already entered an aging society. The proportion of older adults increased from 18.24% in 2020 to 20.66% in 2022 and continues to rise at an estimated 3.6% annually, with projections suggesting that by 2035, older adults may represent 28.55% of the population [3]. Although most older

adults remain socially active, chronic noncommunicable diseases including cardiovascular disease, diabetes, and hypertension are common, and falls and low levels of desirable health behaviors remain persistent concerns [4] and [5]. These realities underscore the need for health promotion strategies that strengthen knowledge, self-care behaviors, and physiological well-being among older populations.

In parallel with domestic aging, Thailand has become an attractive destination for long-stay foreign retirees and has strong potential to develop as a regional medical and wellness hub [6] and [7]. However, elderly care services in Thailand are delivered through diverse facility types, and prevailing service models have tended to emphasize dependent care, creating a gap for foreign retirees in Independent Living and Assisted Living categories who require culturally appropriate, autonomy-supporting health promotion rather than primarily dependent-care services [6]. Additional challenges include cultural adaptation and communication barriers, which can limit access and reduce the fit of services for older adults from diverse backgrounds [7]. This gap creates a clear rationale for evidence-based models designed specifically for foreign retirees residing in elderly care centers in Bangkok and its metropolitan areas.

The attached manuscript responds to this need by developing and implementing a structured health promotion model grounded in self-efficacy theory and established health promotion frameworks [8] and [9]. The model comprises five integrated dimensions Health Education, Health Prevention, Health Protection, Spiritual Improvement, and Nutrition Therapy intended to improve health promotion knowledge, self-care behaviors, and physiological outcomes among foreign retirees living in elderly care centers. To strengthen metropolitan-scale applicability without altering the model's core logic or claims, this article further positions Geographic Information Systems (GIS) as an enabling implementation layer that can support three practical functions aligned with real-world planning needs: (1) risk mapping to visualize spatial patterns relevant to older adult health risks and service accessibility; (2) facility suitability mapping to inform evidence-based decisions on optimal locations for new or expanded elderly care centers; and (3) predictive GIS modeling to forecast future service demand under spatial-demographic scenarios. In this way, GIS is presented not as an additional tested intervention, but as a decision-support and scale-up architecture that operationalizes the five-dimension model across Bangkok's metropolitan context. In this study, geospatial analysis plays an important role in translating the health promotion model into practical planning intelligence for elderly care centers. GIS-based maps enable planners and care providers to visualize spatial differences in service access, risk concentration, facility suitability, and projected demand, thereby supporting more transparent decisions on where to intensify health promotion activities, where to expand elderly care services, and how to prepare care capacity for future metropolitan aging needs.

Recent geoinformatics studies provide strong support for positioning GIS as a decision-support mechanism in elderly care and health service planning. GIS has been applied to map elderly households, health-risk clusters, service coverage, and resource gaps in long-term care contexts, demonstrating its value for targeted intervention and resource allocation [10]. Similarly, geospatial analysis has been used to identify disparities in functional independence and healthcare accessibility among older adults, reinforcing the need for spatially sensitive elderly care planning [11]. In Thailand, spatial factors associated with falls among older adults have also been shown to vary geographically, indicating that elderly health risks are not evenly distributed and should be addressed through area-specific planning strategies [12]. These studies justify the integration of GIS into the present self-efficacy–based health promotion model as an operational layer for identifying priority service areas, improving elderly care center planning, and aligning health promotion resources with spatially uneven needs.

2. Background and Problem Significance

The world is rapidly entering an aging society. In 2019, the global population was 7.713 billion, with 1.016 billion people aged 60 years and above. This number is projected to increase to approximately 1.2 billion in 2025 and 2.0 billion by 2050, around 20% of the world's population [2]. Thailand is undergoing the same transition. The proportion of older adults increased from 18.24% in 2020 to 20.66% in 2022, rising at an estimated annual rate of 3.6%, and is projected to reach 28.55% by 2035 [3]. These demographic shifts intensify the urgency for health promotion strategies that can sustain functional ability and well-being in later life.

