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The impact of medical insurance on medical expenses for older Chinese
Evidence from the national baseline survey of CLHLS

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Abstract
With the deepening population aging process in China, the medical expenses of older adults has become a widespread concerned. Medical insurance is a major source of Chinese medical financing and payment. The study aims to understand the current status of medical expenses for older adults and explore the effect of different types of health insurance on medical expenses in China.

The data came from the Chinese Longitudinal Health Longevity Survey (CLHLS) in 2014. The Kruskal–Wallis test and general multivariate linear regression model were applied to analyze the current situation and to explore how medical insurance as the main payment impacts medical expenses.

A total of 4376 older participants were included in this study. The median of medical expenses of a total was 1500 Yuan per year. The proportions of participants who had the urban employee-based basic medical insurance (UE-BMI), the urban residents basic medical insurance (UR-BMI), the new rural cooperative medical insurance scheme (NCMS), and the commercial medical insurance were 10.8%, 8.4%, 72.7%, and 0.9%, respectively. 34.8% of older adults paid the health care service via the NCMS and 11.9% paid via the UE-BMI. Participating in the NCMS and UR-BMI are significantly related to the level of the medical fees of older adults. UE-BMI, UR-BMI, and NCMS as main payment eased the pressure of medical expenses.

The influence of different types of medical insurances as main payments on the medical expenses of older adults is varied. Implementation of medical insurance should be taken to further relieve the medical expenses of older adults.

Abbreviations: CLHLS = the Chinese Longitudinal Health Longevity Survey, NCMS = the new rural cooperative medical insurance scheme, UE-BMI = urban employee-based basic medical insurance, UR-BMI = the urban residents basic medical insurance, WHO = World Health Organization.

Keywords: medical expenses, medical insurance, older adults

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1. Introduction

The increase of health expenditures has introduced a series of problems to each country in the world, and the aging population has been considered as a dependent factor to it.[1,2] In 2011, the World Health Organization (WHO) forecasted that older adults population of China would reach 27% of the total population until 2050, which would add a new burden to the Chinese health insurance in the future.[3] With the deepening population aging process in China, the medical costs of older adults have become a widespread concern.

A previous study indicated that in health-care seeking behaviors, medical insurance can ease the economic pressure induced by medical treatment, improve the residents' medical health service accessibility, and actively protect the people's health.[4] In a retrospective analysis of global family catastrophic expenses, medical insurance forms a strong guarantee to reduce the family burden.[5] The health insurance program of Vietnam causes a reduction in annual out-of-pocket expenditures on health.[6] Whether patients have insurance may decide their choices of medical services and treatment plans, since patients without medical insurance have a limited ability to pay.[7]

In addition to the studies that show certain medical insurances affect medical expenses in the general population, many previous studies have provided evidence for linkages between health insurance and the health care expenditure of older adults,[8] and medical insurance is an important factor of the medical cost for

older adults.[9] For example, drug expenditure of older adults in the USA experienced an average annual increase of more than 18% from 1997 to 2000 and the significant cost of medical insurance for older adults was caused by the use of brand-name drugs.[10] Research on medical services for people who were aged 65 and above in the USA indicated that medical insurance could reduce both personal and family medical burden, and increase the consumer's demand for medical services.[11] Therefore, improving health insurance coverage would increase the probability of medical treatment for older adults.[12]

However, evidence suggests that the impact of medical insurance to older adults or residents on different economic levels is controversial. Researchers reported that the universal health insurance in Taiwan increased the utilization of medical services, especially in both low and middle-income class; however, this trend did not affect the health and mortality.[13] Several researchers suggested that the health insurance system of Taiwan reduced infant mortality, while not significantly reducing the mortality of older adults.[14,15] Several previously published studies have shown that health insurance does not significantly reduce the ratio of family-pocket medical expenses for older adults and the probability of poverty due to catastrophic medical expenses.[16,17] Therefore, the influence of medical insurance may be diverse throughout different groups, which would directly impact the direction and efficiency of public health investment in China. It is worth examining the impact of medical insurance on medical expenses of the older Chinese to improve the medical health service accessibility and affordability for older adults.

