Postprint: Study on the Assessment System for Health-Poverty Vulnerability among Elderly Patients with Chronic Diseases in Xinjiang' s Agricultural and Pastoral Areas

Authors: Shuping You, Aifeirei Abeibao, Meng Na, Song Xiaowei, Wu Pei, Liu Qin, Yuan Yuan, You Shuping

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Abstract

Background: To prevent poverty relapse due to illness, identifying risk factors for health poverty vulnerability is crucial. Due to geographical environment, dietary habits, and other characteristics, the pastoral and agricultural areas of Xinjiang have a relatively large number of elderly chronic disease patients. Moreover, these areas represent regions with relatively slow economic development in Xinjiang. Therefore, there is an urgent need to construct an evaluation index system to identify high poverty vulnerability among elderly chronic disease patients in these local areas.

Objective: To explore and construct an evaluation index system applicable to elderly chronic disease patients in the pastoral and agricultural areas of Xinjiang, in order to provide a theoretical basis for future targeted poverty alleviation and the implementation of targeted preventive measures.

Methods: From December 2023 to February 2024, a preliminary evaluation index pool for health poverty vulnerability among elderly chronic disease patients in the pastoral and agricultural areas of Xinjiang was constructed through literature review. From March to April 2024, three rounds of expert consultation were conducted using the Delphi method. Finally, the Analytic Hierarchy Process (AHP) was used to calculate the weight values of each index.

Results: After three rounds of expert consultation to revise and improve the index system, the final constructed index system included 3 first-level indicators, 6 second-level indicators, and 37 third-level indicators. In the first round, the expert response rate was 92.0%, the authority coefficient was 0.876, and Kendall' s W coefficients for indicators at each level were 0.264, 0.395, and 0.365, respectively. In the second round, the expert response rate was 84.0%,

the authority coefficient was 0.900, and Kendall' s W coefficients were 0.273, 0.403, and 0.370, respectively. In the third round, the expert response rate was 84.0%, the authority coefficient was 0.905, and Kendall' s W coefficients were 0.301, 0.466, and 0.412, respectively.

Conclusion: The evaluation index system for health poverty vulnerability among elderly chronic disease patients in the pastoral and agricultural areas of Xinjiang, constructed based on the resilience theory framework of "health stressors —health risks—health protection," demonstrates high reliability and rationality, and can provide reference for the identification and response to health poverty vulnerability risks among elderly chronic disease patients in these areas.

Full Text

Research on the Health Poverty Vulnerability Evaluation System for Elderly Chronic Disease Patients in Agricultural and Pastoral Areas of Xinjiang

YOU Shuping1,2*, **AIFEIRE Abeibao**1, **MENG Na**1, **SONG Xiaowei**1, **WU Pei**1, **LIU Qin**1, **YUAN Yuan**1

1School of Nursing, Xinjiang Medical University, Urumqi 830000, China
2Xinjiang Regional Research Center for Population Disease and Health Care, Urumqi 830000, China

Corresponding author: YOU Shuping, Professor; E-mail: youshupin@163.com

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Abstract

Background: To prevent poverty due to illness, identifying the risk factors of health poverty vulnerability is crucial. In Xinjiang' s agricultural and pastoral areas, the unique geographical environment and dietary habits contribute to a high prevalence of chronic diseases among the elderly population. These regions also face relatively slower economic development, making it urgent to construct an evaluation index system for identifying high poverty vulnerability among elderly chronic disease patients.

Objective: To develop a comprehensive evaluation index system tailored to elderly chronic disease patients in Xinjiang' s agricultural and pastoral areas, providing a theoretical basis for targeted poverty alleviation and preventive interventions.

Methods: From December 2023 to February 2024, a preliminary evaluation index pool was constructed through systematic literature review. From March to April 2024, three rounds of expert consultation were conducted using the Delphi method. Finally, the Analytic Hierarchy Process (AHP) was employed to calculate the weight values of each indicator.

Results: After three rounds of expert consultation and revision, the final indicator system comprised 3 primary indicators, 6 secondary indicators, and 37 tertiary indicators. The first round achieved a 92.0% response rate with an authority coefficient of 0.876 and Kendall' s W coefficients of 0.264, 0.395, and 0.365 for the three levels. The second round showed an 84.0% response rate, authority coefficient of 0.900, and Kendall' s W coefficients of 0.273, 0.403, and 0.370. The third round maintained an 84.0% response rate, authority coefficient of 0.905, and Kendall' s W coefficients of 0.301, 0.466, and 0.412.

Conclusion: The health poverty vulnerability evaluation system for elderly chronic disease patients in Xinjiang' s agricultural and pastoral areas, constructed within the "health stressors—health risks—health security" framework based on resilience theory, demonstrates high reliability and rationality. This system provides a valuable reference for identifying and addressing health poverty vulnerability risks in this population.

