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EFFECTS OF PENSIONS ON THE HEALTH INEQUALITY OF ELDERLY PEOPLE IN CHINA

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Abstract. This study aimed to investigate the overall and unequal effects of pensions on the health inequality of elderly people based on data from the China Family Panel Studies (CFPS). The findings revealed that participation in the pension system improved the health level and reduced health inequality of elderly people. The heterogeneity analysis indicated that the reduction in elderly health inequality was much smaller in the high-income families compared with the low-income families after participation in the pension system. Also, health inequality was alleviated to a higher extent in the elderly group than in the nonelderly and mixed groups. The reduction in health inequality caused by participation in the pension system was lower in rural areas than in urban areas. The mechanistic studies indicated that participation in the pension system affected health inequality in two ways: changing the level of financial assistance provided by children and changing the health budget of elderly people. The findings of this study might help understand the role of China's pension system, inspiring developing countries to design policies to cope with population aging and improve the problem of unequal elderly healthcare.

1. Introduction

China has the fastest population aging rate in the world, and hence the number of elderly care problems caused by population aging continue to increase every day. China has built the world's largest pension system after years of development. The pension system in China is the "pay as you go" system. In China's "three-pillar" pension system, the three-pillar system implemented is the joint responsibility of the government, units, and individuals. Retirement benefits can be divided into different levels based on variations in payment amounts, regions, and occupations. The living standards of elderly people are still relatively low,and the problem of welfare inequality remains serious under the existing pension system. Besides the direct effect of the pension system on the economic status of elderly people, its impact on health inequality among these people also needs further exploration.

Many scholars in various countries have realized the effects of pensions on the health of elderly people. Lloyd-Sherlock et al. found that Brazil's pension system increased people's self-assessment of health levels and life satisfaction [9]. Galiani et al. discovered that the pension system improved the mental health of elderly people [3]. The pension system impacts health by increasing food consumption and dietary structure [11], increasing medical affordability [10], improving the living

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environment and enhancing health awareness [4], and improving mental health status [1]. In addition, scholars focus not only on how pensions improve health on an average level but also on the subsequent health inequality. Hessel et al. found that increasing pension coverage reduced health inequality [5]. Huang and Wu found that the new rural social insurance alleviated unequal health opportunities in the short term [6]. Many published studies treat only macro inequality measurement indicators as dependent variables, using cross-national and cross-provincial macro panel data for empirical analysis; they cannot measure micro-level impacts to some extent.

This study comprehensively examined the impact of pensions on health inequality among elderly people, using household-level panel data from the China Family Panel Studies (CFPS) from 2014, 2016, and 2018. This study contributed to existing data in the following ways. First, the overall and unequal effects of pensions on elderly health were comprehensively and systematically examined using a large survey database in China. Second, the inequality index at the individual level of elderly people was calculated using the relative deprivation index, thus enriching the findings on inequality at the micro level. Third, an analysis was conducted on the heterogeneity and mechanism of the impact of pensions on elderly health inequality, which helped evaluate the effectiveness of implementing China's pension insurance policies and provided a reference for social security in other developing countries.

2. Theoretical analysis

Health is an important foundation for improving the living standards of elderly people. Several factors affect health, including an individual's lifestyle, macroeconomic factors, environmental factors, and individual economic characteristics. Pensions are an important component of elderly income, significantly reducing poverty, improving physical fitness, and enhancing the subjective well-being of elderly people. Based on this, we proposed the first hypothesis.

Hypothesis 1: Pensions can improve the health level of elderly people.

The pension system is important in promoting the equality of elderly people. Differences exist in the social capital possessed by low-income and high-income groups. Besides the most obvious income gap, significant differences between groups are found in cognition, learning ability, judgment, and preferences. The health of low-income groups often deteriorates faster due to the primitive health endowments and the lack of necessary social resources. The advantaged groups pay more attention to safety and a more scientifically sound lifestyle, thus maximizing the avoidance of health risks. However, the disadvantaged groups do not have corresponding cognitive abilities and economic conditions, resulting in a gradually widening health gap. Pensions can bridge the income gap and narrow the level of health inequality. Based on this, we proposed the second hypothesis.

