Analysis of Influencing Factors and Urban-Rural Disparities in End-of-Life Medical Expenses among Chinese Oldest-Old: Postprint

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Abstract

Background End-of-life medical expenses are an important research direction in the health field. Currently, there are few studies on end-of-life medical expenses for Chinese elderly, particularly lacking research analyzing the causes of differences in end-of-life medical expenses between urban and rural elderly in China.

Objective To explore the influencing factors of medical expenses in the last year of life for Chinese oldest-old ($ 80 years), and to analyze the differences and their causes in medical expenses during old. < /PARA >< PARAid = "3" > Methods In September 2021, using data from the 2018 wave of the Chinese L old individuals who died between 2014—2018 with complete data on medical expenditures in the last year of life and dot old, and the Oaxaca—Blinder decomposition method was employed to analyze the differences in medical expenses old. < /PARA >< PARAid = "4" > Results The median medical expense in the last year of life for the 1,399 olde old was 3,500.00 (9,000.00) yuan [the mean value after logarithmic transformation of medical expenses in the lasty Medical expenses in the last year of life for the oldest-old were influenced by residential area, age at death, gender, marital status, living arrangement, disability status, participation in pension insurance, place of death, accessibility of medical services, bedridden status, and annual per capita household income (P<0.05). After controlling for other variables, the medical expenses in the last year of life for urban oldest-old were 42.6% higher than those for rural oldest-old. Oaxaca-Blinder decomposition results showed that among the differences in medical expenses during the last year of life between urban and rural oldest-old, the explained and unexplained portions accounted for 32.86% and 67.14%, respectively; among the explained portion of the difference, 18.70% was attributable to differences in pension insurance participation, 30.18% to differences in place of death, and 40.42% to differences in annual per capita household income.

Conclusion The influencing factors of medical expenses in the last year of life for Chinese oldest-old are complex, with substantial urban-rural differences. It is

recommended to reduce end-of-life medical expenditures for the oldest-old and improve their quality of life and death through measures such as implementing healthy aging strategies, balancing urban-rural allocation of medical resources, improving the social security system for the elderly, and developing hospice care services.

Full Text

Urban-rural Differences in Factors Associated with End-of-life Medical Expenditures among the Oldest-old in China

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Abstract

Background
The cost of end-of-life care is an important topic in the health and wellness sector. There are few studies focusing on the end-of-life medical expenditures of older adults in China, especially regarding the causes of urban-rural differences in these expenditures.

Objective
To investigate the factors associated with medical expenditures among Chinese oldest-old individuals ($ $80 years) in the year before death, and to analyze urban-rural differences in these expenditures and their underlying causes.

Methods
In September 2021, we selected 1,399 oldest-old adults who died between 2014 and 2018 with complete data on medical expenditures and other key variables from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2018 dataset. Ordinary least squares (OLS) regression was used to analyze factors associated with medical expenditures in the year prior to death. The Oaxaca-Blinder decomposition method was employed to analyze urban-rural differences in these expenditures.

Results
The median medical expenditure in the year prior to death was 3,500.00 yuan (interquartile range: 9,000.00 yuan), with a logarithmic mean value of (8.09$±$1.73) yuan. Medical expenditures were significantly associated with residence, age at death, gender, marital status, living arrangement, disability

status, pension insurance participation, place of death, accessibility of medical services, bedridden status, and annual household income per capita ($P<0.05$). After controlling for confounding factors, urban oldest-old individuals had 42.6% higher medical expenditures than their rural counterparts. Oaxaca-Blinder decomposition revealed that 32.86% of the urban-rural difference was explainable by the included variables, while 67.14% remained unexplained. Among the explainable portion, 18.70% was attributable to differences in pension insurance participation, 30.18% to differences in place of death, and 40.42% to differences in annual household income per capita.

Conclusion
Medical expenditures in the year prior to death among Chinese oldest-old individuals are influenced by complex factors and exhibit substantial urban-rural disparities. We recommend implementing healthy aging strategies, balancing urban-rural medical resource allocation, improving the social security system for older adults, and developing end-of-life care services to reduce medical expenditures and improve the quality of life and death for oldest-old individuals.

