A Postprint Study on the Correlation between Regional Disparities in Chronic Disease Prevalence and Types among Middle-aged and Elderly Chinese and Healthcare Resources

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Abstract

Background China is gradually entering an aging society, and health issues among middle-aged and elderly individuals are receiving increasing attention. Chronic diseases such as hypertension, diabetes, coronary heart disease, and stroke have become major health threats. Simultaneously, the uneven distribution of medical and health resources has led to disparities in medical standards and service quality across regions. Objective To investigate the correlation between the prevalence of chronic diseases among middle-aged and elderly individuals in China, regional differences in disease types, and medical and health resources. Methods From October 2022 to March 2023, researchers cleaned, organized, and statistically analyzed data from the 2018 China Health and Retirement Longitudinal Study (CHARLS), including a total of 19,520 middle-aged and elderly individuals aged $ $45 years. Data from the 2018 China Health Statistics Yearbook (2011–2020) were selected as corresponding medical and health resource-related data. Multiple linear regression analysis was employed to examine the correlation between the Theil index of provincial-level indicators—including number of hospital beds, health technical personnel [licensed (assistant) physicians, registered nurses, rural doctors, and health workers], fiscal expenditure (total health expenditure), and number of health institutions (hospitals, primary-level medical and health institutions, and specialized public health institutions)—and the prevalence of chronic diseases among middle-aged and elderly individuals in each province. Results The prevalence of chronic diseases (2=57.900, P<0.001) and the number of chronic conditions (2=11.138, P=0.004) among middle-aged and elderly individuals showed statistically significant differences across eastern, central, and western regions. Among 14 types of chronic diseases, statistically significant differences in prevalence were observed for chronic lung disease (2=30.906, P<0.001), liver disease

(2=17.871, P<0.001), cerebrovascular disease (2=18.313, P<0.001), kidney disease (2=24.383, P<0.001), digestive system disease (2=16.973, P<0.001), memory-related disease (2=6.898, P=0.032), and asthma (2=22.055, P<0.001) across eastern, central, and western regions. Multiple linear regression analysis revealed that the prevalence of chronic diseases among middle-aged and elderly individuals was correlated with the equity of hospitals, primary-level medical institutions, licensed (assistant) physicians, registered nurses, rural doctors, and health fiscal expenditure (P<0.05). Conclusion Regional health management of major chronic diseases should be strengthened, the capacity for disease prevention, treatment, and health management at the primary level should be enhanced, the medical and health workforce should be expanded, and the regional allocation equity of medical and health resources should be improved to reduce regional disparities in chronic disease prevalence among middle-aged and elderly individuals across eastern, central, and western China.

Full Text

Correlation of Regional Differences in the Prevalence and Types of Chronic Diseases among Middle-aged and Elderly People with Health Resources Allocation in China

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Abstract

Background: China is gradually entering an aging society, and the health of middle-aged and elderly individuals has become an increasing concern, with chronic diseases such as hypertension, diabetes, coronary heart disease, and stroke emerging as major health threats. Simultaneously, the uneven distribution of health resources has led to regional disparities in medical standards and service quality.

Objective: To explore the correlation between the prevalence of chronic diseases, regional differences in disease types, and health care resources among middle-aged and elderly people in China.

Methods: Between October 2022 and March 2023, researchers cleaned, organized, and statistically analyzed data from the 2018 China Health and Retirement Longitudinal Study (CHARLS), including a total of 19,520 middle-aged and elderly adults aged $ $45 years. Corresponding health resource data were

obtained from the 2018 statistics in the *China Health Statistics Yearbook* (2011–2020). Multiple linear regression analysis was used to examine the correlation between the Theil index of provincial health resources—including hospital beds, health technicians [practicing (assistant) physicians, registered nurses, rural doctors, and health workers], financial expenditures (total health expenditure), and health institutions (hospitals, primary care institutions, professional public health institutions)—and the prevalence of chronic diseases among middle-aged and elderly individuals in each province.

Results: Significant differences were observed in chronic disease prevalence (^{2}=57.900, P<0.001) and the number of chronic conditions (^{2}=11.138, P=0.004) among middle-aged and elderly people in eastern, central, and western China. Among 14 chronic disease types, significant regional differences were found in the prevalence of chronic lung disease (^{2}=30.906, P<0.001), liver disease (^{2}=17.871, P<0.001), cerebrovascular disease (^{2}=18.313, P<0.001), kidney disease (^{2}=24.383, P<0.001), digestive system diseases (^{2}=16.973, P<0.001), memory-related diseases (^{2}=6.898, P=0.032), and asthma (^{2}=22.055, P<0.001). Multiple linear regression analysis revealed that chronic disease prevalence among middle-aged and elderly individuals was correlated with the equity of hospitals, primary care institutions, practicing (assistant) physicians, registered nurses, rural doctors, and health financial expenditures (P<0.05).