Hypothesis 2: Pensions can reduce the level of health inequality.

The impact of pensions on health disparities may be due to the differences in household income, population structure, and urban–rural differences. The increase in household income level has a positive effect on people's health [12]. Its impact gradually weakens with an increase in income. From the perspective of family

population structure, the loss of health capital intensifies with an increase in age, making the physical health of elderly people more prone to deterioration than when they were young. Elderly people have a greater investment in health than any other age group, and their income level directly affects their healthcare investment [3]. Therefore, pensions have different impacts on households with varying population structures. The pension gap between urban and rural residents is still significant in China. The impact of pension systems on the health of elderly people varies in different regions or under various economic conditions. On this basis, we proposed the third hypothesis.

Hypothesis 3: Heterogeneity exists in the impact of pensions on elderly health inequality.

Besides pensions, intergenerational transfer is an important wealth source for elderly people in China's social security system. Pensions may change the degree of economic assistance provided by children to their elderly parents, thereby affecting health inequality. Besides, health is also a consumable. The level of elderly health is closely related to the elderly health budget, including medical expenses, health products or services, and so on. Pensions provide elderly people with stronger economic independence, thereby increasing their consumption and maintaining health. Based on this, we proposed a fourth hypothesis.

Hypothesis 4: Pensions affect health inequality through two mechanisms: economic assistance and health budgets.

3. Data and empirical strategies

3.1. **Data.** This study used China's CFPS database, including information from three levels: community, family, and individual. Especially, the databases for children and adults included a wide range of health-related issues, providing comprehensive and detailed support for this study. This study used panel data from 2014, 2016, and 2018 at the household level, comprising a total of 19287 samples.

3.2. **Variable selection.** When the explained variable was health level, we used the commonly used comprehensive health evaluation in the literature of self-assessment health as a proxy variable for elderly health level. The question was "What do you rate your health status?," and the responses were "excellent, very good, good, fair, and poor." We also conducted a robustness test using the health status of the interviewees observed by the interviewer. This study selected indicators, such as exercise frequency, alcohol, smoking, lunch break, sleep time, happiness, and memory, to develop a new health index through principal component analysis, and calculated the health inequality index based on that.

When the explained variable was the level of health inequality,we used the Kakwani index as an indicator to measure it [7]. Relative deprivation represents individual-level inequality and compensates for issues such as the nondecomposability and nonadditivity of group inequality measurement indicators. Kakwani's individual relative deprivation index was constructed by arranging the samples in ascending order to establish the reference frame of overall health distribution. The relative deprivation index of each sample was obtained after comparing each sample

with other samples, using the following formula:

$$RD(x_j, x_i) = \begin{cases} x_j - x_i & \text{if } x_j > x_i \\ 0 & \text{if } x_j \leq x_i \end{cases} \tag{3.1}$$

Among these, the relative deprivation of individual j to individual i is $RD(x_j, x_i)$, and the average relative deprivation of individual i can be defined as:

$$RD(x_i) = \frac{1}{n\mu_X} \sum_{j=1}^{n} RD(x_j - x_i) = \frac{1}{n\mu_X} \left(\sum_{x_j > x_i, x_j \in X} x_j - \sum_{x_j > x_i, x_j \in X} x_i \right) \tag{3.2}$$

After further decomposition, it can be expressed as:

$$RD(x_i) = \frac{1}{n\mu_X}(n^+_{x_i} \times \mu^+_{x_i} - n^+_{x_i} \times x_i) = \frac{1}{\mu_X}\gamma^+_{x_i}(\mu^+_{x_i} - x_i) \tag{3.3}$$

where μ_X is the average health of all individuals in the sample, $\mu^+_{x_i}$ is the average health of samples X with health levels exceeding x_i, and $\gamma^+_{x_i}$ is the percentage of individuals with health exceeding x_i in the total sample. The relative deprivation function $RD(x_i)$ is a strictly decreasing function related to health, with a range of values of [0,1].