Keywords: Chronic disease; Xinjiang agricultural and pastoral areas; Health poverty vulnerability; Indicator system; Delphi technique

Introduction

Health-related poverty has become a critical factor driving poverty relapse in China. To fundamentally break the vicious cycle of falling into and returning to poverty due to illness, it is essential to accurately identify relevant risk factors and implement prospective preventive measures. Health poverty vulnerability possesses forward-looking predictability—higher values indicate greater risk of falling into health poverty [1], making it an important metric for identifying poverty-due-to-illness risks. Current research on health poverty vulnerability primarily focuses on households or the general elderly population, but evaluation indicator systems vary significantly across different population groups due to their distinct characteristics [2].

Elderly chronic disease patients represent one of the groups with the heaviest global disease economic burden, and their health poverty vulnerability intensifies with disease progression [3]. Existing studies on influencing factors of health poverty among elderly chronic disease patients typically examine dimensions such as individual characteristics, medical service utilization, health security systems, and health behaviors. However, a unified indicator system for health poverty vulnerability among this population has yet to be established [4].

Xinjiang' s agricultural and pastoral areas face relatively lagging economic development and numerous challenges in health security for elderly chronic disease patients [5-7]. Regarding medical resources, pastoral areas suffer from shortages of professional healthcare personnel. Many elderly herders with chronic diseases have limited mobility and must expend substantial time and energy traveling to medical institutions due to geographical constraints, increasing physical burden

and potentially delaying optimal treatment timing. In terms of health awareness and disease management capabilities, elderly chronic disease patients in these areas face additional challenges. Traditional high-salt, high-fat dietary habits hinder disease control, limited Mandarin proficiency impedes access to professional health knowledge and disease management guidance, and lack of proper disease understanding leads to poor adherence to medical advice for treatment and rehabilitation, further exacerbating health poverty vulnerability.

Current research on health poverty in Xinjiang typically treats it as merely one dimension of multidimensional poverty, overlooking its rich connotations and extensions. Building on the three core dimensions of resilience theory—stressors, risk factors, and protective factors—and drawing inspiration from health capability and health inequality theories, this study employs the Delphi method and Analytic Hierarchy Process to construct an evaluation system tailored to the health poverty vulnerability of elderly chronic disease patients in Xinjiang' s agricultural and pastoral areas, providing a robust reference for subsequent targeted poverty alleviation efforts.

Methods

1.1 Construction of Health Poverty Vulnerability Indicators for Elderly Chronic Disease Patients in Xinjiang's Agricultural and Pastoral Areas Based on capability theory and health inequality theory, we developed search strategies using combinations of terms including "health," "poverty," "medical," "health poverty," "medical/disease impoverishment," "catastrophic health expenditure," and "vulnerability to poverty." Literature searches were conducted in CNKI, Wanfang Data, and Web of Science databases for publications from January 1, 2009, to December 20, 2023. Exclusion criteria were: (1) literature without full-text availability; (2) non-Chinese or non-English publications; and (3) non-core journal articles unrelated to the research theme. Two research team members independently screened the literature. Using online SPSSAU software, we performed text analysis, generated social network relationship diagrams, and identified high-frequency terms to form a preliminary evaluation index pool for health poverty vulnerability among elderly chronic disease patients in Xinjiang' s agricultural and pastoral areas.

1.2 Expert Consultation Following principles of authority, representativeness, and feasibility, three rounds of expert consultation were conducted via email using the Delphi method to establish a scientific and comprehensive evaluation index system framed by resilience theory. From March to April 2024, we developed expert consultation forms and invited 21 experts and scholars from key national universities, research institutions, and administrative agencies. All participants held intermediate or higher professional titles with expertise in medical security, rural health, health management, and health economics (Table 1). Questionnaires were collected within one week of distribution. We calculated

arithmetic means, standard deviations, and variation coefficients of importance scores for each indicator. Based on expert feedback, indicators were adjusted according to selection criteria retaining only those with importance score means >3.5 and variation coefficients <0.25 [9].

