Does informal care reduce health care utilisation in older age? Evidence from China

Yixiao Wang [a], Wei Yang [a,*], Mauricio Avendano [b,c]

[a] Department of Global Health and Social Medicine, King's College London, London, UK
[b] Center for Primary Care and Public Health (Unisanté), University of Lausanne, Lausanne, Switzerland
[c] Department of Social and Behavioural Sciences, Harvard School of Public Health, Boston, MA, USA

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ABSTRACT

Studies in Western countries suggest that receiving informal care from family members may reduce utilisation of health care services. This hypothesis has not been examined in China, where the population is ageing rapidly. We assess the impact of informal care from offspring (children and grandchildren) on health care utilisation and expenditures among older people in China. Data are drawn from the 2011, 2014, and 2018 waves of the Chinese Longitudinal Healthy Longevity Survey. Using lagged model with the instrumental variable approach, we find that the impact of informal care is different by type of health care: More hours of informal care from offspring reduces overall health care utilisation, and in particular, outpatient care utilisation, but it increases inpatient care utilisation and expenditures. Our results suggest that informal care reduces the demand for outpatient care but increases the demand for inpatient care, possible reflecting the fact that the latter involves more advanced procedures for which informal care is not a substitute but a complement. Results highlight the need for incorporating health care impacts in the analysis and evaluation of policies that affect informal care provision.

1. Introduction

As the number of older people living longer in poor health is increasing, demand for older-age care is also rising (World Health Organization, 2015). It is projected that the number of older people with needs for care will nearly triple from 101 million in 2010 to 277 million in 2050 (Prince et al., 2013). This suggests that the number of older people who use long-term care (LTC) and health care services is likely to increase, significantly contributing to increased spending (Suzman and Beard, 2011). Existing studies have stressed the interdependences between LTC and health care, with some research suggesting that the availability of informal care reduces utilisation of health care (Forder et al., 2019). Addressing this question is particularly important for China, where formal LTC is under-developed and informal care makes up the majority of care provided to older people (Hu and Ma, 2018).

Informal care, defined as unpaid care in daily activities provided to older people by a spouse, children, grandchildren, other relatives, neighbours or friends, is the most common form of LTC in most countries (Groenou and Glaser, 2006). Current policy in Western countries favours informal over formal care as the preferred form of LTC provision for several reasons (Yang et al., 2020). Older people often feel more comfortable and secure when receiving care from informal carers. Receiving informal care also means more frequent communication and social engagement with family members and friends (Wiles et al., 2012). Informal care may also reduce budget expenditures by reducing the demand for health care services (Bremer et al., 2017), and governments around the world have implemented policies to incentivise informal care as a way to reduce health care costs. In California and Missouri, for example, a special tax credit for full-time carers is provided under the argument that supporting informal carers will reduce public expenditures in health care (Van Houtven and Norton, 2004). Yet, existing empirical studies in Western countries do not fully support the hypothesis that informal care provision reduces health care expenditure. Some studies suggest that informal care may reduce adverse health outcomes, reducing length of hospital stay and inpatient expenditures (Van Houtven and Norton, 2008; Weaver and Weaver, 2014). Other studies suggest that informal care significantly increases the use of outpatient surgery and inpatient care costs, as informal carers act as informed agents for older people (Bolin et al., 2008; Torbica et al., 2015; Van Houtven and Norton, 2004).

Although the Chinese government has made increased investment in home- and community-based care, these services are either fragmented

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or non-existent in most parts of the country (Shi and Hu, 2020). As preferences for informal care in China are unlikely to change drastically in the near future, informal care will likely continue to be the most important source of LTC (Lu et al., 2015). China also offers a unique context given important health reforms over the last decades. In response to rising health demand and higher out-of-pocket (OOP) payments for health care, China has established three main public social health insurance schemes: The Urban Employee Medical Insurance, the Urban Resident Medical Insurance, and the New Rural Cooperative Medical Insurance. By the end of 2017, 95% of the population was covered by one of these insurance schemes (Du et al., 2017). In order to expand health care coverage and improve social health insurance benefit packages, government health care expenditures have increased rapidly since 2000, exceeding OOP payments in 2015, accounting for more than 65% of total health expenditures (Meng et al., 2019). Since some studies suggests that older people receiving informal care have a slower health decline and better quality of life (Hu and Li, 2018), and the Chinese government also encourages informal caregiving in order to reduce health care spending (Lin, 2019).

