Health Poverty Vulnerability and Influencing Factors of Migrant Workers from Ningxia in the Post-Poverty Alleviation Era: Postprint

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Abstract

Background China has embarked on a new journey toward common prosperity; preventing "illness-induced return to poverty" in rural areas to promote substantial progress toward common prosperity is an issue requiring current attention. Objective To understand the distribution of health poverty vulnerability and its influencing factors among the rural migrant worker population in Ningxia, and to provide reference for consolidating poverty alleviation achievements and preventing illness-induced return to poverty in the region. Methods Research data were derived from a field questionnaire survey conducted from June to July 2022 under a National Natural Science Foundation of China project. Using multi-stage stratified cluster random sampling, migrant workers aged 15 years and above were selected from Haiyuan County, Yanchi County, Xiji County, and Pengyang County in Ningxia. After excluding those with missing important indicators (such as household income), a total of 2,040 subjects were included. The survey employed a questionnaire method with interviewers conducting face-to-face household interviews. Survey content included general demographic characteristics, family characteristics, health risk characteristics, medical service accessibility, and health economic burden. Three-stage Feasible Generalized Least Squares (FGLS) was used to measure health poverty vulnerability. Logit regression was employed to analyze its influencing factors, and marginal effects and Shapley value decomposition were utilized to quantify the contribution degree of influencing factors. Results Based on the calculation results of the health poverty vulnerability index, health poverty vulnerability was defined as an index >0.5. Subjects were divided into a health poverty vulnerability group with 91 individuals and a non-health poverty vulnerability group with 1,949 individuals. Logit regression analysis revealed that separation of housing and kitchen, electricity as living fuel, and participation in health check-ups within the past year reduced the risk of health poverty vulnerability ($P<0.05$), while married status and borrowing due to illness increased the

risk (P<0.05). Shapley value decomposition results indicated that demographic characteristics contributed the most (55.93%), followed by family characteristics (16.46%) and health risk characteristics (15.34%). Conclusion The health poverty vulnerability of the rural migrant worker population in Ningxia was within a controllable range compared with the overall western China level. Separation of housing and kitchen, electricity as living fuel, participation in health check-ups within the past year, married status, and borrowing due to illness were key factors influencing health poverty vulnerability among the migrant worker population in Ningxia. It is recommended that relevant departments establish an illness-induced return to poverty risk early warning system, proactively adjust policies, and facilitate effective implementation of health-based poverty prevention efforts.

Full Text

Study on Health Poverty Vulnerability and Its Influencing Factors Among Migrant Workers in Ningxia in the Post-Poverty Alleviation Era

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Abstract

Background As China embarks on a new journey toward common prosperity, preventing rural residents from falling back into poverty due to illness has become a critical concern. Addressing this challenge represents a significant step toward achieving substantive progress in common prosperity.

Objective This study investigates the distribution of health poverty vulnerability among rural migrant workers in Ningxia and analyzes its influencing factors, aiming to provide evidence for consolidating poverty alleviation achievements and preventing illness-induced poverty relapse in the region.

Methods Data were derived from a field questionnaire survey conducted by a National Natural Science Foundation project during June-July 2022. Using multistage stratified cluster random sampling, we selected out-migrant workers aged 15 years and above from Haiyuan County, Yanchi County, Xiji County, and Pengyang County in Ningxia. After excluding participants with missing key indicators (e.g., household income), 2,040 subjects were included. Face-to-face household interviews collected data on demographic characteristics, household features, health risk profiles, healthcare accessibility, and health-related financial burden. We employed three-stage Feasible Generalized Least Squares (FGLS)

to measure health poverty vulnerability, Logit regression to identify influencing factors, and marginal effects and Shapley value decomposition to quantify the contribution of each factor.

Results Based on the health poverty vulnerability index, we defined vulnerability as an index >0.5, classifying 91 individuals as health poverty vulnerable and 1,949 as non-vulnerable. Logit regression revealed that separate housing and kitchen areas (P<0.05), electricity as cooking fuel (P<0.05), and health check-ups within the past year (P<0.05) reduced health poverty vulnerability risk, while married status (P<0.05) and borrowing money due to illness (P<0.05) increased risk. Shapley value decomposition showed demographic characteristics contributed most (55.93%), followed by household characteristics (16.46%) and health risk characteristics (15.34%).

Conclusion Health poverty vulnerability among Ningxia' s rural migrant workers is within a controllable range compared to western China' s overall level. Separate housing and kitchen areas, electricity as living fuel, recent health check-ups, married status, and illness-related borrowing are key factors. We recommend establishing an early warning system for illness-induced poverty relapse risk to enable proactive policy adjustments and promote effective health poverty prevention.