Although many older adults remain socially active, chronic noncommunicable diseases are prevalent, including cardiovascular disease, diabetes, and hypertension [4]. Falls continue to be a major contributor to morbidity and mortality, and desirable health behaviors among older adults remain low [5]. Alongside domestic aging, Thailand has strong potential to become a regional medical hub,

supported by increasing numbers of foreign retirees seeking long-term residence and health services. While elderly care facilities in Thailand exist in multiple forms, service models are still largely oriented toward dependent care, leaving a service gap for foreign retirees in Independent Living and Assisted Living categories [6].

To address this gap, integrating self-efficacy concepts with health promotion approaches is essential because it emphasizes behavior modification and strengthening self-care capacity [8] and [9]. In this context, health promotion is operationalized through five dimensions Health Education, Health Prevention, Health Protection, Spiritual Improvement, and Nutrition Therapy aimed at improving both physical and mental well-being. Developing a structured health promotion model for foreign retirees residing in elderly care centers is therefore significant for elevating service standards and supporting Thailand's long-term health tourism policy.

3. Research Methodology

3.1 Study Design

This research employed a sequential mixed-methods design to (1) develop a health promotion model for foreign retirees residing in elderly care centers in Bangkok and its metropolitan areas and (2) implement and evaluate the model using a quasi-experimental one-group pretest–posttest approach. The methodological rationale aligns with health promotion and self-efficacy–based behavior-change frameworks [8] and [9]. Accordingly, the GIS-related objective of this paper is to operationalize the tested five-dimensional health promotion model through geospatial decision support by: (1) mapping spatial patterns of health risk and service access among foreign retirees in elderly care centers; (2) identifying suitable zones for new or expanded elderly care centers using spatial accessibility and service-coverage criteria; and (3) estimating future service demand to guide resource allocation and phased metropolitan-scale implementation [10][13][14] and [15].

3.2 Study Setting and Population

The study was conducted in elderly care centers in Bangkok (Figure 1). The target population comprised foreign retirees aged 55 years and older who resided in elderly care centers and were categorized within Independent Living or Assisted Living service needs, consistent with the problem context and service-gap rationale described in the manuscript [6].

3.3 Phase 1: Model Development (Qualitative Procedures)

Phase 1 used qualitative inquiry through in-depth interviews and focus group discussions with experts/stakeholders to identify core needs, contextual barriers (e.g., cultural differences and communication issues), and practical components required for a culturally responsive health promotion model for foreign retirees [6] and [7]. Data were synthesized using content-oriented analysis to generate a structured model comprising five dimensions: Health Education, Health Prevention, Health Protection, Spiritual Improvement, and Nutrition Therapy. The model's conceptual grounding reflects the role of self-efficacy and health promotion frameworks in strengthening health knowledge and self-care behaviors [8] and [9].