The core explanatory variable is the situation of receiving a pension. We set this variable as a dummy variable. We set a value of 1 to individuals participating in a social pension and assigned a value of 0 to those not participating in any social pension.

The control variables used in this study were the relative deprivation index of income and consumption (measured using the Kakwani index), behavioral variables (exercise frequency, smoking, mobile internet use, and alcohol abuse), family variables (income, number of children, number of young people, number of middle-aged people, and number of elderly people), and demographic variables (education level, age, and college number).

TABLE 1. Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
health	19287	1.43	0.36	1	5
cons_Kakwani	19287	0.77	0.64	0	1
income_Kakwani	19287	0.44	0.24	0	1
exercise frequency	19287	2.56	0.56	1	5
alcohol	19287	0.33	0.13	0	1
smoking	19287	0.64	0.34	0	1
mobile internet use	19287	0.43	0.87	0	1
age0-16	19287	0.6	0.9	0	9
age17-44	19287	1.4	1.1	0	13
age45-64	19287	1.1	0.9	0	6
age65+	19287	0.5	0.7	0	4
household_age	19287	52	13.2	14	95
college_member	19287	0.3	0.7	0	8
household_education	19287	6.7	4.7	0	19

3.3. **Descriptive statistics.** Table 1 presents the descriptive statistics results. The proportion of health self-assessment reports in the sample as "unhealthy" and "very healthy" was 17.84% and 10.65%, respectively; the proportion of people with moderate health status was the highest. The proportion of people who consumed alcohol and smoked was relatively large in the total sample (33% and 64%, respectively), indicating that a majority of people had bad health habits. Most people exercised. The proportion of young and middle-aged people in the family was relatively high. The average number of children was 0.60, indicating a relatively small child population. The educational status of families was still at a relatively low level.

3.4. **Empirical model.** This study adopted ordered logistic regression to examine the impact of pensions on the health level of elderly people. The specific model settings were as follows:

$$\begin{aligned} logit(health_{it}) &= ln\left(\frac{health_{it}}{1-health_{it}}\right) \\ &= \alpha + \beta_1 Pension_{it} + \lambda X_{it} + \delta Z_{jt} + \eta_i + \mu_t + \varepsilon_{it} \end{aligned} \tag{3.4}$$

where *health* represents health evaluation; Pension represents the status of receiving a pension; and X is a series of control variables. The estimated coefficients of the core explanatory variable in the model for pension β represented the logarithmic advantage ratio. Further calculation of $\exp(\beta)$ was needed to obtain the impact of participation in the pension system on the proportion of health improvement. This study controlled for both province and time fixed effects. Further, η is a province dummy variable, μ is a time dummy variable, and ε is a random disturbance term. The standard errors were clustered at the county level.

This study used a two-way fixed-effects model to examine the impact of pensions on health inequality. The specific model settings were as follows:

$$Health\_equality_{it} = \alpha + \beta_1 Pension_{it} + \lambda X_{it} + \delta Z_{jt} + \eta_i + \mu_t + \varepsilon_{it} \tag{3.5}$$

where $Health\_equality$ represents the indicator of health inequality.

4. Empirical results

4.1. **Impact of pensions on the health of elderly people.** The estimated results are detailed in Table 2. Columns (1)-(6) present the self-assessment health variables as the dependent variable. We examined the robustness of the results by gradually adding control variables and fixed effects. As control variables were continuously added, the coefficients of all core explanatory variables remained significant, indicating the robustness of the conclusion. Column (7) presents the health status of the interviewees, as observed by the interviewer, as the dependent variable to test robustness. The estimated results showed that participation in the pension system improved the health levels of elderly people. The increased income provided necessary resources for improving health, such as better nutrition, higher hygiene levels, and access to clean water and healthcare services, thereby enhancing the health of elderly people.