1.3 Determination of Indicator Weights The Analytic Hierarchy Process was used to determine indicator weights through the following steps: (1) Constructing a hierarchical model combining the evaluation framework, with primary indicators as the goal layer, secondary indicators as the criterion layer, and tertiary indicators as the index layer [10]. (2) Calculating item weights: First, arithmetic means of expert importance scores for each level were computed as initial weights. Based on these initial weights and structural indicator categories, pairwise comparisons were made using the Saaty 1-9 scale method to construct judgment matrices. The weights for each level were then calculated using the sum-product method. (3) Conducting consistency tests: Matrix consistency was assessed using the consistency ratio (CR), with CR<0.1 indicating acceptable consistency and reasonable weight distribution across hierarchical indicators. (4) Constructing judgment matrices: Using mean differences in importance scores from the third round of expert consultation to determine Saaty scales [11], we established the following rules for any two indicators with importance scores aij and aik: if aij = aik, they are equally important (scale=1); if 0.25<aij-aik$ 0.5, $aijisslightlymoreimportant(scale = 3)$; $if 0.75 < aij - aik$ 1.0, $aijisobviouslymoreimportant(scale = 5)$; $if 1.25 < aij - aik$ $1.5, aij is strongly more important (scale=7); if 1.75<aij-aik, aij is extremely more important (scale=9); intermediate differences correspond to scales of 2, 4, 6, or 8. (5) Calculating relative weights: The geometric mean method was used to compute relative weight coefficients for each indicator. (6) Calculating composite weights: Weights at each level were multiplied by corresponding upper-level indicators. (7) Consistency testing: CR values were calculated as the ratio of consistency index to random consistency index, with CR<0.10 indicating satisfactory matrix consistency.

1.4 Statistical Methods SPSSAU online software was used for text 计量 analysis and social network diagram generation. SPSS 27.0 software calculated expert positivity coefficients, authority coefficients (Cr), judgment basis (Ca), familiarity degree (Cs), and expert coordination coefficients (W). Yaahp 10.3 software computed indicator weights and performed consistency tests.

Results

2.1 Preliminary Evaluation Framework Construction A total of 873 Chinese and 1,433 English articles were retrieved. After screening, 761 articles were retained (573 Chinese, 143 English). Social network relationship diagrams were generated (Figure 1 [Figure 1: see original paper], Figure 2 [Figure 2: see

original paper]). Based on text analysis results and the "health stressors—health risks—health security" framework, combined with research team discussions, a draft evaluation index system was developed comprising six secondary indicators —health status, health capability, behavioral risks, environmental risks, social security, and non-social security—with 31 tertiary indicators.

2.2 Basic Information of Experts This consultation invited 21 experts with strong representation, including specialists from universities and research institutions with long-term involvement in health management, health economics and policy, and medical security research, as well as experts from healthcare administrative departments with rich practical experience. The majority held master' s degrees or higher and senior professional titles. Detailed expert demographics are presented in Table 2 .

2.3 Expert Positivity, Authority, and Coordination In the first round, 25 questionnaires were distributed with 23 returned (92.0% response rate). The second and third rounds distributed 25 questionnaires each, with 21 returned (84.0% response rate). Expert authority coefficients were 0.876, 0.900, and 0.905 across the three rounds (Table 3), indicating high credibility. Kendall' s W coefficients ranged from 0.264–0.395 in the first round, 0.273–0.403 in the second, and 0.301–0.466 in the third, demonstrating good expert coordination with statistically significant differences ($P<0.05$) (Table 4).

2.4 Indicator System Refinement and Construction Based on selection criteria and expert feedback from the first round, adjustments included: (1) Deleting indicators: "physical examination status," "sleep duration," and "medical compliance behavior." (2) Adding indicators: "cognitive function," "tourism business participation," "supplementary insurance purchase," "social medical assistance," "regular medication adherence," and "living with children." (3) Modifying indicators: "social security" was changed to "health service accessibility" ; "non-social security" to "social support" ; "Mandarin proficiency" to "Putonghua mastery level" ; "health status self-rating scale" to "self-rated health status" ; "low mood" to "psychological stress adaptability" ; and "sheep sales quantity" to "household livestock sales quantity." (4) Merging indicators: "state-covered expenses" and "insurance type" were combined into "medical insurance participation status." These revisions yielded a second-round consultation system with 3 primary, 6 secondary, and 34 tertiary indicators.

The second round consultation led to further adjustments: (1) Adding tertiary indicators: "family size" and "unmet hospitalization needs." (2) Splitting indicators: "village clinic resource allocation" was separated into "village clinic personnel allocation" and "village clinic drug allocation."

The third round consultation achieved consensus, finalizing the system with 3 primary indicators, 6 secondary indicators, and 37 tertiary indicators (Table 5).

2.5 AHP Calculation of Core Indicator Weights Judgment matrices were constructed through pairwise comparison of expert importance score means using Thomas Saaty' s scaling method. All consistency ratios (CR) were below 0.1, confirming meaningful weight assignments. The final weight distribution for the health poverty vulnerability evaluation system is presented in Table 5 .