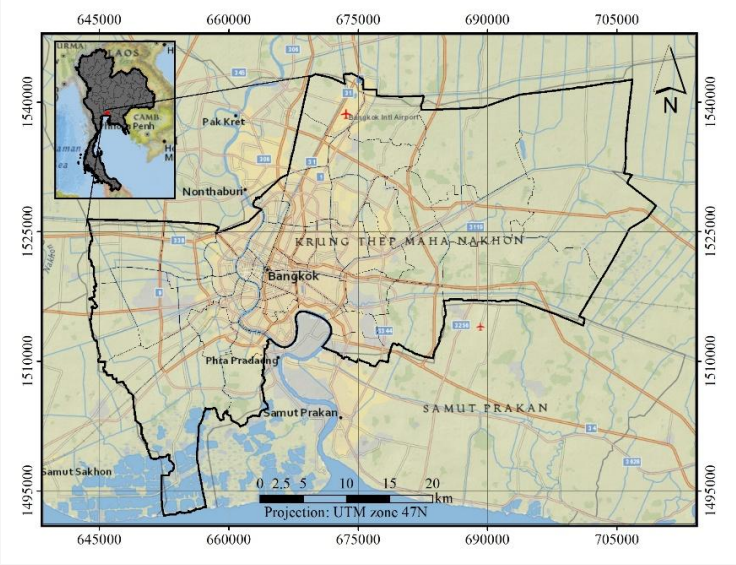

Figure 1: Bangkok, the capital of Thailand

3.4 Phase 2: Model Implementation and Evaluation (Quasi-Experimental Procedures)

Phase 2 implemented the finalized model among foreign retirees residing in elderly care centers in Bangkok. The manuscript reports a sample size of n = 33 and indicates purposive sampling. The evaluation used a one-group pretest–posttest design with outcomes assessed before and after the intervention period.

3.5 Measures and Instruments

Data collection followed the instruments specified in the manuscript:

- Health promotion knowledge test (pre–post assessment)
- Health behavior assessment focusing on self-care behaviors (pre–post assessment)
- Physiological indicators assessed pre–post, including blood pressure, body mass index, blood sugar, and muscle mass

An interview guide supported qualitative data collection during Phase 1.

3.6 Data Analysis

- Qualitative analysis (Phase 1): Thematic/content synthesis was conducted to derive dimensions and activities, supported by systematic coding and synthesis of expert inputs.
- Quantitative analysis (Phase 2): Pre–post differences were tested using paired t-tests to evaluate changes in health promotion knowledge, health behaviors, and physiological indicators.

3.7 GIS Integration as an Implementation Layer

To support metropolitan-scale planning without changing the original intervention logic or the evidence derived from Phase 2, GIS is integrated here as a cross-cutting operational layer in three applications:

1. Risk Mapping
   - Inputs (implementation-ready): geocoded locations of participating elderly care centers; basic service-access layers that are routinely available for planning (e.g., administrative boundaries, road networks, locations of health services).
   - Process: spatial visualization of center catchments (e.g., distance/time buffers), identification of access-sensitive zones, and production of "risk-context profiles" that guide where to intensify activities across the five dimensions.
   - Outputs: risk/access maps to support targeting of Health Education, Prevention, and Protection activities.
2. Facility Suitability Mapping
   - Inputs: candidate areas for expansion; spatial criteria aligned with holistic care and service accessibility consistent with the manuscript's problem framing.
   - Process: GIS-based multi-criteria overlay (MCDA) to generate a suitability surface and ranked candidate zones.
   - Outputs: suitability maps to inform evidence-informed placement of new or expanded elderly care centers.
3. Predictive GIS modeling
   - Inputs: spatial-demographic scenario layers suitable for planning in Bangkok metropolitan areas.
   - Process: demand surface estimation and scenario comparison to support program capacity planning (e.g., anticipated intensity of education/prevention sessions).
   - Outputs: forecast maps and priority areas for phased service development.

Importantly, GIS components are presented as decision-support deliverables to operationalize and scale the proven five-dimension model; they are not reported as additional tested effects beyond the manuscript's original evaluation.

4. Results

4.1 Phase 1: Development of Health Promotion Pattern

4.1.1 Results from in-depth interviews

Results from in-depth interviews with five experts revealed key perspectives on elderly care for retired foreigners, reflecting four main dimensions of elderly care, namely the health care dimension, economic and welfare dimension, social participation dimension, and environmental and service access dimension. Experts emphasized that elderly foreigners living in Thailand have specific health needs that differ from Thai elderly, particularly in terms of cultural background, health beliefs, communication, and expectations toward care services. The interviews highlighted the importance of shifting elderly care from a disease-focused approach toward a health promotion approach that supports autonomy, self-reliance, and quality of life, especially for those in Independent Living and Assisted Living groups. Effective elderly care services should integrate preventive care, health education, psychosocial support, and appropriate living environments rather than focusing solely on dependent or bedridden elderly. These findings

provided the conceptual foundation for developing a structured health promotion pattern for retired foreigners in elderly care centers.