Keywords: End-of-life medical expenditures; The oldest-old; Urban-rural differences; Influencing factor analysis; Oaxaca-Blinder decomposition; Hospice and palliative care nursing

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1. Data and Methods

1.1 Data Source This study utilized data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2018 dataset (https://doi.org/10.18170/DVN/WBO7LK). The CLHLS project collects information retrospectively from family members of deceased older adults, including data on time and cause of death, health status before death, medical and care costs, and quality of life. Detailed information about the CLHLS can be found in the literature [9]. Researchers applied for and obtained approval to use the CLHLS 2018 data through the Peking University Open Research Data Platform. In September 2021, we selected 1,399 oldest-old individuals aged 80-117 years who died between 2014 and 2018 and had complete data on medical expenditures and other key variables.

1.2 Variable Selection **(1) Medical expenditures in the year prior to death:** Based on responses to the question "Actual medical expenses spent by the older adult in the year before death," we determined the medical expenditures in the year prior to death. To normalize the distribution, this variable was log-transformed.

(2) Potential influencing factors: Drawing on previous literature [10], we identified potential factors that might influence medical expenditures, including: residence, age at death, gender, marital status, living arrangement, care mode, disability status, pension insurance participation, place of death, accessibility of medical services, bedridden status, and annual household income per capita. Residence (urban vs. rural) was determined by responses regarding the deceased's place of residence. Marital status was categorized as "with spouse" (including married and living with spouse, or married but not living with spouse) or "without spouse" (including divorced, widowed, or never married). Living arrangement was classified based on the primary residence pattern in the year before death: nursing home, living alone, couple-only household, or living with children/grandchildren/other relatives. Care mode was determined by identifying the primary caregiver: spouse, children, grandchildren/other relatives, social care (including professional services and hired caregivers), no caregiver, or no care needed. Disability status was assessed using the Activities of Daily Living (ADL) scale developed by Katz et al. [11]. Individuals who could independently perform all ADLs (bathing, dressing, toileting, indoor mobility, continence, and eating) were classified as not disabled; otherwise, they were considered disabled. Pension insurance participation was determined by whether the older adult had pension insurance before death. Accessibility of medical services was assessed by responses to whether the older adult could receive timely treatment when ill between the 2014 survey and death, with responses categorized as yes, no, or never ill. Bedridden status was determined by whether the older adult was bedridden before death. Annual household income per capita was measured by self-reported per capita net income in the year before death and was also log-transformed.

1.3 Statistical Methods We used Stata 16 MP for statistical analysis. Categorical variables were expressed as frequencies and percentages, with between-group comparisons using chi-square tests or Fisher-Freeman-Halton tests. Normally distributed continuous variables were expressed as means ± standard deviations, compared between two groups using independent samples t-tests and among multiple groups using one-way ANOVA. Non-normally distributed continuous variables were expressed as medians and interquartile ranges [M(QR)]. OLS regression was used to analyze factors influencing medical expenditures in the year prior to death. To further analyze urban-rural differences and the contribution of each factor, we employed the Oaxaca-Blinder decomposition method.

Originally developed to analyze wage differentials between male and female

workers [12], the Oaxaca-Blinder method has been widely applied to decompose differences in continuous variables between two groups. We expressed the urban-rural difference in end-of-life medical expenditures as:

$$R = [E(X_u) - E(X_r)]'\beta^* + [E(X_u)'(\beta_u - \beta^*) + E(X_r)'(\beta^* - \beta_r)]$$

where u = urban, r = rural; R represents the expected difference in medical expenditures between urban and rural oldest-old individuals; X represents control variables (age at death, gender, marital status, living arrangement, care mode, disability status, pension insurance participation, place of death, accessibility of medical services, bedridden status, and annual household income per capita); β represents the coefficients of predictors; and β^* represents the non-discriminatory coefficients used to determine each predictor's contribution. $[E(X_u) - E(X_r)]'\beta^*$ represents the portion explained by control variables in the model, while $[E(X_u)'(\beta_u - \beta^*) + E(X_r)'(\beta^* - \beta_r)]$ represents the unexplained portion, which includes both differences in coefficients of included variables and other unmeasured factors.

