

The Impact of Informal Care on Elderly People's Physical Health Outcomes

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Abstract—The empirical study of informal care on care receivers' physical health has not been gained comprehensive attention. We aim to investigate the effects of informal care on the physical health of elderly people in China. We pure the potential endogeneity of informal care time by introducing the distance from the care receiver's to their child's whose is closest to where his elderly parents live, and the communication frequency between receivers and their children as instrument variables. The probability for blood urea nitrogen at higher risk level can be reduced 0.6%. For creatinine, elder people's probability at higher risk level can be decreased 0.2%. The cystatin C at higher risk level can be reduced 0.4%. The results show that the informal care can improve the elderly people's physical health by driving their blood biomarkers into lower risk level.

Keywords—*informal care; health; instrumental variables; CHARLS*

I. INTRODUCTION

The world is facing an increasing aging population, and the elderly people's well-being has been of great importance both to their individuals and societies. However, with age, it is inevitable for the elderly to be ill with some physiological changes. For instance, elderly people have lower body weight, less body cell mass, less body fat, and less total body water [1]. And elderly people are more likely to fall, unintentional weight loss and pain compared to the youth or mid-aged people.

Caring for elderly people has been part of aging healthily. Traditionally, Chinese elderly people are cared by their families in the form of informal care. Studies show that informal care in China will be greatly needed and will be increasing significantly[2]. However, the social foundation of informal care in China have been weakened as a result of Chinese economic reforms [3]. The one-child policy lead to a smaller family which shrunk the potential caregivers' amount. This will affect family's capacity and willingness to provide care to the older people. At the same time, older people in China are still quite poor, which makes them be hard to get access to health care resource. Also, they are challenged with chronic diseases including hypertension, higher disability rate and over-nutrition accompanied with low rates of treatment and control for chronic disease and a large degree of under-diagnosis of hypertension [4,5,6]. Besides, health care is tight and in the near future, this status will be more intensified because of the accumulated huge ageing population.

Informal care is an important way to keep health for elderly people. Naturally, older people's health would be improved

with informal care as input. However, the related empirical literatures are rare, especially for physical health outcome. This paper will estimate the effect of informal care on elder people's health. We use three blood biomarkers: blood urea nitrogen, cystatin C, creatinine. The strength of using biomarker data in the empirical studies is free of biased health indicator results. Biomarker data is widely used in empirical studies. We overcome the potential endogeneity of informal care by introducing instrumental variable. Our results are helpful to better understand the impact of informal care on health and design the targeted care strategies.

II. DATA AND METHOD

In this paper we use CHARLS, a nationally representative of people ages 45 and older in Chinese population[7]. For our research, we select individual who ages 60 and older. We exclude the individuals who lack of informal care information and related blood biomarker. We have 839 respondents for blood urea nitrogen estimation, 634 for cystatin C estimation and 714 for creatinine estimation.

Here we aim to estimate the effects of informal care on the following three blood biomarkers: blood urea nitrogen, creatinine, cystatin C. The three blood biomarkers used in our research provide full profile of kidney risk. According to CHARLS blood data users' guide[8], if the blood urea nitrogen > 20 mg/dL, creatinine > 1.4 mg/dL, cystatin C > 1.44 mg/L, the related blood biomarkers are considered as high risk levels. The related blood biomarkers would be coded as 1 if it's at high risk level, otherwise it would be set as 0.

The explanatory variable is informal care hours per week. This comes from following questions: during the last month, how many days did the helper help you and during the days the helper helps you, how many hours per day? The care issues here are mainly about dressing, bathing, eating, getting out of bed, using the toilet, controlling urination and defecation, doing chores, preparing hot meals, shopping, and managing money, making phone calls and taking medications. The respondent should have up to 3 persons who help him/her. In this paper, informal care hours are measured by per week instead of per month. If the respondent says he/she does not get any help from others, we consider his/her informal care hours per week as 0.