4.1.2 Results from focus group discussions and development of activities

Results from focus group discussions with experts and stakeholders revealed five important aspects related to the development of a health promotion pattern for retired foreigners, including cultural differences and perspectives on care services, the need for comprehensive holistic health services, language barriers affecting access to health systems, vulnerability regarding legal rights and health system status, and appropriate approaches to health service model development for elderly foreigners. Based on the synthesis of these findings, a five-dimension health promotion pattern was developed, with specific activities in each dimension as follows:

1) Health Education dimension (3 activities)
Activity 1: Provision of basic health information
Activity 2: Skill training and practical demonstrations
Activity 3: Individual and small-group consultations

2) Health Prevention dimension (3 activities)
Activity 1: Health risk screening and assessment
Activity 2: Development of self-care skills
Activity 3: Creation of safe and health-conducive environments

3) Health Protection dimension (3 activities)
Activity 1: Enhancement of physical immunity
Activity 2: Strengthening of mental immunity
Activity 3: Integration of Thai wisdom with modern health concepts

4) Spiritual Improvement dimension (4 activities)
Activity 1: Meditation and relaxation activities
Activity 2: Promotion of meaning in life and happiness
Activity 3: Support for dignified adaptation to illness and physical decline
Activity 4: Development of mental resilience

5) Nutrition Therapy dimension (2 activities)
Activity 1: Nutritional assessment and personalized nutrition therapy planning
Activity 2: Healthy cooking training and communal dining activities

This five-dimension health promotion pattern was designed to address the specific needs of retired foreigners in Independent Living and Assisted Living groups residing in elderly care centers in Bangkok.

4.2 Phase 2: Implementation Results

The results of the implementation of the health promotion pattern for retired foreigners in elderly care centers in Bangkok were evaluated using a quasi-experimental one-group pretest–posttest design. Outcomes were assessed in terms of health promotion knowledge, self-care behaviors, and physiological health indicators, including blood pressure, body mass index, blood sugar, and muscle mass.

4.2.1 Health promotion knowledge

Table 1 presents a comparison of average self-care knowledge scores before and after receiving the health promotion pattern. The results indicated that the mean self-care knowledge score after receiving the health promotion pattern was significantly higher than before the intervention ($p < .01$), demonstrating an improvement in health promotion knowledge among retired foreigners following participation in the program.

4.2.2 Self-care health behaviors

Table 2 shows a comparison of average self-care behavior scores before and after receiving the health promotion pattern. The findings revealed that self-care health behavior scores after receiving the health promotion pattern were significantly higher than before the intervention ($p < .01$), indicating improved engagement in health-promoting behaviors among participants.

4.2.3 Physiological health indicators

Table 3 presents a comparison of physiological health indicators before and after receiving the health promotion pattern, including blood pressure, body mass index, blood sugar, and muscle mass. The results demonstrated statistically significant differences in all physiological health indicators before and after the intervention ($p < .01$). Following implementation of the health promotion pattern, systolic and diastolic blood pressure values showed improvement and remained within acceptable ranges, body mass index demonstrated a positive trend, blood sugar levels decreased within normal ranges, and muscle mass increased. These findings indicate that the health promotion pattern had a positive impact on both physical health status and functional capacity among retired foreigners residing in elderly care centers.