Conclusion: Regional health management of major chronic diseases should be strengthened, the capacity for disease prevention and health management in primary care should be improved, the health workforce should be expanded, and the balanced allocation of regional health resources should be enhanced to reduce regional disparities in chronic disease prevalence among middle-aged and elderly people in eastern, central, and western China.

Keywords: Chronic disease; Middle-aged and elderly people; Regional differences; Health resources; Theil index; Correlation

Introduction

As China's economy continues to develop, the pension system, medical insurance system, and national essential public health service programs have gradually improved, leading to rapidly growing, multi-level, and diversified demands for health services. However, the uneven regional distribution of health resources in China may perpetuate the contradiction between insufficient health resource supply and increasing health service demand, which inevitably affects individuals' accessibility and convenience in utilizing health services and consequently impacts individual health outcomes. Health resources constitute external environmental and medical condition factors that influence health determinants, typically examined as macro-level health influences in other studies. While existing literature discussing micro-level factors affecting individual health often considers personal health service utilization, most focus on demographic character-

istics, lifestyle, socioeconomic status, and health insurance participation. This study diverges from existing research by examining the relationship between regional differences in chronic disease prevalence and types among middle-aged and elderly individuals and the equity of health resource allocation from a macro perspective rather than exploring how individuals can improve health through lifestyle changes. The findings aim to provide empirical references for shortening regional disparities in chronic disease prevalence and promoting integrated medical and elderly care services and balanced regional health development.

Methods

Data Sources

This study utilized chronic disease data for middle-aged and elderly individuals from the 2018 China Health and Retirement Longitudinal Study (CHARLS), a large-scale interdisciplinary survey project hosted by the National School of Development at Peking University and executed by the China Center for Social Science Survey and Peking University Youth League Committee, funded by the National Natural Science Foundation of China. CHARLS aims to collect high-quality micro-level data representative of Chinese households and individuals aged $ $45 years. The 2018 CHARLS data covered 28 provinces (autonomous regions, municipalities), 150 counties, and 450 communities (villages), comprising 12,400 households with 19,816 respondents. Between October 2022 and March 2023, researchers excluded 64 samples with mismatched respondent IDs between health status and basic information tables and 232 samples aged under 45 years, ultimately selecting 19,520 middle-aged and elderly individuals aged $ $45 years with complete data. Corresponding health resource data were obtained from the 2018 statistics in the *China Health Statistics Yearbook* (2011–2020).

Research Methods and Content

Based on provincial information available in CHARLS data, this study classified regions as follows: eastern China included Beijing, Tianjin, Liaoning, Hebei, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, and Guangdong (10 provincial-level administrative regions); central China included Heilongjiang, Jilin, Shanxi, Anhui, Jiangxi, Henan, Hunan, and Hubei (8 regions); and western China included Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, and Xinjiang (10 regions).

Scope of Chronic Diseases: Based on CHARLS questionnaire content and the question "Has a doctor ever told you that you have any of the following chronic diseases?", this study identified 14 chronic conditions: hypertension, dyslipidemia, diabetes, malignant tumors, chronic lung disease, liver disease, heart disease, stroke/cerebral infarction, kidney disease, digestive system diseases, mental illness, memory-related diseases, arthritis, and asthma.

Variable Setting: The chronic disease status of middle-aged and elderly individuals was designated as the dependent variable. Independent variables were selected from four dimensions: (1) general demographic characteristics: gender, age, ethnicity, residence, religious belief, marital status, and education level; (2) health evaluation: self-rated health, number of chronic diseases, types of chronic diseases, physical disability, brain damage or intellectual deficits, vision, hearing, and pain; (3) lifestyle: social activity, smoking, alcohol consumption, and sleep duration; and (4) health resource allocation: number of hospital beds, health technicians [practicing (assistant) physicians, registered nurses, rural doctors, and health workers], financial expenditures (total health expenditure), and health institutions (hospitals, primary care institutions, and professional public health institutions).

Statistical Analysis

SPSS 25.0 statistical software was used for data analysis. Categorical data were expressed as relative frequencies, and inter-group comparisons were performed using the ^{2} test. An Excel database was established for health resource allocation, and the Theil index was calculated to analyze disparities in health resource allocation across eastern, central, and western regions from 2011 to 2020 based on population dimensions. The Theil index is an evaluation indicator for measuring the equity of social resource allocation across regions, with lower values indicating more equitable distribution and better fairness. The Theil index calculation formula is: $T = \Sigma\{Y/Y \times \log[(Y/Y)/(X/X)]\}$, where T is the Theil index, Y is the health resource quantity in region m, Y is the total health resources across all regions, X is the year-end population in region m, and X is the total population across all regions. Multiple linear regression analysis was used to examine the correlation between the Theil index of provincial health resources (beds, health technicians, financial expenditures, health institutions) and chronic disease prevalence among middle-aged and elderly individuals, exploring the relationship between health resource equity and chronic disease prevalence. A significance level of α=0.05 was used to determine the existence of linear relationships between dependent and independent variables.

