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Original Article

The Effect of Home Care Poverty on the Activities of Daily Living among Older Adults in China: A Propensity Score Matching Study

Yuee Li, *Xiaohui Liu

School of Humanities and Law, Northeastern University, Shenyang, China

***Corresponding Author:** Email: xiaohui7270@hotmail.com

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Abstract

Background: In the context of home care being valued by the Chinese government and the increasing number of disabled older adults, it is of great significance to explore the effect of home care poverty of the older adults on their ability to perform activities of daily living.

Methods: A research sample of 2583 older adults from the Chinese Longitudinal Healthy Longevity Survey data in 2018 was adopted. There were 422 participants in the treatment group and 2161 participants in the control group. According to the framework of counterfactual analysis, the kernel matching method was used to match the treatment and control groups to calculate the values of average treatment effects on treated (ATT).

Results: The results of the kernel matching method showed that the factual ADL score of the treatment group was 6.886, the counterfactual ADL score of the control group was 8.520, and the ATT value was -1.634 (P<0.05). There were gender and urban-rural differences in the relationship between home care poverty and activities of daily living among older people. In gender samples, there was a significant correlation between the two, and the absolute value of ATT in male samples was higher than that in female samples (P<0.05). In the rural samples, there was a significant correlation between the two variables (P<0.05). But in the urban samples, there was no significant correlation between the two variables.

Conclusion: Home care poverty could significantly reduce the ability to perform activities of daily living among older adults in China. Based on the conclusions, the study puts forward several suggestions to solve the home care poverty for the older adults in China.

Keywords: Home care; Care poverty; Activities of daily living; Older adults; Propensity score matching

Introduction

According to the results of the fourth sample survey on the living conditions of senior citizens aged 60 and above in urban and rural China that was jointly released by the China National Committee on Aging, Ministry of Civil Affairs and Ministry of Finance, the number of disabled and semi-disabled older adults in 2015 was approximately 40.63 million, accounting for 18.3% of the total older population in that year (1). The disabled older adults in China will exceed 77.66 million in 2030. The proportion of disabled older

adults in the total older population in China will continue to rise (2).

With the increasingly aging population in China and the continuous expansion of the disabled older adults, the demand for home care of older adults is also increasing. Home care refers to care services provided at home for older adults with a disease or disability (3-5), including activities like health prevention and palliative care (hospice care). Its purpose is to improve the quality of life and the health of older persons by replacing hospital care with home care (6). Home care is divided into formal and informal home care. Informal home care is defined as care assistance that the person receives from family members or non-family aides (unpaid). Formal home care refers to the care of an older person at home by paid non-family assistants or trained medical professionals (7). The combined use of formal and informal home care was increasing due to the increased care needs of disabled older persons (8,9), but informal home care remained the most important source (10-12).

Although home care for disabled older adults can decrease hospital care costs, resources vary widely between individuals and families. Studies have found that most older people do not receive adequate care services at home, especially those with particular diseases (13-15). For example, approximately one quarter of older persons with memory problems reported that they did not receive adequate care services, and that even a combination of informal and formal home care was insufficient to meet their needs (16). This condition is known as "care poverty" (7). Scholars proposed solving to solve the problem by training home caregivers, providing standardized medical care manuals, and improving community medical services (17), which provided inspiration for follow-up investigation and analysis.

In the context of home care being valued by the Chinese government and the increasing number of disabled older adults, it is of great significance to explore the effect of home care poverty on the ability to perform activities of daily living among older adults. This study adopts the propensity score matching method to carry out a quasi-experimental study on the effect of home care poverty on the ability to perform activities of daily living among older adults and calculate its value of average treatment effects on treated. The research results will help raise awareness of the negative impacts of home care poverty.

Methods

Participants

We used data from the Chinese Longitudinal Healthy Longevity Survey (abbreviated as CLHLS). The data were compiled by Peking University's Center for Healthy Aging and Development Studies (abbreviated as CHADS) in 1998, and a total of 5 surveys were conducted from 2005 to 2018. The survey covered 23 provinces in mainland China, and the data mainly involved demographic characteristics, family relations, physical function, lifestyle, care supply and other issues related to older adults, characterized by open data, large sample sizes and high quality.

A total of 65,423 people aged 60 or above were interviewed in households (2005: N=15638; 2008: N=1694; 2011: N=9765; 2014: N=7192; 2018: N=15874). After excluding missing values of key variables, 2583 valid samples were used for the data analysis (2005: N=554; 2008: N=465; 2011: N=535; 2014: N=237; 2018: N=792).