1.1. The health insurance system in China

Medical insurance is a major source of Chinese medical financing and payment. According to the most recent China health system reform scheme, the medical security system is one of the 4 systems within the health care reform.[18] The medical insurance system is composed of basic medical insurance and commercial insurance. The basic medical insurance system is directly managed by the central and local governments and covers 3 different types of population planning in urban and rural areas. However, commercial medical insurance currently accounts for only a small proportion and mainly applies to the population with relatively affluent economic level. Therefore it only forms a supplement of the social medical insurance.[19] By the end of 2017, the number of people who participated in basic medical insurance (UE-BMI, UR-BMI or NCMS)had reached 1176.64 million and the coverage rate remained about 84.6%.[20]

In rural areas, the new rural cooperative medical insurance scheme (NCMS) is a type of mutual aid and risk sharing health security system.[21,22] The proportion of participants in the NCMS has reached 98.7%; however, the level of protection still remains low. For example, the NCMS fund accumulatively spent about 290.92 billion Yuan, which was equivalent to 363 Yuan per capita in 2013.[23]

In urban areas, 2 major health insurance programs exist: urban employees can be insured under the urban employee-based basic medical insurance (UE-BMI) and unemployed urban residents can be insured under the urban residents basic medical insurance (UR-BMI). Among these, the UR-BMI is mainly used for inpatient expenses and some outpatient costs for key diseases and both the employer and employees share the financial burden.[19] In addition, the main subjects who participated in the

UR-BMI consist of minor groups who did not participate in the UE-BMI in the city or residents without formal employment. Searching the *"China Health Statistics Yearbook"* for 2012 showed that the enrollment in the UE-BMI and UR-BMI reached 26.467 million and 27.122 million, accounting for 37.18% and 38.10% of the urban population, respectively.

At the same time, the per capita medical costs in China have sharply increased between 1990 and 2012. In 1990, medical expenses for the health care of urban and rural residents were 25.7 Yuan and 19 Yuan, respectively. However, in 2012, the expenses of urban and rural residents on healthcare were 1063.7 Yuan and 513.8 Yuan, respectively. With the ageing population, the Chinese government has felt the necessity and urgency to improve the rights of medical security and the interests of older adults. Therefore, numerous measures have been taken to alleviate the contradictions between supply and demand of medical security and the interests of older adults in recent years. For example, in 2007 July, the State Council promulgated *"The State Council guidance on the pilot urban resident basic medical insurance"*.

1.2. Research question

In previous investigations of medical services for older adults, few studies have explored the use of medical insurance and its influence on medical expenses for older adults. In addition, most of the data about costs was derived from different levels of either medical insurance center or hospital, rarely involving economic information, such as individual and family income. In general, among studies of basic medical insurance in China, some continued the discussion of the medical insurance policy, to increase fairness and effectivity of various medical insurance operations; others discussed the medical insurance coverage and cost of health care. Few studies exist that have collected and analyzed the data from the view about service users of medical insurances, and evaluated the impact of medical insurance on older adults' medical expenses.

Since there has been a long-standing debate and very little is actually known about the subject for China, we conducted an exploratory analysis on the impact of medical insurance on the medical expenses from the view of older adults as the service users. The emphasis of this paper was to address the following 3 questions:

1. What is the current status of the medical expenses of older adults in China, including the total medical expenses, part of household payments for medical expenses, and part of the medical insurance paying for medical expenses?
2. What is the effect of health insurance on medical expenses of older Chinese?
3. How does medical insurance as the main payment affect the medical expenses of older adults?

2. Materials and methods

2.1. Data and sample

The data used in this study mainly originated from the Center for Healthy Aging and Development Studies, Peking University in 2014—the seventh wave "Chinese longitudinal Healthy Longevity Survey (CLHLS)". In this investigation, the total sample size of individuals aged 60+ years was 7168. We removed the samples with medical expenses of 0 Yuan or with missing data, because

these older people could not be considered to incur medical expenses. Therefore, the rest of the total sample size of older adults in both urban and rural areas was 4376, which accounted for 61.05% of the total sample.