Results

Regional Distribution Characteristics of Chronic Diseases Among Middle-aged and Elderly Chinese

Among the 19,520 valid samples, 8,520 (43.65%) were aged 45–59 years, 8,508 (43.59%) were aged 60–74 years, and 2,492 (12.76%) were aged $ $75 years; 9,284 (47.56%) were male and 10,236 (52.44%) were female; 6,600 (33.81%) resided in eastern China, 6,441 (33.00%) in central China, and 6,479 (33.19%) in western China. Significant differences were observed among eastern, central, and western regions in residence, ethnicity, education level, marital status, religious belief, self-rated health, physical disability, brain damage or intellectual deficits, vision, hearing, pain, social activity, alcohol consumption, and sleep duration ($P<0.05$),

while no significant differences were found in age or gender (P>0.05). The chronic disease prevalence was 40.83% (2,719/6,600) in eastern China, 45.46% (2,928/6,441) in central China, and 47.20% (3,058/6,479) in western China, with statistically significant differences among regions (P<0.001) .

Univariate Analysis of Regional Differences in Chronic Disease Prevalence and Types

The overall chronic disease prevalence among middle-aged and elderly individuals was 44.46% (8,705/19,520), with 27.41% (5,367/19,520) having one chronic condition, 10.45% (2,047/19,520) having two chronic conditions, and 6.59% (1,291/19,520) having three or more chronic conditions. The prevalence was 20.90% (4,098/19,520) in males and 23.55% (4,607/19,520) in females. Significant differences were observed in the age composition of chronic disease patients across eastern, central, and western regions (P<0.001), with western China showing higher proportions in both the 45–60-year-old middle-aged group and the $ $75-year-old elderly group, while central China showed a higher proportion in the 60–75-year-old group. In terms of chronic disease burden, all regions were dominated by patients with one chronic condition, but eastern China had a higher proportion of individuals with one condition, central China had a higher proportion with two conditions, and western China had a higher proportion with three or more conditions .

Significant regional differences were found in the prevalence of chronic lung disease (^{2}=30.906, P<0.001), liver disease (^{2}=17.871, P<0.001), cerebrovascular disease (^{2}=18.313, P<0.001), kidney disease (^{2}=24.383, P<0.001), digestive system diseases (^{2}=16.973, P<0.001), memory-related diseases (^{2}=6.898, P=0.032), and asthma (^{2}=22.055, P<0.001) among middle-aged and elderly individuals in eastern, central, and western China. Chronic lung disease, asthma, liver disease, kidney disease, and digestive system diseases showed higher prevalence in western China, while cerebrovascular disease and memory-related diseases showed higher prevalence in central China. No regional differences were observed for high-prevalence diseases such as hypertension, diabetes, or dyslipidemia .

Health Resource Quantity and Equity in Eastern, Central, and Western China in 2018

Regional Differences in Health Resources: In 2018, central China demonstrated the best equity in health resource allocation, followed by eastern China, while western China showed the poorest equity. Health technicians, registered nurses, hospital beds, and health financial expenditures exhibited relatively good equity, whereas total medical institutions, hospitals, public health institutions, practicing (assistant) physicians, and rural doctors showed relatively poor equity .

Inter-provincial Differences Within Regions: Analysis of intra-regional

provincial/municipal equity revealed that in eastern China, Liaoning, Shandong, Shanghai, and Guangdong showed relatively poor equity. Liaoning exhibited poor equity primarily in total medical institutions, rural doctors and health workers, and practicing (assistant) physicians; Shandong showed poor equity in rural doctors and health workers and practicing (assistant) physicians; and Shanghai and Guangdong showed poor equity in practicing (assistant) physicians. In central China, Jiangxi and Henan showed relatively poor equity, with Jiangxi primarily in total medical institutions and Henan in rural doctors and health workers. In western China, overall equity was poor, particularly in Guangxi, Guizhou, and Shaanxi, all showing poor equity in total medical institutions, hospitals, and public health institutions .

Correlation Analysis Between Regional Differences in Health Resource Allocation and Chronic Disease Status

Medical Institution Equity and Chronic Disease Prevalence: The prevalence of memory-related diseases was associated only with hospital equity (P=0.003); liver disease prevalence was associated only with primary care institution equity (P=0.050); and diabetes (P=0.043) and memory-related disease (P=0.038) prevalence were associated with equity in total medical institutions and primary care institutions. Primary care institution equity was associated with chronic disease prevalence among middle-aged and elderly individuals (P<0.05), while public health institution equity showed no linear correlation (P>0.05).