Table 1: Comparison of Average Self-Care Knowledge Scores before and after Receiving the Health Promotion Pattern (n = 33)

Self-Care Knowledge	Mean ± SD (Level)	t	df	Mean Difference (95% CI)	P-value
Before intervention	18.64 ± 1.92 (High)	4.53	32	0.67 to 1.76	0.001**
After intervention	19.85 ± 0.62 (High)				

** $p < .01$

Table 2: Comparison of Average Self-Health Care Behavior Scores before and after Receiving the Health Promotion Pattern (n = 33)

Self-Care Behavior	Mean ± SD (Level)	t	df	Mean Difference (95% CI)	P-value
Before intervention	4.65 ± 0.14 (High)	5.90	32	0.11 to 0.22	0.001**
After intervention	4.82 ± 0.07 (High)				

** $p < .01$

Table 3: Comparison of Physiological Health Indicators before and after Receiving the Health Promotion Pattern (n = 33)

Health Status	Mean ± SD	t	df	Mean Difference (95% CI)	P-value
Blood Pressure (Systolic) – Before	138.08 ± 12.50	5.04	32	2.27 to 5.38	0.001**
Blood Pressure (Systolic) – After	143.24 ± 11.97				
Blood Pressure (Diastolic) – Before	81.21 ± 7.01	4.03	32	1.49 to 4.47	0.001**
Blood Pressure (Diastolic) – After	78.24 ± 6.37				
Body Mass Index – Before	22.75 ± 2.55	4.49	32	0.63 to 2.37	0.001**
Body Mass Index – After	22.31 ± 2.34				
Muscle Mass (kg) – Before	32.64 ± 2.41	6.78	32	0.27 to 0.50	0.001**
Muscle Mass (kg) – After	33.03 ± 2.89				

4.2.4 Summary of phase 2 results

Overall, the implementation of the health promotion pattern resulted in significant improvements in health promotion knowledge, self-care behaviors, and key physiological health indicators among retired foreigners in elderly care centers. The results confirm the effectiveness of the developed health promotion pattern in enhancing holistic health outcomes in this population.

4.3 GIS Decision-Support Outputs for Metropolitan-Scale Deployment

4.3.1 Risk mapping outputs: GIS-triggered intervention intensity

Risk mapping generated spatial decision layers that support program targeting by visualizing catchment variation and access-sensitive contexts relevant to center-based delivery. The core deliverable is a risk surface linked to care-center catchments, which can be operationalized into a tiered implementation logic: zones with higher priority profiles receive greater intervention intensity within the five dimensions particularly Health Education (basic information provision and consultations), Health Prevention (risk screening and self-care skill development), and Prevention/Protection elements related to safe and health-conducive environments. This approach enables place-sensitive delivery while preserving the self-efficacy orientation and the original activity structure of the health promotion pattern.

4.3.2 Facility suitability mapping outputs: evidence-informed location planning

Facility suitability mapping in Figures 2 and 3 produced a suitability surface to inform decisions on new center development or expansion of existing centers. The suitability output was designed to reflect the expert-identified dimensions of elderly care health care, economic and welfare, social participation, and environmental/service access by integrating spatial criteria into a transparent decision layer. The resulting map supports metropolitan-scale planning that strengthens the feasibility and accessibility of delivering the five-dimension health promotion pattern (Health Education, Health Prevention, Health Protection, Spiritual Improvement, and Nutrition Therapy) at scale.

4.3.3 Predictive GIS modeling outputs: future demand and capacity readiness

Predictive GIS modeling generated forward-looking demand surfaces for scenario-based capacity planning across Bangkok metropolitan areas (Figure 4). These outputs support strategic readiness by identifying where program capacity may need

strengthening and by informing anticipated resourcing for core activities, including education sessions, screening cycles, psychosocial/spiritual support programming, and nutrition-related interventions. Predictive outputs are presented as planning deliverables that enhance future preparedness without extending claims beyond the original Phase 2 evaluation.