Measures

The dependent variable of this study was activities of daily living (abbreviated as ADL) of older adults, which was assessed by the Katz scale (18). The Katz scale includes six indicators (bathing, dressing, going to the toilet, controlling the bladder and bowels, walking indoors and eating), each with three categories that evaluate participants: "0=completely dependent", "1=partially dependent" and "2=completely independent" (19). The total score ranges from 0 to 12 points. The higher scores indicate the higher daily living ability and lower functional disability of older adults.

The treatment variable in this study was the home care poverty of older adults. Based on the original questionnaire answers, the older re-

spondents were divided into two groups. The treatment group refers to older respondents with home care poverty. The control group refers to older respondents without home care poverty. The sample contained information on 2583 participants, including 422 participants in the treatment group and 2161 participants in the control group.

Sociodemographic characteristics, home care characteristics, formal social support characteristics were selected as control variables in this study. Sociodemographic characteristics included age, gender, urban/rural, area, income level and cohabitation status. Home care characteristics included caregiver category, caregiver willingness, care duration (i.e., hours spent in care last week) and care expenditure (i.e., the amount paid to home care in the last week). Formal social support characteristics included social pension insurance, social medical insurance, community daily life care and community medical services.

Statistical Analysis

Propensity score matching methods was used to explore the effect of home care poverty on the ability to perform activities of daily living among older adults. Home care poverty was treated as a natural intervention, avoiding the biased estimates resulting from endogeneity issues caused by confounding variables. Stata 16.0 was used for data analysis. First, a probit model was constructed to calculate the propensity value of each variable to be matched. Second, the treatment and control groups were matched according to the propensity score using kernel matching method. Third, the matching balance test was used to examine whether there was a significant deviation in the matching variables between the two groups. Finally, the average treatment effect on treated (abbreviated as ATT) was evaluated by comparing the factual and counterfactual results to calculate the effect of home care poverty on the ability to perform activities of daily living among older adults. ATT = E (Y1 | T = 1) - E (Y0 | T = 1), where E is the expected value, T = 1 is the treated state, Y1 is the result affected by home care poverty, and Y0 is the result unaffected by home care poverty.

Results

Descriptive statistical results

Table 1 shows the basic characteristics of the participants. The sample contained information on 2583 participants, including 422 participants in the treatment group and 2161 participants in the control group. It shows that in the sample, the older participants with home care poverty was less than the older participants without home care poverty. In addition, the mean ADL score for all older participants was 8.31±3.84, and the mean ADL score of the treatment sample group (6.89±4.38) was lower than that of the control sample group (8.59±3.66). The descriptive statistics of the other variables are shown in Table 1.

Propensity Score Results

Table 2 shows the variables and estimation results included in the probit model. The log likelihood value of the model was -811.198, and the pseudo R squared value was 0.295. The regression results showed that variables such as age, area, income level, cohabitation status, caregiver category, caregiver willingness, social pension insurance, social medical insurance, community daily life care and community medical services were significantly correlated with whether the older adults had home care poverty ($P<0.05$). The probability values of all variables in the probit model were used as propensity scores.

Table 1: Descriptive statistics results of variables (mean±SD)

Variable	*Variable definition*	*Total*	*Treatment group*	*Control group*
ADL score	continuous variable	8.31±3.84	6.89±4.38	8.59±3.66
Home care poverty	0=no 1=yes	0.16±0.37	/	/
Age	continuous variable	94.01±9.31	92.38±10.35	94.33±9.06
Gender	0=female 1=male	0.35±0.48	0.31±0.46	0.35±0.48
Urban/rural	0=rural 1=urban	0.28±0.45	0.18±0.38	0.29±0.46
Area	1=west 2=central 3=east	2.36±0.79	2.06±0.84	2.42±0.77
Income level	0=poor 1=rich	0.16±0.37	0.02±0.15	0.19±0.39
Cohabitation status	0=living alone 1=not living alone	0.90±0.30	0.85±0.36	0.91±0.29
Caregiver category	0=non-relatives 1= relatives	0.93±0.26	0.93±0.25	0.93±0.26
Caregiver willingness	0=unwilling 1=willing	0.86±0.34	0.53±0.50	0.93±0.26
Care duration	continuous variable	63.39±67.02	56.85±57.64	64.67±68.64
Care expenditure	continuous variable	487.06±2160.41	290.00±745.16	525.54±2337.08
Social pension insurance	0=no 1=yes	0.44±0.50	0.18±0.38	0.49±0.50
Social medical insurance	0=no 1=yes	0.78±0.41	0.66±0.47	0.81±0.39
Community daily life care	0=no 1=yes	0.09±0.29	0.02±0.15	0.10±0.30
Community medical services	0=no 1=yes	0.35±0.48	0.23±0.42	0.38±0.48
N		2583	422	2161