Discussion

3.1 Rationale for Constructing the Health Poverty Vulnerability Evaluation System This study conducted extensive literature review and text mining. With advances in digital technology, text 计量 analysis has emerged as a cutting-edge research approach, offering a scientific paradigm that combines grounded theory with quantitative methods to extract influencing factors from texts, thereby minimizing subjective bias in research hypothesis formation. Using SPSSAU software, we generated social network diagrams where node size reflects term frequency [13-14]. Additionally, grounding the indicator system in resilience theory, health capability theory, and health inequality theory enhanced scientific rigor. The study strictly adhered to Delphi methodology standards through three consultation rounds. As shown in Table 2, invited experts from universities and research institutions nationwide specialized in health management, health economics, and medical security, with 76.18% holding master' s degrees or higher. The three-round response rates of 92.0%, 84.0%, and 84.0% demonstrated high participation. Authority coefficients of 0.886, 0.900, and 0.905 indicated strong expert credibility, while significant Kendall' s W coefficients ($P<0.01$) after three rounds showed convergent expert opinions. Thus, the consultation demonstrated excellent expert representativeness, enthusiasm, and authority with reliable results.

Analysis of the constructed evaluation system and its weight coefficients reveals minimal differences among the three primary indicators, indicating comparable value and significance. Among secondary indicators, behavioral risk carried the highest weight (0.571), consistent with Lai Yongqiang' s findings [15], underscoring the importance of health behaviors for poverty vulnerability. This suggests future efforts should strengthen township health education to improve self-management capabilities and prevent health poverty vulnerability. Among tertiary indicators, medical insurance participation status (0.041) held the highest weight, reflecting expert consensus on insurance' s critical role in improving health outcomes and alleviating poverty. Medical insurance provides essential protection against disease shocks by reducing household health poverty vulnerability [16]—both short-term (through cost-sharing to prevent financial collapse) and long-term (through resource optimization and preventive interventions). In Xinjiang' s agricultural and pastoral areas, continuous improvement of insurance policy design, strengthening of primary care capacity, and removal of "last-mile" implementation barriers are essential to achieving sustainable healthcare access and poverty alleviation.

The health security dimension added "communication barriers with medical staff"because elderly chronic disease patients in these areas often lack Putonghua proficiency, potentially delaying care and increasing poverty risk without children' s accompaniment. "Neighborhood relationships" was also included to explore social support' s role in health poverty vulnerability. Beyond insurance policy improvements, village committees and resident work teams can organize regular visits to elderly chronic disease patients living alone, monitoring their health and living needs.

3.2 Innovation and Policy Recommendations for the Evaluation System Domestic research has focused on multidimensional poverty dynamics and group heterogeneity, revealing vulnerability differences across urban-rural, regional, and migrant populations while emphasizing policy resilience through new rural cooperative medical schemes, household capabilities, and regional coordination [17]. International studies integrate socioeconomic determinants and welfare system analyses to quantify independent and synergistic effects of poverty risk and income inequality on health [18]. Considering regional variations in geography, culture, and economic development across China, this study developed a health poverty vulnerability indicator system tailored to Xinjiang' s agricultural and pastoral areas.

Income emerged as a high-frequency term in this evaluation system, as income disparity significantly influences health poverty vulnerability [19]. The health stressors dimension added indicators including "livestock sales quantity," "herding patterns," "tourism business participation," and "Putonghua mastery level." "Livestock sales quantity" and "herding patterns" directly relate to core production methods and household income in these areas [5]; "tourism business participation" aligns with Xinjiang' s rich tourism resources, reflecting how diversified income channels mitigate health poverty; "Putonghua mastery level" addresses information access constraints on economic participation and health knowledge acquisition [20]. Township governments should enhance courtyard tourism and handicraft production training, establish e-commerce partnerships for livestock product direct sales to stabilize herding income, and encourage development of light-labor projects like farmhouse tourism and handicrafts for elderly chronic disease patients.

The health risk dimension added "household fuel type" based on local living habits and preliminary fieldwork showing residents' preference for coal cooking and heating. Literature indicates household fuel types affect chronic disease prevalence [21], though few studies have examined its impact on health poverty vulnerability among elderly chronic disease patients. The health security dimension included "communication barriers with medical staff" due to Putonghua proficiency gaps that may prevent timely care, and "neighborhood relationships" to explore social support' s protective effects.

This study constructed a scientifically sound and applicable evaluation system comprising 3 primary, 6 secondary, and 37 tertiary indicators for health poverty

vulnerability among elderly chronic disease patients in Xinjiang' s agricultural and pastoral areas. However, limitations remain: (1) AHP is a subjective weighting method dependent on expert judgment, potentially introducing bias [23]; (2) The system' s objective validity in evaluating health poverty vulnerability requires further empirical testing and application.

Author Contributions: YOU Shuping conceptualized the study; AIFEIRE Abeibao designed and implemented the research, collected and analyzed data, and drafted the manuscript; MENG Na, SONG Xiaowei, WU Pei, LIU Qin, and YUAN Yuan revised the manuscript; YOU Shuping supervised quality control and bears overall responsibility.

Conflict of Interest: None declared.

ORCID IDs:
YOU Shuping: https://orcid.org/0000-0001-8550-1944
AIFEIRE Abeibao: https://orcid.org/0009-0006-2042-5593

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