The effectiveness of this policy depends on whether encouraging more informal care leads to cost savings in health care, yet current findings are limited. Compared with a large number of studies in Western countries, limited studies have investigated this issue in China. Lin et al. (2014) find that informal care significantly reduces the use of outpatient care, but outpatient care expenditures are not investigated in the study. Huang and Fu (2017) find that informal care has no significant impact on the use of health care or health care expenditures. However, this study does not distinguish the effect of informal care on different types of health care, e.g., outpatient care and inpatient care. Chen et al. (2022) find that informal care increases the both of outpatient and inpatient use, but they do not consider reverse causation between informal care and health care (e.g., informal care receipt may influence the use of health care, and vice versa).

Using data from three waves (2011, 2014 and 2018) of the Chinese Longitudinal Healthy Longevity Survey (CLHLS), we examine the impact of informal care from children and grandchildren on the health care utilisation and expenditures among older people in China. Given the potential for reverse causation, we use lagged model with the instrumental variable approach that exploits potentially exogenous variation in informal care receipt to identify its effect on health care utilisation and expenditures.

1.1. Informal care receipt and health care utilisation

Several studies suggest that there is a relationship between formal LTC and health care. These studies conceptualise this relationship based on Van Houtven and Norton's (2004) conceptual framework, an extension of the classic Grossman (1972) model of health demand. By including informal caregiving into the model, Van Houtven and Norton (2004) propose a family decision-making process where the health status of older people is modelled as a "production function" with the amount of care provided by children and use of health care as input factors. In particular, when older people have health problems, the child decides whether to provide informal care, while the parent decides whether to seek health care to maintain health. In this model, the parent chooses how much health care to utilise based on the amount of informal care the child provides. According to this model, informal care may reduce the demand for health care by preventing or slowing age-related health decline (Van Houtven and Norton, 2004). For example, assistance in bathing and indoor transferring may prevent burns or accidental falls; assistance in feeding or preparing meals may improve diet and nutrition; and regular monitoring in taking medicine may improve the management of chronic disease. Van Houtven and Norton (2004) find that informal care significantly reduces total health care utilisation by reducing the length of hospital stay and Medicare expenditures among single older people in the United States. Based on four waves of the Swiss

Household Panel Survey, Weaver and Weaver (2014) focus on the entire older population in Switzerland and report similar findings. Research suggests that more intensive informal care slows the decline in functional ability and improves the recovery process. In addition, an empirical study conducted by Lin et al. (2014) find that longer hours of informal care received is associated with a significant reduction of outpatient care among Chinese older people.

Literature to date has provided mixed results on the relationship between informal care and health care. Some other studies find that informal care increases health care utilisation. Torbica et al. (2015) argue that informal carers play a double role, acting as both providers of care and enabling agents of older people. While informal care in daily activities may improve the health status of older people, it may also increase the probability of identifying significant health problems, help older people to overcome barriers to access, and facilitate the use of health care services. Some empirical studies find support for this hypothesis. Research in the United States find that informal care helps older people with attending outpatient appointments by assisting them on public or private transportation (Van Houtven and Norton, 2004). Research in Sweden suggests that informal carers also look after the older people's medication and can often quickly notify the pharmacy or medical staff if there are problems with the prescription (Condelius et al., 2010). In addition, Bolin et al. (2008) argues that highly professional and highly skilled care cannot be replaced by informal care, and informal carers may encourage and empower older people in using these advanced diagnostic procedures and treatments. They find that informal care increases the probability of using hospital care among single older Europeans.

A challenge in understanding the causal impact of informal care on health care utilisation is endogeneity: The demand for informal care may change as a result of changes in the demand for health care. Prior studies have not fully addressed this issue, which may lead to potential bias in estimating the causal effect of informal care on health care. In addition, there may be heterogeneous effects of informal care on different types of health care, reflecting the different level of skills and potential for substitution with outpatient and inpatient health care.

2. Data and methods

2.1. Data and sample

Individual-level data are drawn from the 2011, 2014, and 2018 waves of the CLHLS, a nationally-representative interview survey of healthy longevity in China (Zeng, 2004). Following the panel design, the CLHLS began in 1998 and was conducted in a random sample of approximately half of the total number of counties and cities of 22 China's provinces, which covered 985 million persons and 85% of the total population in China (Zeng, 2004). At each wave, survivors were re-interviewed, while refreshment samples were added to maintain representativeness of the sample. The CLHLS collected information on socio-demographic characteristics, physical and mental health status, chronic diseases, family and social supports, and health behaviours. It has few missing values for most items, with a 2% or lower item non-response rate (Zeng, 2004). CLHLS started to collect information on expenditures in outpatient and inpatient care separately from 2011. Therefore, our study sample encompasses older people who were interviewed in at least two waves. We exclude people living in nursing homes or whose primary source of care was from formal home- and community-based care (60 participants, 1% of the full sample) to reduce potential bias, as these individuals were not asked about care from adult offspring in the CLHLS survey. The final sample size comprised 6348 participants. Table 1 shows the descriptive statistics of the study sample.