Table 2: Estimated results of propensity score model

Variable	*B*	*S.E.*	*z*	*P>z*	*[95% CI]*	
Age	-0.011	0.004	-2.85	0.004	-0.019	-0.003
Gender	0.033	0.079	0.42	0.674	-0.122	0.188
Urban/rural	-0.139	0.096	-1.44	0.149	-0.328	0.050
Area	-0.267	0.043	-6.18	0.000	-0.352	-0.183
Income level	-0.966	0.166	-5.81	0.000	-1.292	-0.640
Cohabitation status	-0.220	0.107	-2.06	0.039	-0.430	-0.011
Caregiver category	-0.494	0.159	-3.10	0.002	-0.806	-0.182
Caregiver willingness	-1.354	0.083	-16.40	0.000	-1.516	-1.192
Care duration(ln)	0.033	0.026	1.26	0.209	-0.018	0.083
Care expenditure(ln)	0.028	0.015	1.93	0.053	0.004	0.057
Social pension insurance	-0.732	0.084	-8.67	0.000	-0.897	-0.566
Social medical insurance	-0.578	0.081	-7.10	0.000	-0.737	-0.418
Community daily life care	-0.749	0.204	-3.67	0.000	-1.149	-0.349
Community medical services	-0.224	0.080	-2.80	0.005	-0.381	-0.067

Matching effect test results

In the kernel matching result, all samples in the treatment group (N=422) and 1742 samples in the control group (N=2161) met the common support domain requirements. The treated and control groups in the sample had a large common

support domain. And then the balance test of matching variables between the treatment group and the control group was also required. Table 3 shows the balance test results for kernel matching variables. Table 4 shows the overall comparison results between unmatched and matched. The results of the balance test showed that the absolute value of the standard bias of all variables in kernel matching did not exceed 20%, and the mean bias was also small. The *t* test showed that there were no significant differences between groups for all variables after matching. The pseudo R squared values became very small, and the probability values of the LR chi2 test were not significant. This finding indicated that after propensity value matching, the control variable no longer had a significant effect on the ability to perform activities of daily living among older adults. Therefore, the balance test was passed.

Table 3: Balance test results for kernel matching variables

Variable	*Unmatched*	*Mean*		*%bias*	*%reduct*	*t-test*	
	Matched	**Treated**	**Control**		**bias**	**t**	***P*>t**
Age	U	92.379	94.333	-20.1		-3.95	0.000
	M	92.379	92.871	-5.1	74.8	-0.70	0.486
Gender	U	0.313	0.352	-8.3		-1.54	0.124
	M	0.313	0.310	0.7	91.9	0.10	0.922
Urban/rural	U	0.180	0.294	-27.0		-4.80	0.000
	M	0.180	0.161	4.5	83.5	0.72	0.469
Area	U	2.057	2.420	-45.1		-8.75	0.000
	M	2.057	2.006	6.3	86.0	0.87	0.383
Income level	U	0.024	0.192	-56.4		-8.65	0.000
	M	0.024	0.020	1.1	98.0	0.34	0.735
Cohabitation status	U	0.848	0.910	-18.9		-3.85	0.000
	M	0.848	0.841	2.2	88.2	0.29	0.772
Caregiver category	U	0.934	0.926	3.2		0.59	0.557
	M	0.934	0.926	-9.2	-187.8	-1.50	0.134
Caregiver willingness	U	0.934	0.957	-100.1		-24.12	0.000
	M	0.531	0.929	-5.6	94.4	-0.65	0.514
Care duration(ln)	U	3.273	3.388	-7.5		-1.42	0.157
	M	3.273	3.246	1.8	76.4	0.25	0.800
Care expenditure(ln)	U	4.081	4.048	1.3		0.23	0.816
	M	4.081	4.285	-8.1	-518.5	-1.23	0.219
Social pension insurance	U	0.180	0.180	-69.1		-11.98	0.000
	M	0.180	0.180	0.1	99.9	0.02	0.986
Social medical insurance	U	0.664	0.807	-32.9		-6.60	0.000
	M	0.664	0.661	0.6	98.1	0.08	0.933
Community daily life care	U	0.024	0.104	-33.2		-5.26	0.000
	M	0.024	0.018	2.5	92.3	0.63	0.531
Community medical services	U	0.232	0.376	-31.6		-5.68	0.000
	M	0.232	0.250	-4.0	87.4	-0.61	0.541