2.2. Variables and measures

The dependent variables in our study was the total medical expenses characterized by question: "how much did you spend on medical expenses last year?" We transformed the obtained data on medical expenses into logarithmic form, since the distribution of medical expenses showed a remarkable skewness.

The key independent variables were:

- which type of medical insurance older participants were enrolled in, and was presented by dummy variables capturing UE-BMI, UR-BMI, NCMS, commercial insurance, and others;
- which type of main payment covered the participant's medical expenses.

The variable was defined as: out-of-pocket spending, UE-BMI, UR-BMI, NCMS, commercial insurance, no money to pay, and others. We set the out-of-pocket spending as the reference.

We also control for a variety of independent variables affecting medical expenses. The demographic characteristics included age (60–79, 80+), gender (male, female), residence (rural area, urban, and town), marriage (not in marriage, in marriage), education (illiterate, 1–6 years in school, 7+ years in school), pension (no, yes). Annual per capita income was set as continuous variables. Medical service (no, yes) was based on the respondents' answer to the question "Can you get adequate medical service when you are sick?". Self-reported health was based on the question "How do you rate your health at present?" and self-rated economic status was based on the question "How do you rate your economic status compared with others in your local area", which contained 5 categories: (1) very bad; (2) bad; (3) so-so; (4) good; and (5) very good.

2.3. Statistical analyses

For standard descriptive analysis, Kruskal–Wallis tests were applied to analyze the influence of single factors on the medical expenses of older adults. In this study, we compared different models by gradually introducing different types of independent variables. The independent variable of model 1 only introduced personal basic information. We added the per capita income of the family, medical service, and health status into model 2. Then, we introduced the type of insurance into model 3 as an independent variable, and the independent variable of model 4 included the main payment of the insurance. We also used 4 multiple linear regression models to screen the influencing factors of direct medical cost factors with the software R3.5.0, which elaborated the influence of the particular medical insurance system on medical expenses.

3. Results

3.1. Description of the sample

As shown in Table 1, the total sample size of older adults in urban and rural areas was 4376. The constituent ratios of young older adults (60–79 years old) and oldest older adults (≥ 80 years old) were 35.2% and 64.8%, respectively. Men accounted for 46.3%, and women accounted for 53.7%. Older adults in rural areas accounted for 50.3%. The research objects with non-marital status accounted for 58.7% and those currently married accounted for 41.3%. Participants who did not accept education, those with years of education between 1 year and 7 years, and those with up to 7 years and above accounted for 55.8%, 32.4%, and 11.8%, respectively. We also found that 19.1% of older adults had pensions and 96.2% of older adults could get adequate medical service at present. While investigating the health status of old people, we found that the proportion of self-rated health that answered fair, good, and excellent were 40.2%, 32.9%, and 8.1%, respectively.

This survey showed that the proportions of older adults who participated in UE-BMI, UR-BMI, NCMS, and commercial medical insurance were 10.8%, 8.4%, 72.7%, and 0.9%, respectively. For the main insurance to pay the medical expenses, we found that 46.8% of older adults paid the health care service by out-of-pocket spending, while those who used the NCMS to pay the incurred costs only accounted for 34.8%. Other insurances such as the UE-BMI, the UR-BMI, and the commercial medical insurance accounted for 11.9%, 5.3%, and 0.1%, respectively. Older adults who did not have the money to pay accounted for 0.1%.

Using Kruskal–Wallis tests for the single factor analysis of medical expenses over the past year showed that apart from age, residence, marriage, education, pension, medical service, income, self-rated health, the type of insurance, and main payment could also influence the medical expenses of older adults.

Table 2 presents the total medical expenses, households payment, and medical insurance payment of older Chinese who had medical expenses in 2014. The median of medical expenses was 1500 Yuan, in which the median of household payment was 200 Yuan, and the median of insurance payment was 500 Yuan.

3.2. Influence of medical insurance on medical expenses

Multiple regression analysis showed that the factors influencing medical expenses differed. Table 3 shows the different influential factors on the medical expenses of older adults in China. We found all 4 regression models to be statistically significant.

