Health Equity and Its Decomposition Analysis among Middle-aged and Elderly People in Ningxia Pilot Counties: Postprint

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Abstract

Abstract Background: With the development of science and technology and advancements in medical care, people' s living standards and quality of life have markedly improved, and life expectancy has increased compared to previous years. However, the growing elderly population has rendered population aging increasingly severe. Currently, rural elderly individuals demonstrate underutilization of health services, and their health status is even more concerning. Objective: To analyze the health equity among middle-aged and elderly individuals in two healthcare reform pilot counties (Haiyuan and Yanchi) in Ningxia, and to examine the contribution of various influencing factors to health inequity, providing evidence for improving the health of middle-aged and elderly populations and for government refinement of relevant health policies. Methods: From January to March 2022, using follow-up data from the 2019 "Rural Household Health Interview Survey" and employing a multistage cluster random sampling method, a total of 5,908 middle-aged and elderly individuals aged $ $45 years who had been permanent residents of their households for over one year were selected as study subjects. The main content included demographic characteristics, household characteristics, and personal health status, among others. The concentration index was used to analyze health equity among middle-aged and elderly individuals, and the concentration index decomposition method was applied to analyze the contribution of various influencing factors to health inequity. Results: In Haiyuan County, Ningxia, the concentration indices (CI) for two-week prevalence, chronic disease prevalence, two-week bedridden rate, and two-week work-loss rate among middle-aged and elderly individuals were 0.0300, 0.0029, 0.0114, and 0.0327, respectively; in Yanchi County, Ningxia, the corresponding concentration indices (CI) were 0.0004, -0.0001, 0.0374, and 0.0374, respectively. Concentration index decomposition revealed that age had the highest contribution to health inequity, with contribution rates of 30.01%

for two-week prevalence, 218.56% for chronic disease, 1.21% for two-week bedridden rate, and 129.53% for two-week work-loss rate; educational level and annual household per capita income had relatively high contributions to health inequity, while gender, occupation, and drinking water type had relatively low contributions. Conclusion: Overall, health equity among middle-aged and elderly individuals in the Ningxia pilot counties is relatively good, but biased toward higher-income populations, with age being the greatest contributor to health inequity among this group. Society should prioritize the health of middle-aged and elderly individuals, local primary healthcare institutions could conduct regular free health screenings and provide health education to raise health awareness among this population, and the government should adjust relevant medical and health policies to meet their health needs, ultimately achieving health equity.

Full Text

Health Equity and Its Decomposition Analysis Among Middle-Aged and Elderly Adults in Ningxia Pilot Counties

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Abstract

Background: With the development of social science and technology and advances in medical care, people' s living standards and quality of life have significantly improved, and life expectancy has increased compared to previous years. However, the growing elderly population has intensified population aging, and rural elderly individuals currently underutilize health services, making their health status particularly concerning.

Objective: To analyze health equity among middle-aged and elderly adults in Haiyuan and Yanchi, two medical reform pilot counties in Ningxia, and to exam-

ine the contribution of various influencing factors to health inequity, providing evidence for improving health outcomes and informing health policy development.

Methods: Using follow-up data from the 2019 "Rural Residents' Family Health Survey," we selected 5,908 middle-aged and elderly adults aged $ $45 years who had lived in their households for more than one year through multi-stage cluster random sampling between January and March 2022. The survey included demographic characteristics, household features, and personal health status. Concentration index (CI) was used to analyze health equity, and decomposition of the concentration index was employed to assess the contribution of each factor to health inequity.

Results: In Haiyuan County, the CIs for two-week morbidity, chronic disease prevalence, two-week bed rest rate, and two-week work absence rate were 0.0300, 0.0029, 0.0114, and 0.0327, respectively. In Yanchi County, the corresponding CIs were 0.0004, -0.0001, 0.0374, and 0.0374. Decomposition analysis revealed that age contributed most substantially to health inequity, accounting for 30.01% of the inequality in two-week morbidity, 218.56% for chronic diseases, 1.21% for two-week bed rest, and 129.53% for two-week work absence. Education level and annual household per capita income also made substantial contributions, while gender, occupation, and drinking water type contributed relatively little.