Other explanatory control variables include: age, registered permanent residence (RPR), gender, marital status, physical functioning (instrumental activity of daily living, IADL), annual household income and housing characteristics. RPR represents

where the respondent lives in (rural area or urban area). RPR could not be changed until the respondent completes a series of official transfer procedures. Here we consider the respondent's current RPR status namely now his/her living place is in either the rural or the urban. There are 6 marital options for the respondent to select from. The 6 options are: separated, divorced, widowed, never married, cohabit and married. We consider "separated", "divorced", "widowed" and "never married" as "unmarried". We categorize "cohabit" into "married". For education levels, we attribute the respondent who did not complete primary school to illiteracy. The old-style private school is assigned as primary school.

We summarize the annual household income from 6 parts: (1) wage and salary income, (2) individual transfer income, (3) agricultural income, (4) self-employment income, (5) government transfer income and (6) capital income.

Instrumental activity of daily living (IADL) is measured as whether the respondent has difficulties for completing various activities because of health or physical problem. The activities contain: (1) doing household chore, (2) preparing hot meals, (3) shopping, (4) making telephone calls and (5) taking medications. There are 4 options for the respondent to evaluate each of the above items: (1) no, I don't have any difficulties, (2) I have difficulties but can still do it, (3) yes, I have difficulties and need help; (4) I cannot do it. We measure the (1) option with 0, others are measured as 1. The IADL is a summary of the above 5 items. We also add disability status in our control variables. For this, the interests focus on whether the respondents have (1) physical disabilities, (2) brain damage/mental retardation, (3) vision problem, (4) hearing problem and (5) speech impediment. If the respondent has any of the above items, this variable will be coded as 1, otherwise it will be set as 0.

We consider the housing characteristics from the following aspects: (1) housing age range, (2) toilet types, (3) whether the house can use the electricity and (4) whether the respondent can use the running water. Housing age range has 6 levels: (1) 0-5 years, (2) 5-10 years, (3) 10-20 years, (4) 20-30 years, (5) 30-40 years and (6) more than 40 years. Running water item has two levels: (1) yes and (2) no.

To estimate the causal relationship between informal care (IC) and physical health (PH), we use an IV-Probit model. We specify the probit model as following:

$$PH_i^* = \beta_0 + \beta_1 \times IC_i + \beta_2 \times X_i + \varepsilon_i \quad (1)$$

Where IC_i is informal care hours per week, β_1 is our research interest, it measures how informal care hour can affect the probability of blood biomarker into higher risk level.

We may get biased estimation results if we estimate equation (2) directly due to the potential endogeneity. First, the reverse causality that respondent at worse health status may consume more informal care hours may exist. Individuals diagnosed with chronic diseases or have more disability items are more likely to consume more informal care. Second, unobservable variables associated with informal care may exist. For example, the childhood nutrition has great impact on the respondent's body composition and its later life. Also the same as the medication utilization in the respondent's childhood,

youth or mid-aged life. Medication help the respondent attach to rehabilitation and keep in good health status. The possible unobserved factors may also contribute to the potential endogeneity and the biased estimation results.

To overcome the potential endogeneity, we attempt to introduce instrument variables. We introduce two instrument variables. Since exogeneity assumption of the instrument cannot be tested directly, researchers typically confirm the validity of instruments according to the theoretical justifications and statistical tests. The first instrument is having at least one child living within 10 kilometers from the elder people. The theoretical basis for this instrument is that child's caregiving decision is partly determined by the living distance between child and parents and it can only influence the care acceptor's informal care hours but unlikely to influence the elder people's health directly. If the distance between child and their parents is too long, the cost of the providing informal care is higher and child is less likely to provide informal care[9]. The other instrument is seeing a child at least once in a month. We assume that in a certain period of time, the higher frequency of seeing children means that elder people are likely to receive informal care from their children. But the seeing frequency can only influence the informal care hours and cannot influence the care acceptor's health. Although elder people in worse health status are likely to require more informal care and thus see their children more often, we don't consider this point since this instrument passes the overidentification test.

The credibility of IV approach needs to test the validity and relevance of the instruments. We use Sargan test to check the validity of overidentifying restrictions[10,11]. There are no standard methods to conduct the weak instrument test. We test whether the IV estimates suffer from weak instruments through Anderson-Rubin test and F-statistics of first stage. We also test whether informal care is an endogenous variable through Hausman-Wu test. All of our research work are conducted on R language programming platform[12]. The econometric R package used here is "AER"[13]. The bloodweight is used to adjust for people who don't participate in the blood test.