In model 1, except for the age and education, individual-level factors including gender, residence, marriage, and pension were statistically associated with medical expenses ($P < .01$). We added the income, medical service, and self-rated health in Model 2. Controlling for the personal basic situation, income, and self-rated health affected medical expenses ($P < .001$). In model 3, different types of medical insurance were introduced. The NCMS had a negative impact on medical expenses while the UR-BMI had a positive impact.

Compared to model 4 in Table 3, we found that the income and self-rated health also affected medical expenses, and participating in NCMS were significantly related to the level of medical fees for older adults that could reduce the cost of health care. Insurances with main payment also had different effects on medical expenses, and the UE-BMI, UR-BMI, NCMS, and the other medical insurance as the main payment exerted positive influences on medical expenses of older adults.

4. Discussion

Debates remain although the Chinese government has conducted a massive reform on the health insurance system. To verify the impact of medical insurance on medical expenses for older

Kruskal–Wallis test for medical expenses of the older adults over the past year.

	Variables	N (%)	Chi-Square	P
Age (years)	60–79	1540 (35.2)	16.897	<.001
	80+	2836 (64.8)		
Gender	Male	2024 (46.3)	1.164	.281
	Female	2352 (53.7)		
Residence	Urban and Town	2176 (16.1)	75.845	<.001
	Rural	2200 (50.3)		
Marriage	Not married	2545 (58.7)	46.835	<.001
	Married	1794 (41.3)		
Education (years)	0	2417 (55.8)	47.328	<.001
	1~	1404 (32.4)		
	7~	511 (11.8)		
Pension	No	3353 (80.9)	211.830	<.001
	Yes	792 (19.1)		
Medical service	No	165 (3.8)	0.037	.847
Self-rated Economic Status	Yes	4183 (96.2)	1.029	.905
	Very bad	92 (2.2)		
	Bad	439 (10.0)		
	So-so	3092 (70.7)		
	Good	677 (15.5)		
	Very good	70 (1.6)		
Self-rated health	Very bad	83 (1.9)	212.12	<.001
	Bad	735 (16.8)		
	So-so	1761 (40.2)		
	Good	1441 (32.9)		
	Very good	356 (8.1)		
Types of insurance	UE-BMI	434 (10.8)	216.68	<.001
	UR-BMI	337 (8.4)		
	NCMS	2911 (72.7)		
	Commercial medical insurance	35 (0.9)		
	Other insurance	287 (7.2)		
Types of main payment	UE-BMI	518 (11.9)	270.41	<.001
	UR-BMI	232 (5.3)		
	NCMS	1509 (34.8)		
	Commercial medical insurance	3 (0.1)		
	Out-of-pocket spending[*]	2030 (46.8)		
	No money to pay	3 (0.1)		
	Others	46 (1.1)		

Out-of-pocket spending: including self, spouse, children, or grandchildren.
NCMS = the new rural cooperative medical insurance scheme, UE-BMI = urban employee-based basic medical insurance, UR-BMI = the urban residents basic medical insurance.

Chinese, we analyzed various parameters on health insurance program and health expenses from the dataset based on CLHLS in 2014 which collected from all over China.

This survey showed that the total proportion of older adults who participated in 3 main health insurances program (UE-BMI, UR-BMI, or NCMS) is about 91.9%, in which we can say that the coverage of health insurance is universal among elder aged 60 years and more who incurred medical expenses. The proportion of older adults who purchased the 3 main health insurance as their main payment for the medical expenses was about 52% and

still, 46.8% of older adults paid all or part their medical billings by out-of-pocket spending. Surely the health insurances have greatly affected the patterns of paying but there are still plenty of parts in medical expenses which can not be paid by health insurance. As for the specific medical expenses, we found that the median of the medical expenses covered by medical insurance was 500Yuan, which was higher than the mean of households paying. We may say that health insurance has relived the budget of health expenses on older adults and their families.