Conclusion: Overall, health equity among middle-aged and elderly adults in Ningxia pilot counties is relatively good but favors higher-income groups. Age represents the most significant contributor to health inequity. Society should prioritize the health of middle-aged and elderly populations, with local primary health institutions conducting regular free health screenings and health education campaigns to raise health awareness. The government should also adjust relevant medical and health policies to meet the health needs of middle-aged and elderly adults and ultimately achieve health equity.

Keywords: Health equity; Middle-aged and elderly; Concentration index; Concentration index decomposition; Pilot counties

Introduction

With rapid economic development and scientific advancement, living standards continue to improve while the healthcare system undergoes continuous optimization. Since the implementation of Ningxia' s New Rural Cooperative Medical Scheme (NRCMS), utilization of outpatient and inpatient services has improved, though inequities persist [**?**]. Health equity in medical services has gradually entered public discourse. However, equity differs from equality: equity emphasizes equal opportunity for all individuals to access resources, whereas equality focuses on equal distribution and possession of material goods [**?**]. The concept

of equity has now permeated various aspects of health services.

Health equity represents a crucial indicator of social justice, theoretically entailing that every individual has a fair opportunity to achieve complete health [**?**]. In reality, health status varies considerably among individuals. With the growing middle-aged and elderly population, aging poses significant challenges to the healthcare system. Coupled with declining physical function, the health status of elderly individuals warrants particular attention. In rural southern Ningxia, remote geographical locations, irrational distribution of health resources, and low economic levels exacerbate health issues among middle-aged and elderly adults, making health equity a major research focus [**?**]. This study examines middle-aged and elderly adults in Haiyuan and Yanchi, two medical reform pilot counties in Ningxia, analyzing health equity through concentration index and decomposition methods to identify key contributing factors and provide evidence for policy adjustment.

1.1 Data Sources

Data were derived from the "Innovative Payment System to Improve Health Efficiency" pilot project, a collaborative initiative between the Ningxia Health and Family Planning Commission and research teams from Harvard and Oxford Universities. Using multi-stage cluster random sampling, Haiyuan and Yanchi counties were selected as pilot sites in 2019. All administrative villages in each county were stratified into three categories based on economic level (good, medium, poor), with 40% randomly selected as sample villages. Within each sample village, 20-33 households were randomly chosen. After double data entry and consistency checks, we screened 6,874 individuals aged $ $45 years who had resided in their households for over one year between January and March 2022. Following exclusion of missing and invalid data, 5,908 valid samples remained, yielding an effective response rate of 85.95%.

1.2 Survey Content

Health status served as the dependent variable, measured through four indicators: illness in the 14 days preceding the survey, chronic disease prevalence in the six months prior, bed rest during the previous two weeks, and work absence during the previous two weeks. Independent variables included demographic characteristics (gender, age, marital status, education level, occupation) and household characteristics (annual household per capita income, drinking water type). Annual household per capita income was categorized using the internationally common quintile method [**?**]. This study selected two-week morbidity, chronic disease prevalence, two-week bed rest rate, and two-week work absence rate to reflect health equity.

1.3.1 Concentration Index

The concentration index [**?**] is commonly used to evaluate health service equity, ranging from -1 to 1. Values approaching -1 indicate health services favor low-income populations, while values approaching 1 indicate favoritism toward high-income populations. The formula is:

$$CI = \frac{2}{\mu}\mathrm{cov}(x, h)$$

where x represents the fractional rank by economic status, h represents health or disease level across economic strata, and μ denotes the mean health or disease level for the entire population.