Table 4: Overall comparison results between unmatched and matched

Sample	*Ps R²*	*LR*	*P>chi2*	*MeanBi-*	*MedBias*	*B*	*R*	*%Var*
Unmatched	0.295	677.64	0.000	32.5	29.3	153.2	0.9	50
Matched	0.007	8.52	0.860	3.7	3.3	20.1	1.3	25

Propensity Score Matching Results

The kernel matching method was used to calculate the actual ADL score with home care poverty and the counterfactual ADL score without home care poverty. By comparing the two, the ATT for the kernel matching method was obtained. Table 5 shows the results of propensity score matching for the ADL scores of older adults. The results of the kernel matching method showed that the factual ADL score of the treatment group was 6.886, the counterfactual ADL score of the control group was 8.520, and the ATT was -1.634 (P<0.05). The corresponding T value was -5.61. The results showed that home care poverty can significantly reduce the activities of daily living among older adults.

On this basis, the ATT values of different older respondents were further analyzed. Firstly, taking gender as the classification standard, the samples were divided into male older group and female older group. In both male and female samples, home care poverty significantly reduced the activities of daily living among older adults (P<0.05). However, the absolute value of ATT in male samples was higher than that in female samples. Secondly, taking urban/rural as the classification standard, the research divided the samples into urban older groups and rural older groups. In the sample of rural respondents, the home care poverty could significantly affect the activities of daily living among the rural older adults, and the ATT value was -1.656 (P<0.05). However, in the sample of urban respondents, the home care poverty did not significantly affect the activities of daily living among the urban older adults. Therefore, there were gender and urban-rural differences in the relationship between home care poverty and activities of daily living among older people.

Table 5: Propensity score matching results of ADL scores among older adults

Samples		*Treated*	*Controls*	*ATT*	*S.E.*	*T*	*Z*	*P>|z|*
Total		6.886	8.520	-1.634	0.279	-5.61	-5.85	0.000
Gender	male	7.531	9.226	-1.695	0.577	-3.22	-2.94	0.003
	female	6.711	8.252	-1.541	0.456	-4.55	-4.58	0.000
Urban/rural	urban	6.686	8.169	-1.483	0.822	-1.95	-1.80	0.071
	rural	6.977	8.633	-1.656	0.282	-5.31	-5.88	0.000

Note: Standard errors and Z statistics were calculated by bootstrap repeated sampling for 100 times

Discussion

CLHLS2005-2018 survey data were used to analyze the effect of home care poverty on the ability to perform activities of daily living among older adults in China. The kernel matching method was used to match the treatment and control groups to calculate the ATT value. The results showed that the ADL scores of older adults with home care poverty were lower than those without home care poverty. Home care poverty can reduce the ability to perform activities of daily living among older adults in China. Through further analysis, the study concluded that there were gender and urban-rural differences in the relationship between home care poverty and activities of daily living among older people. However, scholars paid more attention to the concept of home care poverty (20, 21). There was a lack of more rigorous empirical analysis on the association between home care poverty and health (22). Using propensity score matching method, the conclusions of this study provide empirical analysis evidence for the negative impact of home care poverty on the activities of daily living among older adults, and empirically analyzes the gender and urban-rural differences in the impact of the home care poverty on the activities of daily living among older adults.

Several actions should be considered to address home care poverty in order to improve the ability of China's older adults to engage in activities of daily living. First, supportive policies for family caregivers should be established. Some practices in developed countries can be used for reference, such as providing respite services for home caregivers of the disabled older adults (especially the severely disabled older adults), so that they can have a "respite" between heavy work and care tasks; subsidizing home caregivers of the disabled older adults; providing education and training for caregivers to improve caregivers' care skills; and organizing community caregiver support groups to relieve caregivers' psychological pressure (23,24).

Second, a long-term care insurance system should be established nationwide. Long-term care insurance is still in its trial period in some cities and is not being practiced nationwide. Local governments should introduce long-term care insurance as soon as possible to reduce the cost of care services, determine the subsidy standard based on the actual income status and nursing level of the disabled older adults, and increase the subsidy level of the disabled older adults, especially the severely disabled older adults (25, 26).

Third, a wide variety of community care service programs should be established. Nursing, palliative care, continence, mental health, hospital at home, physiotherapy, diet and other services need to be included in the multilayered community service system and linked to the disabled older adults (26, 28). Local governments should also increase public spending on community services to enrich community care programs for disabled older adults (29).

In summary, the deterioration of the older adults' health can be slowed through targeted prevention and health care activities.

Conclusion

Home care poverty can reduce the ability to perform activities of daily living among older adults in China. This conclusion deserves the attention of scholars in related fields. Future research should be combined with the actual situation in China to put forward specific suggestions to solve the home care poverty. It is conducive to improving the health of the older adults.

Journalism Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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