Table 1
Descriptive statistics of the sample.

Variables	Mean (SD)/ Percentages
Dependent variables	
Total health care	
Whether use or not	80.02
Health care expenditures (N = 5080) (RMB)	5932.43 (14,584.34)
Outpatient care	
Whether use or not	77.83
Outpatient care expenditures (N = 4940) (RMB)	2507.97 (6863.43)
Inpatient care	
Whether use or not	41.23
Inpatient care expenditures (N = 2617) (RMB)	7160.36 (14,821.64)
Independent variable	
Hours of informal care in the last week	24.14 (43.29)
Instrumental variable	
Number of surviving adult daughters	1.72 (1.34)
Control variables	
Age	85.66 (10.89)
Gender	
Female	54.91
Male	45.09
Self-rated health	
Bad	22.03
Fair	36.13
Good	41.84
Number of chronic diseases	1.13 (1.35)
Number of ADL limitations	0.69 (1.54)
Cognitive function	22.49 (9.03)
Smoking	
No	69.53
Yes	19.97
Drinking	
No	74.37
Yes	25.63
Household per capita income last year (RMB)	9990.43 (11,663.96)
Education	
None	82.94
Elementary school	14.50
Middle school and above	2.56
Marital status	
Other	2.68
Widowed	59.59
Married	37.74
Living arrangement	
Living alone	18.21
Living with family members	81.79
Money transfers received from daughters and daughters' spouse	2462.55 (4407.37)
Having medical insurance	
No	13.47
Yes	86.53
Residence	
City	15.33
Town	30.02
Rural	54.65
N	6348

Notes: The unit of this study sample is the individual. These characteristics are the summary statistics across waves. Mean (SD) is presented for continuous variables, and Percentages is presented for categorical variables. ADL = activities of daily living.

2.2. Variable specification

2.2.1. Dependent variable: health care utilisation

The outcome of interest is health care utilisation, including utilisation of total health care, outpatient care, and inpatient care. CLHLS collected information on outpatient and inpatient care by asking: 'how much did you spend on outpatient costs before insurance reimbursement last year', and 'how much did you spend on inpatient costs before insurance reimbursement last year'. We aggregate outpatient and inpatient care expenditures to create a new variable, total health care expenditures before insurance reimbursement. For each type of health care, there is a high fraction of observations having no expenditures before insurance reimbursement during the year, so we construct two dependent variables for each type of health care. The first dependent variable is a binary outcome that indicates whether the respondent used health care last year. The second dependent variable is the natural logarithm of the amount of health care expenditures before insurance reimbursement in the last year among those who reported using health care.

2.2.1.1. Independent variable: informal care receipt from children/grandchildren. Our key independent variable of interest is hours of informal care from children/grandchildren in the last week, a continuous variable constructed based on the question 'How many hours in total did your children, grandchildren and their spouses help you in activities of daily living (ADLs) last week'.

2.3. Other covariates

Based on existing studies (Huang and Fu, 2017; Lin et al., 2014), we control for a set of needs-related variables, including age, gender, self-rated health, number of chronic diseases, number of ADL limitations, cognitive function, smoking, and drinking. Age is a continuous variable measured by years. Gender is a binary variable with the female set as the reference category. Self-rated health is a categorical variable, comprising 'bad' (the reference group), 'fair' and 'good' status. Number of chronic diseases is a count variable representing the number of chronic diseases the respondent suffered from. The ADL variable summarises the number of ADLs that the individual is unable to perform or has difficulties with. Cognitive function score is a count variable measuring the number of correct answers of a total of 30 questions. These questions comprised six dimensions: orientation, registration, naming, attention and calculation, recall, and language. The total score was 30. The validity and reliability of the Chinese Mini-Mental Status Examination has been verified in many studies (Peng and Wu, 2015). We construct a single score which is then normalised (Philipps et al., 2014). Smoking and drinking are binary variables with 'no' set as the reference category.