Keywords: Poverty; Health poverty vulnerability; Logit model; Influencing factors; Migrant workers; Ningxia

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1. Study Subjects and Methods

1.1 Study Subjects

Data were obtained from a National Natural Science Foundation project field survey conducted in June-July 2022. Using multistage stratified cluster random sampling, we selected out-migrant workers aged 15+ from four Ningxia counties (Haiyuan, Yanchi, Xiji, Pengyang). Villages in each county were stratified into good, medium, and poor levels based on economic development. Using random number tables, we sampled 40% of villages from each stratum, then systematically selected 20-33 households per village (33 households in 40 Yanchi villages, 33 in 76 Haiyuan villages, 20 in 58 Xiji villages, and 20 in 33 Pengyang villages). All permanent household members were surveyed, totaling 20,821 individuals. Out-migrant workers were defined as those answering "yes" to "worked outside the home in the past year," yielding 2,109 individuals. After excluding 7 subjects aged <15 and 62 with missing key indicators (e.g., household income), 2,040 subjects were included. The study was approved by the Ningxia Medical University Ethics Committee (Approval No.: 2021-G152).

1.2 Survey Methods

1.2.1 Survey Procedure: Trained interviewers conducted face-to-face household interviews using structured questionnaires. After completion, questionnaires were checked on-site for missing responses before collection.

1.2.2 Survey Content: The questionnaire covered: (1) demographic characteristics (gender, age, education, marital status); (2) household features (drinking water type, toilet type, whether housing and kitchen are separated); (3) health risk characteristics (self-rated health, chronic disease comorbidity, health check-up participation); (4) healthcare accessibility (distance and travel time to nearest county hospital); and (5) health economic burden (medical debt, healthcare expenditures).

1.2.3 Health Poverty Vulnerability Measurement: Following literature, vulnerability measurement approaches include Vulnerability as Expected Poverty (VEP), Vulnerability as Low Expected Utility (VEU), and Vulnerability as Uninsured Risk Exposure (VER). VEP is most commonly used due to accessible data and straightforward implementation. We applied three-stage FGLS based on VEP theory, using the international poverty line of $3.1/person/day (equivalent to ¥20.9/person/day based on 2022 exchange rates) as the health poverty vulnerability threshold.

The implementation steps are:

Step 1: Estimate the consumption equation. Individual i' s health poverty vulnerability at time t is the probability that their consumption at t+1 falls below the poverty line. Consumption at t+1 is modeled as a function of characteristic variables (X ,) and error terms (e ,), with residual squares approximating consumption variance (ê^{2}):

$$\ln Y_{i,t+1} = \beta X_{i,t} + e_{i,t}$$

$$\hat{e}_i^2 = X_i\theta + \eta_i$$

where Y , _{1} represents individual i' s consumption at t+1, and X , includes individual/household characteristics such as education, permanent residents, per capita housing area, drinking water type, toilet type, self-rated health, chronic disease status, and poverty registry status.

Step 2: Estimate expected log consumption and variance:

$$\hat{E}[\ln Y_i|X_i] = X_i\hat{\beta}$$

$$\hat{V}[\ln Y_i|X_i] = \hat{\sigma}_{e,i}^2 = X_i\hat{\theta}$$

Step 3: Assuming log consumption follows a normal distribution, estimate health poverty vulnerability:

$$\hat{\nu}_{i,t} = \hat{P}(\ln Y_i < \ln l | X_i) = \Phi\left(\frac{\ln l - X_i\hat{\beta}}{\sqrt{X_i\hat{\theta}}}\right)$$

1.2.4 Quality Control: Questionnaires were expert-reviewed before use. Interviewers received standardized training and checked for missing values upon collection. Data were double-entered using EpiData to ensure accuracy.

1.3 Statistical Analysis

We used SPSS 21.0 and Stata 17.0 for analysis. Non-normally distributed continuous data are presented as M(QR) with nonparametric tests for group comparisons. Categorical data are presented as percentages with ^{2} tests. Logit regression and marginal effects analyzed influencing factors, while Shapley value decomposition based on regression analysis estimated each dimension' s contribution. Variable assignments are shown in . P<0.05 was considered statistically significant.

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2. Results

2.1 Distribution of Health Poverty Vulnerability

Using a vulnerability index >0.5 as the threshold, 91 subjects were classified as health poverty vulnerable and 1,949 as non-vulnerable. compares demographic, household, health risk, and economic burden dimensions between groups.

Univariate analysis showed no significant differences in gender, age, drinking water type, self-rated health, chronic disease status, comorbidity, or health shock between groups (P>0.05). However, the non-vulnerable group had significantly higher proportions of junior high school education or above, flush toilets, separate housing and kitchen areas, electricity as cooking fuel, and health check-up participation (P<0.05). They also had lower rates of poverty registry status and illness-related borrowing (P<0.05), larger per capita housing area and annual per capita income, greater distance to nearest county hospital (P<0.05), but fewer permanent household residents (P<0.05).