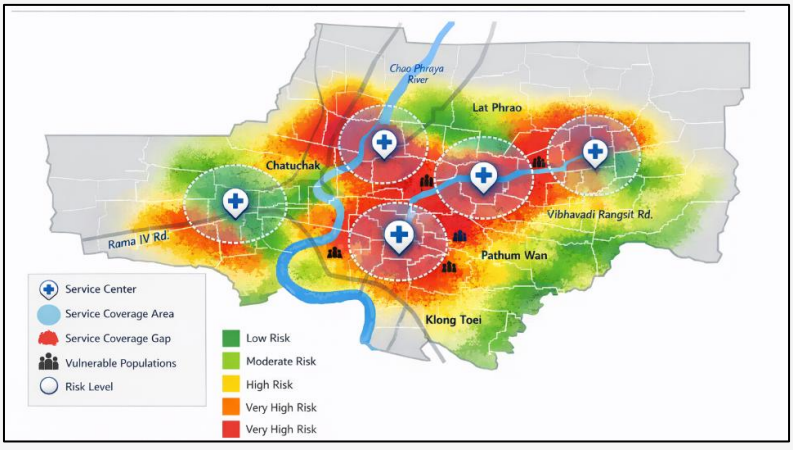

Figure 2: Risk mapping surface (bangkok metropolitan area)

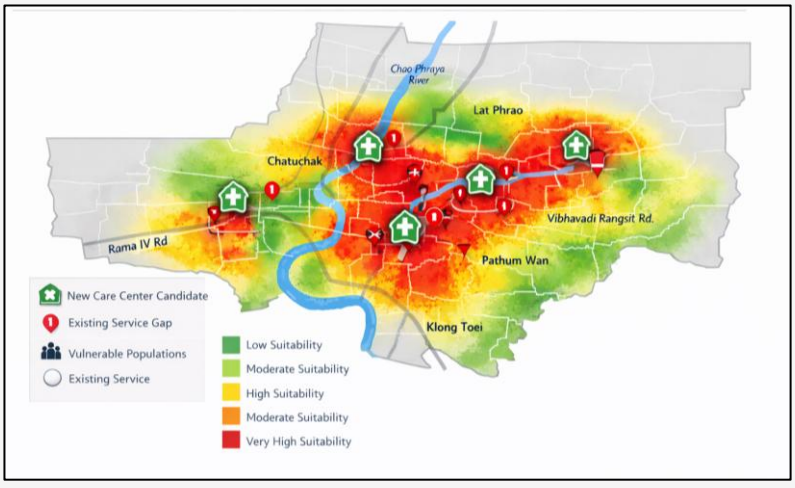

Figure 3: Facility suitability surface for new/expanded care centers

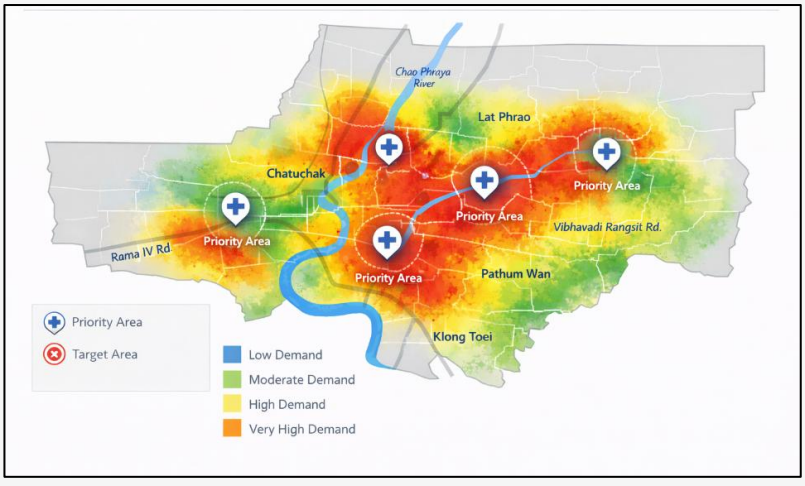

Figure 4: Predictive demand surface (scenario year: 2035)

4.3.4 Integrated interpretation

Taken together, risk mapping, suitability mapping, and predictive modeling function as an implementation architecture that supports (i) targeted and tailored intervention intensity, (ii) transparent facility planning, and (iii) anticipatory resource allocation for metropolitan needs. These GIS decision products operationalize deployment of the self-efficacy–based, five-dimension health promotion pattern across Bangkok's metropolitan context, while the Phase 2 outcomes remain the empirical foundation of effectiveness.