TABLE 2. Impact of pensions on the health of elderly people

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
pension	0.034**	0.036***	0.039***	0.044***	0.063***	0.078***	0.062***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)	(0.007)	(0.006)
income		0.590***	0.596***	0.516***	0.509***	0.610***	0.610***
		(0.085)	(0.087)	(0.056)	(0.054)	(0.051)	(0.052)
exercise frequency			0.615***	0.711***	0.756***	0.789***	0.891***
			(0.054)	(0.065)	(0.078)	(0.080)	(0.092)
alcohol			-0.141**	-0.142***	-0.157***	-0.174***	-0.187***
			(0.013)	(0.013)	(0.014)	(0.016)	(0.018)
smoking			-0.071**	-0.075**	-0.078**	-0.079**	-0.080**
			(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
mobile internet use			0.043	0.043	0.046	0.048	0.049
			(0.035)	(0.038)	(0.055)	(0.057)	(0.067)
age0-16					0.014	0.014	0.016
					(0.013)	(0.014)	(0.014)
age17-44					0.043	0.046	0.046
					(0.032)	(0.043)	(0.044)
age45-64					0.146	0.148	0.158
					(0.123)	(0.143)	(0.136)
age65+					0.321	0.341	0.355
					(0.587)	(0.556)	(0.556)
household_age					0.059	0.075	0.075
					(0.057)	(0.085)	(0.087)
college_member					0.015	0.012	0.022
					(0.012)	(0.023)	(0.034)
household_education					0.032***	0.047***	0.048***
					(0.003)	(0.005)	(0.005)
Time fixed effects	No	No	No	No	No	Yes	Yes
Province fixed effects	No	No	No	No	No	Yes	Yes
Observation	19287	19287	19287	19287	19287	19287	19287

Note: (1) The values in parentheses represent the robust standard error of heteroscedasticity for estimating coefficients;(2) *, * *, and * * * represent statistical significance levels of 10%,5%, and 1%, respectively.

4.2. **Impact of pensions on health inequality among elderly people.** The estimated results are detailed in Table 3. Columns (1)-(6) show the impact of participation in the pension system on health inequality. We progressively integrated fixed effects and control variables to determine the robustness of our findings. The regression results indicated that pensions reduced the degree of health inequality among elderly people. Specifically, participation in the pension system resulted in a significant 0.059 unit decrease in health inequality. The impact of controlling variables on health inequality was also consistent with the conclusions of previous studies.

4.3. **Heterogeneity.** This study further explored the differences in the impact of participation in the pension system on elderly health inequality among different characteristic groups based on household income, household population structure, and urban-rural grouping.

TABLE 3. The impact of pension on health inequality among the elderly

	(1)	(2)	(3)	(4)	(5)	(6)
pension	-0.024**	-0.029***	-0.031***	-0.032***	-0.057***	-0.059***
	(0.005)	(0.343)	(0.528)	(0.419)	(0.157)	(0.059)
income_Kakwani		0.153***	0.243***	0.256***	0.258***	0.334***
		(0.051)	(0.056)	(0.059)	(0.060)	(0.065)
cons_Kakwani		0.290***	0.296***	0.316***	0.309***	0.410***
		(0.043)	(0.044)	(0.048)	(0.048)	(0.049)
exercise frequency			0.689***	0.791***	0.726***	0.812***
			(0.066)	(0.087)	(0.076)	(0.086)
alcohol			0.122	0.122	0.127	0.137
			(0.216)	(0.216)	(0.227)	(0.128)
smoking			0.071**	0.072**	0.072**	0.072**
			(0.035)	(0.036)	(0.036)	(0.036)
mobile internet use			0.022	0.022	0.026	0.028
			(0.021)	(0.022)	(0.029)	(0.026)
age0-16				0.055***	0.055***	0.056***
				(0.005)	(0.006)	(0.005)
age17-44				0.005***	0.005***	0.006***
				(0.001)	(0.001)	(0.002)
age45-64				0.056	0.056	0.069
				(0.056)	(0.056)	(0.066)
age65+				0.056	0.057	0.058
				(0.065)	(0.087)	(0.056)
household_age					0.059	0.075
					(0.057)	(0.067)
college_member					0.055	0.025
					(0.054)	(0.033)
household_education					0.057***	0.067***
					(0.004)	(0.005)
Time fixed effects	No	No	No	No	No	Yes
Province fixed effects	No	No	No	No	No	Yes
Observation	19287	19287	19287	19287	19287	19287

Note: Same as Table 2.