III. RESULTS

Table I provides the descriptive results for the three samples. For our research purpose, nearly 19% people suffer from high risk level for blood urea nitrogen. For cystatin C the related percentage is also very high which exceeds 15%. The percentage for people at high risk level when considering creatinine is much lower, it's only 2.5%. In the three group populations, people are cared similarly with an equal average informal care of 28 hours per week.

The demographic and socioeconomic characteristics are waved in a small range. The IADL is in a range of 2.41 to 2.44. The mean age is 70.42, 70.43 and 71.35, with a maximum span less than 1 years. Female elder people are in a larger percentage. More than 86% of the elder people live in the rural areas. Marital status is similar to RPR status. More than 74% elder people are now married. The education level of illiteracy occupies the majority percentage with a number of 90%, followed by primary school with no more than 8%. Most of their annual household income are less than 15 000 RMB.

TABLE I. DESCRIPTIVE STATISTICS FOR SAMPLES

	Blood urea nitrogen		Creatinine		Cystatin C	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Informal care (hours per week)	27.98	42.16	27.89	42.09	28.03	42.32
IADL	2.41	1.52	2.41	1.52	2.44	1.53
Disability (yes) (%)	426	45.8	425	45.7	384	46.5
Age	70.42	7.42	70.43	7.43	71.35	7.35
Gender (female) (%)	560	60.2	559	60.1	491	59.5
RPR (urban) (%)	123	13.2	122	13.1	111	13.5
Marital status (married) (%)	712	76.5	711	76.5	611	74.1
Illiteracy (%)	841	90.3	840	90.3	744	90.2
Primary school (%)	68	7.3	68	7.3	61	7.4
Middle school (%)	16	1.7	16	1.7	14	1.7
High school and above (%)	6	0.6	6	0.6	6	0.7
≤ 2000 RMB (%)	252	27.1	251	27.0	225	27.3
(2000, 5000] RMB (%)	166	17.8	166	17.8	153	18.5
(5000, 15000] RMB (%)	230	24.7	230	24.7	199	24.1
> 15000 RMB (%)	283	30.4	283	30.4	248	30.1
0-5 years (%)	77	8.3	77	8.3	69	8.4
5-10 years (%)	79	8.5	79	8.5	74	9.0
10-20 years (%)	248	26.6	248	26.7	218	26.4
20-30 years (%)	252	27.1	252	27.1	227	27.5
30-40 years (%)	131	14.1	131	14.1	108	13.1
Above 40 years (%)	144	15.5	143	15.4	129	15.6
Have running water (yes) (%)	449	48.2	448	48.2	401	48.6
At least one child living within 10 km (%)	810	87.0	809	87.0	578	91.2
Seeing a child at least once in a month (%)	773	83.0	772	83.0	546	86.4
Number of individual at higher risk (%)	176	18.9	23	2.5	129	15.6
Number of total observations	931		930		825	

TABLE II. EFFECTS OF INFORMAL CARE ON BLOOD UREA NITROGEN, CREATININE, CYSTATIN C- PROBIT AND IV ESTIMATIONS

Dependent variables	Blood urea nitrogen		Creatinine		Cystatin C	
	Probit	IV	Probit	IV	Probit	IV
Informal care	-0.001** (0.0003)	-0.006** (0.003)	0.0001 (0.0001)	-0.002* (0.001)	-0.0001 (0.0003)	-0.004 (0.002)
First stage for informal care						
Having at least on child living within 10 km		-14.800*** (4.990)		-14.800*** (4.990)		-18.500*** (5.530)
Seeing a child at least once in a month		11.600*** (4.560)		11.600*** (4.560)		13.300*** (4.990)
F-statistics (first stage)		10.500***		10.500***		9.650***
Anderson-Rubin wald test		5.620***		5.600***		6.790***
Hausman-Wu test		5.730**		4.930**		2.780*
Sargan test, p-value		0.479		0.494		0.670
Number of observations	931	931	930	930	825	825

Note: *p < 0.1; **p < 0.05; ***p < 0.01. Standard errors are reported in parentheses.