5. Discussion

The present study provides evidence that the developed health promotion model for foreign retirees residing in elderly care centers in Bangkok produced significant improvements in health promotion knowledge, self-care behaviors, and physiological health indicators. Collectively, these findings support the application of a structured, multi-dimensional health promotion approach grounded in self-efficacy theory within elderly care settings, particularly for foreign retirees in Independent Living and Assisted Living groups [1] and [2].

5.1 Health Education and Self-Efficacy Mechanisms

The significant increase in health promotion knowledge following implementation suggests that the Health Education dimension effectively strengthened participants' understanding of health-related issues. Activities emphasizing basic health information, practical skill training, and individualized or small-group consultation likely enhanced comprehension and confidence in managing personal health. This pattern is consistent with self-efficacy theory, which highlights the role of mastery experiences and strengthened understanding in improving individuals' beliefs about their ability to perform health-related behaviors successfully [1] and [2]. In practical terms, improved knowledge may have functioned as a proximal determinant that enabled participants to adopt and sustain more effective self-care behaviors during the intervention period.

5.2 Behavior Change and Supportive Environments

Improvements in self-care health behaviors further indicate that participants were able to translate knowledge gains into practice. This finding aligns with health promotion frameworks emphasizing that knowledge, perceived benefits, and supportive environments shape health behavior adoption and maintenance [3][4] and [5]. In the present model, the Health Prevention and Health Protection dimensions particularly risk screening, self-care skill development, and the creation of safe, health-conducive environments represent a coherent pathway for behavior change. These components likely supported sustained engagement in health-promoting behaviors by reducing barriers and reinforcing the feasibility of self-care actions within the residential care context [6] and [7].

5.3 Physiological Outcomes and Functional Capacity

The observed changes in physiological indicators including blood pressure, body mass index, blood sugar, and muscle mass provide objective evidence consistent with improved physical health status and functional capacity. Improvements in blood pressure and blood sugar patterns are consistent with broader evidence indicating that lifestyle modification and regular physical activity can contribute to better control of hypertension and metabolic risks among older adults [8][9] and [16]. Changes in body mass index and muscle mass are similarly relevant to nutritional status, physical functioning, and maintenance of independence, which are critical for reducing functional decline in aging populations [17][18] and [19]. Taken together, these physiological outcomes reinforce the value of combining educational, preventive, and protective elements within a single model that is delivered consistently in elderly care centers.

5.4 Value of the Spiritual Improvement Dimension

A notable strength of the model is the inclusion of Spiritual Improvement as a distinct dimension. Activities such as meditation and relaxation, promotion of meaning in life and happiness, dignified adaptation to illness and physical decline, and mental resilience development address psychosocial domains that are frequently underemphasized in conventional care models. Prior work and international health frameworks have emphasized that psychological and spiritual well-being are integral to holistic health promotion, influencing motivation, coping capacity, and adherence to health-promoting behaviors [20][21] and [22]. In this model, spiritual improvement plausibly served as a supportive mechanism that reinforced engagement across the other dimensions, especially for foreign retirees adapting to new social and cultural contexts.

5.5 Contextual Responsiveness for Foreign Retirees

The model was explicitly designed to address contextual challenges faced by foreign retirees, including cultural differences, language barriers, and vulnerability related to legal rights and health system

access. By integrating culturally sensitive education, individualized consultations, and holistic activities that support autonomy and quality of life, the model responds to the unique needs of retired foreigners residing in Thailand. This approach is consistent with international recommendations for age-friendly health systems and supports Thailand's direction toward strengthening services for long-stay older residents [21] and [22].