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2. Results

2.1 General Characteristics of Participants Among the 1,399 oldest-old individuals, 819 (58.54%) resided in rural areas. The mean age at death was $(94.7\$\pm7.9) years; 797 (56.97\pm2.10) yuan. Medical expenditures in the year prior to death ranged from 1,116.67 to 20$ $trans formed mean of (8.09\pm\$1.73)$ yuan. Significant differences between urban and rural oldest-old individuals were observed in medical expenditures, living arrangements, care modes, pension insurance participation, place of death, and annual household income per capita (P<0.05) .

2.2 Comparison of End-of-Life Medical Expenditures by Characteristics Significant differences in medical expenditures were found across gender, marital status, living arrangement, care mode, disability status, pension insurance participation, place of death, accessibility of medical services, and bedridden status among all participants (P<0.05). Similar patterns were observed within both urban and rural subgroups (P<0.05) . Univariate OLS regression showed that age at death and annual household income per capita significantly affected medical expenditures in the year prior to death among all, urban, and rural oldest-old individuals (P<0.05).

2.3 OLS Regression Analysis of Factors Influencing End-of-Life Medical Expenditures Using log-transformed medical expenditures as the dependent variable and residence as the independent variable, while controlling for age at death, gender, marital status, living arrangement, care mode, disability status, pension insurance participation, place of death, accessibility of medical services, bedridden status, and annual household income per capita, OLS

regression revealed that urban oldest-old individuals had 42.6% higher medical expenditures than rural oldest-old individuals after controlling for other variables. Factors significantly associated with higher medical expenditures included: younger age at death, male gender, having a spouse, non-nursing home residence, disability, pension insurance participation, death in hospital, bedridden status, and higher annual household income per capita (P<0.05) .

Separate OLS regressions for urban and rural samples showed that each additional year of age at death decreased medical expenditures by 3.8% in rural areas and 3.1% in urban areas. Compared to dying at home, dying in hospital increased expenditures by 117.9% for urban and 114.5% for rural oldest-old individuals, while dying in a nursing home increased rural expenditures by 176.8%. Each unit increase in log-transformed annual household income per capita increased expenditures by 17.3% for urban and 18.1% for rural oldest-old individuals .

2.4 Decomposition of Urban-Rural Differences in End-of-Life Medical Expenditures Based on t-test and OLS regression results confirming significant urban-rural differences, we conducted Oaxaca-Blinder decomposition. The difference in log-transformed mean medical expenditures between urban and rural oldest-old individuals was 0.686 [95%CI (0.502, 0.871)], significant at the 1% level, confirming higher expenditures among urban residents. The decomposition revealed that 32.86% [β(95%CI)=0.225 (0.129, 0.323), P<0.001] of this difference was explainable by the included variables, while 67.14% [β(95%CI)=0.461 (0.295, 0.627), P<0.001] remained unexplained. Among the explainable portion, 18.70% was attributable to differences in pension insurance participation (P=0.009), 30.18% to differences in place of death (P=0.004), and 40.42% to differences in annual household income per capita (P<0.001) .

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3. Discussion

3.1 Inverse Relationship Between Age at Death and End-of-Life Medical Expenditures Consistent with previous research [13-14], we found an inverse relationship between age at death and medical expenditures in the year prior to death. Among our 1,399 participants, median end-of-life medical expenditures were 3,500.00 (9,000.00) yuan, ranging from 1,116.67 yuan (for an individual who died at age 111) to 20,943.59 yuan (for an individual who died at age 87). This age-related difference primarily reflects differential use of inpatient services. Research indicates that average hospitalization costs for individuals aged 65-69 are at least double those for individuals aged 85 and older [15]. Older oldest-old individuals show less initiative in seeking medical care, preferring institutional care or family-based support, which reduces hospitalization costs. Additionally, they are more likely to die from age-related decline or unpredictable disease trajectories rather than conditions requiring emergency hospitalization [16-17], contributing to lower end-of-life medical expenditures.