More concerned issue is elder people’s living conditions. More than half of them live in a house with its age ranges more than 20 years. And more than half of elder people cannot use running water. Considering the IADL, this is a concerning matter.

It seems that child living in a nearest distance are not correlated with the blood biomarker risk status. This is also the same to seeing a child at least once in a month. The two instruments here in the three group populations don’t change too much. Most of the elder people have at least one child and can see one of their children at least once in a month.

The test result checked by Hausman-Wu test are significant at 0.05 level, 0.05 level and 0.1 level accordingly. From the

Hausman-Wu test results, we fail to reject the null of informal care being exogenous in the three IV models. The Hausman-Wu test indicates that probit results are biased and the IV estimations are more reliable, thus we prefer the IV models than probit model. Both the Anderson-Rubin F-statistics and F-statistics for first stage are significant at the 1% significance level and we can reject the null hypothesis that the instruments we used are weak or irrelevant. The p-value of the Sargan test in our IV approach is 0.141, 0.821 and 0.381 respectively. The Sargan test results indicate the null hypothesis that the instruments are valid and cannot be rejected.

Table II shows the estimation results. We can find that the informal care effects are underestimated or biased if the informal care is considered as exogenous. The probit results

confirm our suspects in the method discussion that there exists reverse causality that elder people in higher risk level are more likely to consume informal care and unobservable variables may be associated with informal care. The highest effects of informal care on physical health is blood urea nitrogen. The IV results show that the probability for blood urea nitrogen at higher risk level can be reduced 0.6% at the 5% level once the elder people receive one hour's informal care per week. This estimation is 6 times larger than the probit estimation results. For creatinine, elder people's probability at higher risk level can be decreased 0.2% at the 10% level once they consume one hour informal care in a week. However, we may get the biased estimation that receiving informal care can lead elder people's creatinine into higher risk level probability. The effect of informal care on cystatin C is similar to blood urea nitrogen, but it's not significant. The effect of informal care on cystatin C is similar to blood urea nitrogen, but it's a little smaller and not significant. The IV estimations for cystatin C is 0.4% which means that the cystatin C at higher risk level can be reduced 0.4% when elder people receive one informal care hour per week. We get 40 times larger effects compared with the probit estimation results.

IV. DISCUSSION

We estimate the effect of informal care on the elder people's physical health by using IV after adjusting for the potential endogeneity between the informal care and physical health outcomes. We find that receiving informal care can reduce the probability of elder people's physical health at higher risk level.

One contribution of our research results is that it may be an explanation for the positive effects of informal care on health medical care resource. Many existing literature show that informal care can substitute formal care or reduce the medical care utilization[14,15]. Our results may help illustrate the mechanism. Elder people receiving informal care use less health medical care is because receiving informal care can help elder people stay in good health. Although elder people's health status may become worse because of ageing and body composition variations, we can help them stay in good health status by providing informal care to them.

Our results may have some policy indications. As China are ageing more rapidly, the older population are getting larger. This will place high pressure on the national health care system. The government can make some policies to encourage the children provide more informal care and launce policies to allow children having more flexible working time when providing informal care. Another policy indications may be the alleviation of one-child policy. One child policy leads to the children reduction of providing informal care. Revising policy may improve the probability for elder people to receive informal care.

Our study also has some limitations. First, we don't estimate the long term effect because of the blood data limitation. Studies show that providing informal care has long term effect on the care givers' health[16]. So does the long-term effect of informal care on the care acceptor's health still exist? This needs to be further studied. Another may be that we only discuss the effects of informal care on blood urea nitrogen, creatinine, cystatin C. The effects on some other biomarkers should be further studied.

Finally, the gender difference are not included in our study. Some show that the impact of informal care on women is less effective than men[17]. So does this effect on blood biomarkers still exist? This may be an interesting direction in the future research.

V. CONCLUSIONS

In this paper, we find that informal care could improve older people's physical health. For blood urea nitrogen, the probability at higher risk reduced 0.6%, for creatinine, the likelihood of going into higher risk decreased 0.2% and for cystatin C, it dropped 0.4% when receiving one hour of informal care per week.

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