4.1. Influence of basic personal information on medical expenses

Our research has extended the existing studies by analyzing the single factor of health insurance using Kruskal–Wallis test. The study showed that health care costs were different between gender and old women could cost significantly higher than the old men. Previous studies have shown that women live longer than men and have poorer health when getting older,[24] which may lead to higher medical expenses for women. The medical expense for those who received compulsory education was also higher.

Description of the income of family and medical expenses of older Chinese.

Variables	Median (RMB, Yuan)	P25 (RMB, Yuan)	P75 (RMB, Yuan)
Total medical expenses	1500	400	5500
Households paying	200	0	2000
Medical insurance paying	500	0	3000

(N = 4376).

Table 3

Regression analysis coefficient of the total medical expenses of the older adults over the past year.

	Variables	Model 1	Model 2	Model 3	Model 4
	Intercept	6.752‡	8.033‡	8.419‡	8.299‡
Basic personal information	Age	−0.022	−0.029	−0.051	−0.049
	Gender	0.184†	0.154†	0.171†	0.187†
	Residence	0.288‡	0.226‡	0.128*	0.116*
	Marriage	0.290‡	0.298‡	0.292‡	0.278‡
	Education (1~6)	0.127	0.130*	0.140*	0.134*
	Education (>6)	0.051	0.088	0.059	0.025
	Pension	0.840‡	0.598‡	0.392‡	0.254*
	Medical Service		0.068	0.080	0.040
	Income		0.00003‡	0.00003‡	0.00003‡
	Self-rated Economic Status		−0.013	−0.028	−0.027
	Self-rated Health		−0.467‡	−0.473‡	−0.472‡
Types of insurance	UE-BMI			−0.060	−0.215
	UR-BMI			0.294*	0.173
	NCMS			−0.336‡	−0.279†
	Commercial insurance			0.171	0.213
	Others			0.100	0.046
Types of main payment	UE-BMI				0.566‡
	UR-BMI				0.582‡
	NCMS				0.237‡
	Commercial insurance				0.345
	No money to pay				−1.645
	Others				1.084‡

* $P < .05$.
† $P < .01$.
‡ $P < .001$.

NCMS = the new rural cooperative medical insurance scheme, UE-BMI = urban employee-based basic medical insurance, UR-BMI = the urban residents basic medical insurance.

One possible reason is that the awareness of health care demands of older adults with compulsory education is stronger. Therefore, this group was more willing to pay more medical expenses to obtain better health service utilization.[25] Family economic status also affected the medical expenses of older adults. De Nardi reported that medical expenses that quickly increase with permanent income and low economic status might lead to poor health.[26] To obtain a good health status, a good economic status exerts a lower pressure on medical expenses.[27] By analyzing the factor of health status, we found that older adults who had inferior health status often paid higher medical costs. Martin reported that the change in the health status of the whole population affected health care costs.[28] However, older adults are a special group and require more medical expenses to improve their health compared to young people[29]; therefore, health status affects their medical expenses.

Using this dataset derived from a large sample of old persons in China, we found that if only social demographic factors were included into the regression models, gender, residence, marriage, and pension would influence the medical expenses. This means that without the influence of other factors, these 4 factors would be the main cost deciding factors. The cost of health care for older people who live in urban areas or who have marital status is higher. We used pension as a reflection on previous work status for older adults. An interesting finding is that pension showed a great influence on the medical expenses of older adults. One reason may be that older adults with pension have more financial freedom. After we introduced other variables, we found the influence of gender, residence, marriage, compulsory education, and pension on the medical cost of people of old age was still statistically significant.

Unexpectedly, age did not affect the cost of health care for older adults, which is inconsistent with previous studies. For example, Garfinkel suggested that age impacts the medical expenses of older adults[30] and Roudsari suggested that with increasing age, old people easily got hurt by slipping, tripping, or stumbling, which led to substantial hospitalization cost.[31] However, these authors mainly focused on young people, and no specialized research exists for age affecting medical expenses in older adults.