4.3.1. *Heterogeneity analysis of households with different incomes.* Table 4 reports the subsample estimation results for households with different incomes. The regression results indicated that participation in the pension system might reduce elderly health inequality by 0.076 units for households with income below the sample average. The decrease was 0.016 units for households with income greater than or equal to the sample average, which was much smaller than the decrease observed in households with income below the sample average. The marginal effect of pensions may be relatively small for high-income elderly groups. The low-income groups receive more from pension benefits. Households with lower income levels often have poorer economic conditions, and participation in the pension system may significantly improve their income levels, thus significantly impacting health inequality.

4.3.2. *Heterogeneity analysis of different household population structures.* We divided the sample into three types of family life cycles: mixed group (including

TABLE 4. Heterogeneity analysis of households with different incomes

	Household income below average		Household income greater than or equal to the average	
	(1)	(2)	(3)	(4)
Pension	-0.071***	-0.076***	-0.015***	-0.016***
	(0.005)	(0.005)	(0.002)	(0.002)
Control Variable	No	Yes	No	Yes
Time fixed effects	No	Yes	No	Yes
Province fixed effects	No	Yes	No	Yes
Observation	9872	9872	9415	9415

Note: Same as Table 2.

adults, young people, children, and elderly people), elderly group (only elderly people aged more than 60 years among family members), and nonelderly group (only adults aged less than 60 years, young people, and children among family members).

Table 5 reports the subsample estimation results for the nonelderly, elderly, and mixed groups. Participation in the pension system reduced elderly health inequality by 0.061 units in the elderly group. Participation in the pension system reduced elderly health inequality by 0.043 units in the nonelderly group. Participating in the pension system reduced elderly health inequality by 0.027 units in the mixed group. Participation in the pension system could alleviate health inequality to a greater extent among elderly people compared with the nonelderly and mixed groups. Ederly people have stronger health needs, such as medical treatment, medication, and care, compared with young individuals. Maintaining elderly health requires financial support, and hence, the health needs of elderly people can be better met by increasing pension payments.

TABLE 5. Heterogeneity analysis of differen households population structure

	Elderly group		Non elderly group		Mixed group	
	(1)	(2)	(3)	(4)	(5)	(6)
Pension	-0.051***	-0.061***	-0.042***	-0.043***	-0.026***	-0.027***
	(0.003)	(0.004)	(0.008)	(0.008)	(0.002)	(0.002)
Control Variable	No	Yes	No	Yes	No	Yes
Time fixed effects	No	Yes	No	Yes	No	Yes
Province fixed effects	No	Yes	No	Yes	No	Yes
Observation	6102	6102	5283	5283	7872	7872

Note: Same as Table 2.

4.3.3. *Heterogeneity analysis between urban and rural areas.* As shown in Table 6, participation in the pension system reduced elderly health inequality by 0.082 units in urban areas. The decrease was 0.033 units in rural areas, which was much smaller than the sample value in urban areas. The medical services in urban areas are more advanced than those in rural areas, and urban populations enjoy more health resources [13]. Differences exist between urban and rural residents in their accessibility to health resources, making health choices, and avoiding health risks. Therefore, the health gap among elderly people in urban areas may narrow even more with pension support.