1.3.2 Concentration Index Decomposition

Concentration index decomposition [**?**] apportions the concentration index of a health indicator into contributions from various factors. This study used two-week morbidity, chronic disease prevalence, two-week bed rest rate, and two-week work absence rate as health measures. Factors influencing health status were first fitted into regression models:

$$y_i = \alpha + \sum_k \beta_k x_{ki} + \varepsilon_i$$

The decomposition formula is:

$$CI = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu}\right) C_k + \frac{GC_\varepsilon}{\mu}$$

where μ is the mean of y_i, $(\beta_k \bar{x}_k)/\mu$ represents the elasticity coefficient of influencing factors, C_k is the concentration index of x_k, and GC_ε is the generalized concentration index of the residual term.

1.4 Statistical Analysis

EpiData 3.02 software was used for data entry and consistency verification. SPSS 23.0 and Stata 14.0 were employed for descriptive and analytical statistics. Categorical data were presented as relative frequencies. Chi-square tests compared differences in health equity across income groups. Decomposition of the concentration index identified factors influencing health equity. Statistical significance was set at $P < 0.05$.

Results

2.1 Basic Characteristics of Middle-Aged and Elderly Adults in Ningxia Pilot Counties

The survey included 5,908 middle-aged and elderly adults from Haiyuan and Yanchi counties. The sample comprised 2,992 males (50.6%) and 2,916 females (49.4%). Age distribution was: 45-59 years (3,388 individuals, 57.3%), 60-74 years (1,920 individuals, 32.5%), and $ $75 years (600 individuals, 10.2%). Regarding marital status, 5,251 (88.9%) were married, while 657 (11.1%) were divorced or had other statuses. Education levels were: no formal schooling (2,547 individuals, 43.1%), primary school (2,164 individuals, 36.6%), and junior high school or above (1,197 individuals, 20.3%). Occupations included farming (4,004 individuals, 67.8%) and non-farming (1,904 individuals, 32.2%). For drinking water sources, 4,229 (71.6%) used tap water, 1,417 (24.0%) used cellar water, and 262 (4.4%) used other sources. Income distribution across quintiles was relatively even: low income (1,163 individuals, 19.7%), lower-middle (1,167, 19.7%), middle (1,250, 21.2%), upper-middle (1,165, 19.7%), and high income (1,163, 19.7%) .

2.2 Health Indicators and Concentration Indices

2.2.1 Two-Week Morbidity and Concentration Index The two-week morbidity rate among middle-aged and elderly adults in Ningxia pilot counties was 31.9% (1,886/5,908). Significant differences in two-week morbidity across income groups were observed in both Haiyuan and Yanchi counties ($P < 0.05$). The concentration indices were 0.0300 for Haiyuan County and 0.0004 for Yanchi County, indicating that two-week morbidity favored higher-income groups in both counties, with Yanchi demonstrating better equity .

2.2.2 Chronic Disease Prevalence and Concentration Index Chronic disease prevalence was 52.0% (3,073/5,908). No statistically significant differences existed across income groups in either county ($P > 0.05$). The concentration indices were 0.0029 for Haiyuan County and -0.0001 for Yanchi County, with Yanchi showing better equity .

2.2.3 Two-Week Bed Rest Rate and Concentration Index The two-week bed rest rate was 9.1% (535/5,908). No significant income-group differences were found in Haiyuan County ($P > 0.05$), while Yanchi County showed significant differences ($P < 0.05$). Concentration indices were 0.0114 for Haiyuan and 0.0374 for Yanchi, both favoring higher-income groups, with Haiyuan demonstrating better equity .

2.2.4 Two-Week Work Absence Rate and Concentration Index The two-week work absence rate was 6.4% (380/5,908). Haiyuan County showed significant differences across income groups ($P < 0.05$), while Yanchi did not

($P > 0.05$). Concentration indices were 0.0327 for Haiyuan and 0.0374 for Yanchi, both favoring better-off economic groups, with Haiyuan showing better equity .