3.2 Influence of Demographic and Health Factors on End-of-Life Medical Expenditures Beyond age at death, demographic factors including gender, marital status, living arrangement, and annual household income per capita significantly influenced medical expenditures. Male oldest-old individuals had higher expenditures than females, possibly reflecting gender disparities in healthcare utilization influenced by traditional cultural norms [18]. Married individuals had higher expenditures, likely due to greater emotional and social support enhancing healthcare-seeking willingness [19]. Those residing in nursing homes had lower expenditures than those in other living arrangements, possibly because nursing home care costs were classified as care expenses rather than medical expenses. Higher annual household income per capita was associated with higher medical expenditures, as income affects the conversion of healthcare needs into demands and determines access to services [20].

Health-related factors including disability status, pension insurance participation, place of death, accessibility of medical services, and bedridden status also significantly influenced expenditures. Disabled and bedridden individuals had higher expenditures due to greater care needs. Pension insurance participation was associated with higher expenditures, as increased income enhances payment capacity and treatment willingness [21]. Dying in hospital versus at home substantially increased expenditures, consistent with research showing most older adults prefer home death [22] and that home-based end-of-life care reduces hospital utilization and costs [23-24].

3.3 Urban-Rural Disparities and Contributing Factors This study confirms significant urban-rural disparities in end-of-life medical expenditures among Chinese oldest-old individuals, with rural residents having lower expenditures. Similar disparities exist internationally; for example, among elderly cancer patients in the United States, rural residents had 4-10% lower end-of-life medical expenditures than urban residents depending on cancer type [25].

The explainable portion of the urban-rural difference (32.86%) was primarily attributable to three factors. Differences in pension insurance participation accounted for 18.70% of the explainable difference. Rural oldest-old individuals had lower pension insurance coverage than urban residents, and lacking pension insurance reduced rural end-of-life expenditures. China's pension system comprises three tiers with varying benefit levels (government/institutional, urban employee, and urban-rural resident pensions) [26], placing rural residents at a disadvantage in both coverage and benefit generosity, thereby limiting their healthcare payment capacity.

Differences in place of death accounted for 30.18% of the explainable difference. Rural older adults are more likely to die at home, while urban older adults more frequently die in hospitals [27-28], reflecting urban residents' higher incomes and better access to professional medical care. From a health economics perspective, some individuals forego institutional end-of-life care to avoid catastrophic medical expenditures that could cause dual biological and economic depriva-

tion [29-30], leading economically disadvantaged rural residents to choose home death.

Differences in annual household income per capita represented the primary contributor, accounting for 40.42% of the explainable difference. Urban households have long had higher incomes and faster income growth than rural households [31]. High medical costs pose a major barrier to healthcare access [32], particularly for rural older adults without pensions who face greater out-of-pocket burdens and economic constraints [33].

3.4 Policy Recommendations Based on these findings, we propose the following recommendations: (1) Implement healthy aging strategies to extend healthy life expectancy and reduce end-of-life medical expenditures. This requires government support for health education policies and funding, as well as efforts to promote proper health awareness among older adults to prevent disease. (2) Adopt regionally differentiated medical resource allocation strategies, increasing investment in rural primary healthcare infrastructure and expanding telemedicine and health consultation services to impoverished rural areas to improve end-of-life care quality and reduce expenditures. (3) Improve the social security system, particularly pension and medical insurance systems, by integrating urban and rural resident pension systems and increasing coverage to enhance rural older adults' economic capacity to access healthcare. (4) Develop end-of-life care services to reduce economic pressure on families while improving quality of life for dying individuals and their families. China's hospice care system lags behind global standards and should be strengthened through improved legislation, education, and resource development, learning from international experiences.

3.5 Limitations This study has several limitations. First, although using national microdata, some data may lack accuracy and comprehensiveness. Omitted variable bias is possible, and future research should include additional variables to enhance robustness. Second, comparing expenditures between deceased and surviving older adults would provide further insights, which we plan to explore in future work. Despite these limitations, this study offers valuable policy implications for addressing end-of-life care for China's oldest-old population.

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