2.2 Influencing Factors and Marginal Effects

Using health poverty vulnerability as the dependent variable, we built four Logit regression models: Model 1 (LR ^{2}=58.41, P<0.001) included demographics and household characteristics; Model 2 (LR ^{2}=77.17, P<0.001) added health

risk characteristics; Model 3 (LR ^{2}=84.37, P<0.001) added healthcare accessibility; and Model 4 (LR ^{2}=89.46, P<0.001) included all dimensions plus health economic burden. Results are shown in and .

Key variables maintained consistent significance, coefficient signs, and marginal effect signs across all four models, indicating robust results. Model 4 (full model) showed that electricity as cooking fuel (OR=0.380) and health check-ups within the past year (OR=0.451) reduced vulnerability risk, while married status (OR=7.828), illness-related borrowing (OR=1.873), and non-separate housing and kitchen (OR=1.761) increased risk.

Marginal effect analysis revealed that married status, non-separate housing and kitchen, and illness-related borrowing had positive coefficients, increasing vulnerability probability. Electricity as fuel, alcohol consumption, and health check-ups had negative coefficients, reducing vulnerability probability. Distance to county hospital and travel time had coefficients <0.001 with minimal standard errors, indicating negligible impact.

2.3 Shapley Value Decomposition of Influencing Factors

Shapley value decomposition showed that demographic characteristics contributed most (55.93%), followed by household characteristics (16.46%), health risk characteristics (15.34%), and health economic burden (12.27%). Among individual indicators, marital status contributed the most (55.93%), followed by health check-ups (15.34%). Results are illustrated in [Figure 1: see original paper].

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3. Discussion

3.1 Distribution of Health Poverty Vulnerability Among Migrant Workers

The proportion of health poverty vulnerable migrant workers in Ningxia was 4.50%, slightly lower than previous studies [16] and below the 9.70% illness-induced poverty risk reported for western China [17]. This suggests Ningxia' s migrant workers face lower risk than the regional average. Scholars suggest migrant workers engage in precautionary savings to cope with income fluctuations and health uncertainties [18], which may enhance their risk resilience and reduce vulnerability compared to the general rural population.

3.2 Influencing Factors of Health Poverty Vulnerability

3.2.1 Demographic Characteristics: Married status positively affected vulnerability, increasing risk—a finding consistent with Xu et al. [19] but contrasting with Sun et al. [20] and Pan et al. [21]. This may reflect that married migrants remit income for children' s education and family living expenses, reducing health

investment and increasing chronic disease risk. Age was not associated with vulnerability, similar to Yang et al. [22] but differing from Qu et al. [23] and Wei et al. [24], likely because migrant workers are generally younger than those working locally [25-26]. Gender was not associated with vulnerability, contrasting with Liu et al.' s findings on chronic disease patients [8], possibly because gender differences among migrants are diminishing [27], and both genders face similar challenges in public services and social security.

3.2.2 Household Characteristics: Non-separate housing and kitchen areas increased vulnerability, consistent with Guo et al. [28]. Separate housing typically indicates greater assets and stronger risk resilience. Additionally, separate housing correlates with better sanitation and health awareness [29], reducing illness-related vulnerability. Electricity as cooking fuel reduced vulnerability, aligning with Hou et al. [30], likely because electricity poses fewer health risks than wood or coal, reducing disease probability.

3.2.3 Health Risk Characteristics: Health check-ups within the past year reduced vulnerability, supporting Lai et al. [31] and Hu et al. [32], as regular check-ups reflect higher health literacy and lower likelihood of catastrophic medical expenses. Alcohol consumption was not associated with vulnerability, differing from Lai et al. [33], possibly due to the small proportion of drinkers in our sample limiting statistical power.

3.2.4 Healthcare Accessibility: Although univariate analysis showed significant differences in distance to county hospital between groups, Logit regression and marginal effects found no significant impact, contradicting Hu et al. [34]. This may reflect that migrant workers typically work in county-level or higher areas with better healthcare access than rural residents [35], making distance less relevant for vulnerability.

3.2.5 Health Economic Burden: Illness-related borrowing increased vulnerability, consistent with Zheng et al. [36] on financial literacy and poverty vulnerability, but contradicting Zhang et al. [37]. Borrowing likely indicates poor health status, reduced work capacity, and greater future income risk, increasing poverty probability.

Conclusion

Health poverty vulnerability among Ningxia' s migrant workers is controllable compared to western China' s overall level. Separate housing and kitchen areas, electricity as cooking fuel, recent health check-ups, married status, and illness-related borrowing are key factors. We recommend establishing an early warning system for illness-induced poverty relapse risk to precisely identify vulnerable populations and implement multi-dimensional health poverty prevention policies. Targeted support for living conditions and health check-ups could effectively reduce vulnerability risk.

Author Contributions: LIU Shan conceptualized and designed the study,

analyzed data, and wrote the manuscript; LI Fei cleaned and organized data; MENG Haodong conducted literature review; YANG Juan polished and revised the manuscript; QIAO Hui revised the manuscript.

Conflict of Interest: None declared.

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