Health Personnel Equity and Chronic Disease Prevalence: Liver disease prevalence was associated with health technician equity (P=0.048); having two chronic conditions (P=0.040), dyslipidemia (P=0.040), diabetes (P=0.008), liver disease (P=0.012), and overall chronic disease prevalence (P=-0.010) were associated with practicing (assistant) physician equity. Malignant tumor (P=0.016) and digestive system disease (P=0.038) prevalence were associated with registered nurse equity; liver disease (P=0.026) prevalence was associated with rural doctor equity. Practicing (assistant) physician equity was associated with chronic disease prevalence among middle-aged and elderly individuals (P<0.05).

Health Financial Expenditure Equity and Chronic Disease Prevalence: Hypertension (P=0.006), dyslipidemia (P=0.009), diabetes (P<0.001), and mental illness (P=0.004) prevalence were associated with health financial expenditure equity .

Discussion

Regional Differences in Chronic Disease Prevalence and Types in Eastern, Central, and Western China

Eastern China showed the lowest chronic disease prevalence among middle-aged and elderly individuals. Age-specific analysis revealed distinct patterns, with

western China exhibiting the highest proportions in both the 45–60-year-old middle-aged group and the $ $75-year-old elderly group, while central China showed the highest prevalence in the 60–75-year-old group. Regarding chronic disease burden, eastern China had the highest proportion of individuals with one chronic condition, central China with two conditions, and western China with three or more conditions. These patterns may reflect differences in regional population age structures and the deepening spatial clustering of aging, with central and western regions experiencing faster aging growth than eastern regions, particularly along the Yangtze River basin.

Regional variations in specific disease types were also pronounced. Western China showed the highest prevalence of chronic lung disease, asthma, heart disease, liver disease, and digestive system diseases. Chronic lung disease may be associated with temperature and pressure conditions in western China, while liver disease may relate to imbalanced medical development and inadequate mother-to-child hepatitis B virus blocking, resulting in hepatitis B infection rates of 15–18% in western regions. High chronic kidney disease prevalence in western China may be linked to dietary characteristics, as populations in northern and southwestern China consume more red meat, which is significantly associated with increased chronic renal failure. Digestive system cancers were most prevalent in central and western China, particularly in northwestern regions where gastric cancer rates are highest, potentially related to geographic environment, local dietary habits, and genetic factors. Cerebrovascular disease and memory-related diseases (including dementia, brain atrophy, and Parkinson's disease) showed the highest prevalence in central China, possibly due to climate differences, higher salt intake leading to hypertension, and subsequent arteriosclerosis and thrombosis.

Correlation Between Regional Differences in Chronic Disease Prevalence and Health Resource Equity

This study found no association between chronic disease status and bed equity, but significant associations with the equity of medical institutions, health personnel, and health financial expenditures. Primary care institution equity and practicing (assistant) physician equity were particularly important. Chronic disease prevalence is influenced by lifestyle, genetic, and environmental factors, but health resource equity also contributes significantly to prevalence disparities. Primary care institutions serve as the first point of contact for chronic disease diagnosis, treatment, and management, making their equity crucial for early intervention. The equity of practicing (assistant) physicians directly impacts patient experience and treatment outcomes. Therefore, improving primary care infrastructure and physician training is essential for enhancing chronic disease prevention and management, particularly in rural areas where village clinics play a critical role.

Limitations

This study has several limitations. First, using cross-sectional data from the 2018 CHARLS national survey precludes establishing temporal relationships or causal inferences. Second, the variable selection was limited to questionnaire items, without consideration of additional objective factors such as social conditions, living environment, or individual genetic and behavioral influences.

Conclusion

Significant regional differences exist in chronic disease prevalence among middle-aged and elderly individuals across eastern, central, and western China. Additionally, regional variations in health resource investment and allocation persist, with eastern China generally receiving higher health financial expenditures than central and western regions. These disparities significantly impact the health and quality of life of middle-aged and elderly populations, creating barriers to timely diagnosis and treatment for chronic disease patients in remote areas and hindering overall health improvement. To eliminate these regional disparities, China must strengthen health resource allocation and investment, improve health service accessibility and quality, enhance infrastructure in underserved regions, expand pharmaceutical services, improve rural health service capacity, strengthen the health workforce, and accelerate health informatization to achieve equitable national health resource allocation and improve population health.

Author Contributions: LIU Ying was responsible for statistical analysis, manuscript writing, and editing; JIANG Juncheng was responsible for data cleaning, data management, and manuscript review; JING Huiquan was responsible for data management, funding support, conceptualization, supervision, and comprehensive guidance, taking overall responsibility for the manuscript. All authors approved the final version.

Conflict of Interest: None declared.

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