2.3 Decomposition of Health Equity Concentration Indices

Based on logit regression models, decomposition analysis revealed that gender, age, education level, occupation, drinking water type, and annual household per capita income were primary contributors to health inequity. Age contributed most substantially, accounting for 30.01% of inequality in two-week morbidity, 218.56% in chronic diseases, 1.21% in two-week bed rest, and 129.53% in two-week work absence. Education level and annual household per capita income were the next major contributors. Education contributed -13.58% to two-week morbidity, -36.78% to chronic diseases, 3.70% to bed rest, and -29.63% to work absence. Income contributed 7.33% to two-week morbidity, 24.01% to chronic diseases, 2.40% to bed rest, and -29.85% to work absence. Drinking water type contributed substantially to chronic disease prevalence (36.45%) and work absence (22.96%). Gender and occupation contributed minimally [TABLE:6, TABLE:7].

Discussion

3.1 Favorable but Income-Favored Health Equity in Ningxia Pilot Counties

Two-week morbidity, chronic disease prevalence, two-week bed rest rate, and two-week work absence rate are important indicators of disease frequency that reflect health equity to some extent. In this study, two-week morbidity (31.9%) and chronic disease prevalence (52.0%) among middle-aged and elderly adults exceeded rates from Xu Ling' s Fifth National Health Services Survey (20.77% and 33.1%, respectively) [**?**]. The two-week bed rest rate (9.1%) and work absence rate (6.4%) were higher than findings from Cao Liqin' s study of rural residents in Haiyuan County, Ningxia [**?**]. Advanced age, declining physical function, and reduced disease resistance contribute to higher disease frequency in this population.

Across both pilot counties, concentration indices for Haiyuan were 0.0300, 0.0029, 0.0114, and 0.0327 for the four indicators, while Yanchi' s were 0.0004, -0.0001, 0.0374, and 0.0374. Except for Yanchi' s negative CI for chronic disease prevalence, all indices were positive, suggesting these health indicators favor better-off middle-aged and elderly adults, consistent with Lu Ruoyan' s findings in Fujian Province [**?**]. This may reflect higher health awareness and more frequent health screenings among higher-income individuals, leading to higher disease detection rates. However, all absolute CI values were below 0.1, indicating relatively good health equity without substantial inequity.

3.2 Age as the Primary Contributor to Health Inequity

Decomposition analysis identified gender, age, education level, occupation, drinking water type, and annual household per capita income as major contributors to health inequity, aligning with previous research [**?**, **?**]. Age emerged as the most significant factor, consistent with Li Qin' s study of middle-aged and elderly adults in Yanchi County, Ningxia [**?**], as aging brings irreversible health declines and increased disease probability. Household economic status and education level also contributed substantially, echoing findings from Lu Ruoyan' s study of elderly adults in Fujian [**?**] and Liu Rugang' s research on rural Chinese residents [**?**]. These patterns likely reflect differential payment capacities across income groups, with higher-income individuals better managing their health, and varying health knowledge and self-care practices across education levels.

Since NRCMS implementation, increased government investment in health resources and rising reimbursement rates for outpatient and inpatient services have improved health service utilization and reduced health inequity. However, ambiguous definitions of low-income populations have hindered targeted compensation policies, and rural middle-aged and elderly adults often lack self-care awareness and understanding of their health status. Based on these findings, we recommend: (1) Adjusting health service financing mechanisms to prioritize low-income groups through progressive contributions, reducing disparities in health service access; (2) Increasing investment in essential public health services, with village clinics and township health centers providing regular free health screenings and monitoring blood glucose, blood pressure, and other indicators; (3) Implementing regular health education campaigns through radio, video, and printed materials to improve health knowledge and self-awareness; and (4) Prioritizing the cultivation of general practitioners to enhance primary healthcare service capacity.

Author Contributions

Li Pei-wen contributed to data cleaning and preparation. Ma Xi-min drafted the manuscript and conducted literature review and data analysis. He Jia-hui provided theoretical guidance on modeling. Yang Jia-fei developed the research concept. Qiao Hui provided funding support and revised the study design and key content.

Conflict of Interest

The authors declare no conflict of interest.

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