4.2. Influence of different types of medical insurance on medical expenses

We also built 4 different multivariate regression models to examine the influence of health insurance types and payments. According to these models, different medical insurance programs pose different impacts on medical costs. Participating in the NCMS for older adults had a larger impact on the medical expenses than UE-BMI, UR-BMI, commercial medical insurance, and other medical insurance. Therefore, the participation of NCMS is helpful to reduce the pressure of medical costs. Jing considered that compared to those who had new rural cooperative medical insurance, the families that did not participate would be more likely to impoverish if they contracted a disease.[32] Although the health insurance coverage of the older Chinese has reached a high level, there is also a strong increase in the demand for health care. Therefore, compared to the general population, it is necessary to further expand the coverage ratio of the NCMS for older adults.

The medical security system in China is a multi-level health security system. Except for basic medical insurance (including

NCMS, UE-BMI, and UR-BMI), other types of medical insurance contain maternity insurance, industrial injury insurance, civil servants allowance, free medical services, and health benefits.[33] In our study, a group of old people can also claim some other forms of insurance such as free medical services. Jia reported the aim of supplementary medical insurance was to supply health insurance to the people, and the types of these supplementary medical insurances are increasing, which can help older adults to partially pay their medical expenses.[34] Therefore, to encourage and expand these institutions for helping old people in China seems particularly important.

However, we also found that in urban areas whether older adults participate in the UE-BMI and the UR-BMI does not affect their medical fees. This means that since the implementation of the Chinese medical insurance system, the UE-BMI and the UR-BMI exert an important influence on medical expenses of the entire population[35]; however, the basic medical insurance may not play a role in alleviating the medical expenses of older adults in urban areas. But the significance of older adults in urban who participate in NCMS is unexpected. We may think the migration from rural areas to urban areas and urbanization drive this significance together, and older adults hold the same medical insurance during transformation. In consequence, both UE-BMI and UR-BMI did not work for older adults in urban areas. This indicates that it is necessary to increase the participation rate of urban medical insurance for older adults. In general, implementation of the basic medical insurance for older adults in urban areas could not meet the insurance demand of older adults.

4.3. Influence of insurances as main payment on medical expenses

After analyzing the influence of insurances as main payment on the medical expenses of older Chinese in 2011, our analysis found that the UE-BMI, UR-BMI, and NCMS as main payment methods were obviously effective in relieving the medical expenses of older Chinese compared with out-of-pocket spending. However, all 3 main medical insurances as payments increased their medical expenses and NCMS shows a low ratio. The potential reason could be the vast majority of old people participated in the NCMS. The role of this medical insurance is more obvious; therefore, if we improve the coverage rate and reimbursement ratio of the NCMS, this could be helpful to ease the medical costs of rural older adults. Simultaneously, the commercial medical insurance is obtained by people who have a good economic situation and this insurance can pay for a large proportion of the medical expenses to ease the cost of required medical care.[36] But the commercial medical insurance develops slowly as supplementary medical insurance in China, it affects the medical expenses of older adults with no significance. Therefore, we should realize the necessity to strengthen the development of commercial medical insurance, which could alleviate the shortage of the medical insurance system for the demand of older adults.

However, some limitations are notable. First, the data we used may be subject to measurement errors, because it was based on the respondents' self-reported information. Second, the data in CLHLS is lacking specific details for different diseases in the outpatient and inpatient cost for older adults, thus we could not analyze the impact of medical insurances on the outpatient and inpatient cost for specific diseases. Finally, our study only used cross-sectional data for analysis, which is difficult to infer the causal effect of medical insurance on medical expenses.

5. Conclusion

In conclusion, the influence of different types of medical insurances as main payments on the medical expenses of the older adults is varied. Implementation should be taken to relieve the medical expenses of older adults. Firstly, the enrollment of medical insurance for older adults can be strengthened, such as to lower threshold participation of the UR-BMI to expand their coverage into urban areas. Furthermore, it is particularly urgent to improve the reimbursement ratio of the NCMS for older adults in rural areas. Simultaneously, insurance plans should be improved by expanding the benefit package to build a more efficient health system. We also found that expanding social assistance institutions, private association and pension institutions seems particularly important to help old people in China.

Author contributions

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