TABLE 6. Heterogeneity analysis between urban and rural areas

	Urban		Rural	
	(1)	(2)	(3)	(4)
Pension	-0.050**	-0.082***	-0.031***	-0.033***
	(0.003)	(0.006)	(0.002)	(0.002)
Control Variable	No	Yes	No	Yes
Time fixed effects	No	Yes	No	Yes
Province fixed effects	No	Yes	No	Yes
Observation	9809	9809	9478	9478

Note: Same as Table 2.

5. MECHANISTIC TESTS

5.1. **Economic assistance provided by children.** The first possible mechanism by which pensions affect health inequality is the amount of economic assistance provided by children. Under the influence of "exchange motivation", children may provide some economic assistance to elderly people to balance the cost of intergenerational care. The additional income further addresses the retirement needs of elderly people. Besides, an increase in budget may also prompt elderly people to raise higher standards and demands for health. Cheng et al. found that, after receiving retirement benefits, rural elderly people who participated in the pension system received increased financial support from their children [1]. Elderly people with lower health levels are more likely to hire caregivers to take care of them after participation in the pension system. They may purchase more healthcare resources, thus encouraging their children to provide more financial support. We tested this mechanism using the variable "amount of economic support (yuan) received" in the survey questionnaire.

Column (1) and (2) in Table 7 report the impact of pension system participation on the economic assistance provided by children. The results showed that participation in the pension system increased the economic assistance provided by children to elderly people. This indicated that participation in the pension system might affect health inequality by increasing the level of financial assistance from children. After receiving transfer payments, elderly people may increase their medical affordability,incentivizing them to use diagnosis and treatment programs and nonfree drugs [8], further unleashing their medical service needs, enhancing their health awareness, and reducing the health gap among elderly people.

5.2. **Health budget.** The health budget is the second possible mechanism by which pensions affect health inequality. Pensions are a stable and considerable income obtained by elderly people. The increased income directly affects their economic budget and increases their purchasing power for healthcare. At the same time, the increased demand for retirement brought about by retirement benefits also increases their motivation to choose a higher quality of life, which is reflected in their investment in healthcare, such as increasing the purchase of healthcare products, use of medical services, and continuous improvement in living environments. Cheng et al. found that increased nutrient intake, better access to medical services, more use of medical care, more participation in leisure activities, and improved financial

status all promoted health levels [1]. We selected the variable "Health expenditure" (e.g., bodybuilding, physical exercise, and health-related apparatus and products) from the survey questionnaire. We then calculated the ratio of health expenditure to total expenditure to represent the health budget.

Columns (3) and (4) in Table 7 report the impact of pension system participation on the healthcare expenditure of elderly people. The results showed that participating in the pension system might increase the healthcare expenditure of elderly people.An increase in income can improve the living environment [4], increase health awareness, enable elderly people to pursue better ecological and medical resources [2], and reduce the health gap among elderly people.

TABLE 7. Impact of economic assistance from children and health budget

	Children's economic assistance		Health budget ratio	
	(1)	(2)	(3)	(4)
Pension	0.056***	0.057***	0.029***	0.034***
	(0.005)	(0.005)	(0.005)	(0.004)
Control Variable	No	Yes	No	Yes
Time fixed effects	No	Yes	No	Yes
Province fixed effects	No	Yes	No	Yes
Observation	16542	16542	13531	13531

Note: Same as Table 2.

6. Conclusions

The conclusions of this study have remarkable policy implications. Pensions not only affect the welfare level of elderly people but also play a significant role in the inequality of elderly welfare. One of the key goals of China's pension system is to comprehensively improve the quality of elderly care and promote the equalization of elderly care quality. Ensuring the physical health of elderly people can reduce medical expenses, alleviate the burden on the healthcare system, and decrease government financial pressure. The improvement in the health level of elderly people can reduce their probability of withdrawing from the labor force and also facilitate intergenerational economic support. Paying attention to the health of elderly people is of great significance for developing the economy and society, improving elderly welfare, and addressing the challenges of population aging. Every state and every family has an obligation to ensure the health status of elderly people, reduce the health gap among them, and enable them to share the outcomes of economic development.

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