5.6 GIS as Implementation Architecture for Metropolitan Scale-Up

While the intervention effectiveness is supported by Phase 2 outcomes, the GIS component extends the model's operational readiness for metropolitan-scale deployment through decision-support outputs rather than additional tested effects. Risk mapping can support targeted implementation by identifying catchment contexts and access-sensitive areas where activity intensity should be prioritized. Facility suitability mapping can inform evidence-based decisions for new center development or expansion by integrating criteria relevant to accessibility and service feasibility. Predictive spatial modeling can strengthen strategic readiness by anticipating future service load and informing resource planning across metropolitan catchments. In combination, these GIS outputs translate the five-dimension model into actionable planning products for Bangkok and its surrounding areas, supporting standardized, place-sensitive delivery while preserving the core self-efficacy–based intervention logic.

6. Conclusion

This study developed and evaluated a health promotion model for foreign retirees residing in elderly care centers in Bangkok, Thailand. The model was systematically constructed through qualitative inquiry and subsequently assessed using a quasi-experimental approach. The findings indicate that implementation of the model was associated with significant improvements in health promotion knowledge, self-care behaviors, and key physiological health indicators, including blood pressure, body mass index, blood sugar levels, and muscle mass among participating foreign retirees.

The model comprises five integrated dimensions Health Education, Health Prevention, Health Protection, Spiritual Improvement, and Nutrition Therapy and its results highlight the value of comprehensive, holistic health promotion in elderly care settings beyond a narrow disease-treatment focus. Embedding self-efficacy principles within the model appears to have strengthened confidence, motivation, and engagement in health-promoting behaviors, which are essential for sustaining positive outcomes in aging populations.

A key contribution of the model is its responsiveness to the specific context of foreign retirees, including cultural differences, language barriers, and challenges related to access to health and social service systems. Through culturally sensitive health education, personalized consultations, and activities supporting physical, psychological, and spiritual well-being, the model offers a practical framework for elderly care centers serving diverse long-stay older populations. In addition, GIS-based decision-support outputs (risk mapping, facility suitability mapping, and predictive spatial planning) provide an operational pathway for scaling implementation across Bangkok metropolitan areas by strengthening targeting, expansion planning, and future capacity readiness without altering the model's core structure.

Several limitations should be acknowledged. The one-group pretest–posttest design without a control group constrains causal inference, and the relatively small sample size and single setting may limit generalizability. Nonetheless, the findings provide empirical evidence supporting the application of holistic, health promotion–based care models in elderly care centers. In conclusion, the developed health promotion model offers a practical and evidence-informed approach to improving holistic health outcomes among foreign retirees in elderly care centers. The model is adaptable to similar contexts and contributes to strengthening elderly care services in Thailand in line with national health policy directions and the country's aspiration to serve as a regional medical and retirement hub.

7. Limitations and Future Research

Several limitations should be considered when interpreting these findings. First, the one-group pretest–posttest design limits causal inference, as changes cannot be definitively attributed to the intervention in the absence of a comparison group. Second, the sample size was relatively small and drawn from elderly care centers in Bangkok, which may constrain generalizability to other settings. Third, longer follow-up is needed to assess sustainability of behavioral and physiological changes. Future studies should employ controlled designs, larger multisite samples, and extended follow-up periods to evaluate long-term effectiveness and to test implementation strategies for scaling the model. In addition, future work may incorporate prospective spatial datasets to evaluate how GIS-guided targeting and expansion influence program reach, equity, and continuity of care over time. Overall, the findings indicate that a

comprehensive, self-efficacy–based health promotion model integrating Health Education, Health Prevention, Health Protection, Spiritual Improvement, and Nutrition Therapy can enhance holistic health outcomes among foreign retirees in elderly care centers. The results support a shift from disease-centered approaches toward structured health promotion and active aging in residential care settings, with GIS-based decision-support providing a practical pathway to scale implementation across metropolitan contexts.

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