Following existing studies in China, other variables are also included in the models: household per capita income, educational level, marital status, living arrangement, having medical insurance, residence, monetary transfers received from daughters and daughters' spouse. Household per capita income is a continuous variable measured by the question, 'What was the income per capita of your household last year'. In our sample, the percentage of missing values on income is only 2.4%. Income in 2011, and 2014 are inflated to 2018 values using Consumer Price Indexes. In all models, we use the natural logarithmic of household income to account for non-linearities. Highest educational level is defined as no education (the reference group), elementary school, or middle school and above. Marital status has three categories: other (the reference group), widowed, and married. Living arrangement has two categories: living alone (the reference group) and living with other household members (other than the spouse). Having medical insurance is a binary variable with 'no' set as the reference category. Residence status comprises three groups: city (the reference group), town, and rural areas. Money transfers received from daughters and daughters' spouse is included because it may influence their decision to seek health care, which will be discussed further in empirical strategy section. It is a continuous variable measured by the question, 'How much money (including cash and value of materials) did you get last year from your daughters and daughters' spouse'. We logarithmically transformed this variable.

2.4. Empirical strategy

To reduce concern of measurement temporality (i.e., the timeframe of independent is last week, while the timeframe of dependent variable

is last year), we incorporate a lag to examine the impact of informal care in previous wave on health care use in following wave. In descriptive analyses, we first fit nonparametric LOESS curves, a locally weighted regression smoother, to explore the relationship between informal care in previous wave and health care utilisation and expenditures in following wave, controlling for age and gender.

Based on the model developed by Van Houtven and Norton (2004), we then model health care utilisation as a function of informal care variables, controlling for other covariates. Because a high fraction of observations has no expenditures before insurance reimbursement for any specific type of care during the year, we use a two-part model (Duan et al., 1984). The first part is a probit model that predicts the probability of using health care. The second part uses ordinary least squares (OLS) to model the log of health care expenditures, conditional on using health care. We estimate the two-part model separately for total health care, outpatient care, and inpatient care.

Informal care is potentially endogenous to health care utilisation, and it is correlated with personal characteristics. Therefore, we use lagged model with the instrumental variable (IV) approach to control for unmeasured confounding factors influencing both receiving informal care and using health care. A valid instrument must meet two conditions: First, it must be strongly correlated with the endogenous variable; second, it must be exogenous and have no direct effect on health care expenditures other than through influencing informal care (Wooldridge, 2012). We used an instrument that has been widely used in the literature on informal care: the number of surviving adult daughters (Bonsang, 2009; Huang and Fu, 2017). This instrument is believed to meet these two conditions. In China, rural-to-urban and other job-related migration is more common among adult sons than daughters. This increases adult sons' physical distance and reduces the probability that they provide

making it difficult to estimate individual fixed effects models, as the latter only consider changes over time within individuals. Therefore, we use lagged random effects models with IV in a two-part model to exploit both within- and between-individual variation. In the first part, focusing on the whole sample, the general specification for the first stage regression is as follows:

$$IFC_{it-1} = \gamma_0 + \gamma_1\ Adultdaughter_{it-1} + \gamma X_{it-1} + \varepsilon_{it-1} \tag{1}$$

where *IFC* refers to hours of informal care received in the last week, and *X* refers to control variables including needs-related variables, socio-economic variables, and wave dummy variables.

In the second stage, we regress the probability of using health care on the predicted value of hours of informal care received in the last week from the first stage including all controls:

$$\Pr(Expenditures_{it} > 0) = \alpha_0 + \alpha_1 \widehat{IFC}_{it-1} + \alpha_2\Pr(Expenditures_{it-1} > 0) + \alpha X_{it-1} + \varepsilon_{it-1} \tag{2}$$

where $\Pr(Expenditures_{it} > 0)$ means the probability of using health care, $\widehat{IFC}$ reflects the predicted values of informal care from the first stage, and *X* includes the same controls as in equation (1). α_1 can be interpreted as the impact of one additional hour of informal care in the previous wave on the probability of using health care in the following wave.

In the second part, we focus on health care users, but use the same specification as in equations (1) and (2) to examine impacts on expenditures, as follows:

First stage equation:

$$IFC_{it-1} = \delta_0 + \delta_1\ Adultdaughter_{it-1} + \delta X_{it-1} + \varepsilon_{it-1} \tag{3}$$

Second stage equation:

$$\text{Ln}(Expenditures_{it}|Expenditures_{it} > 0) = \beta_0 + \beta_1 \widehat{IFC}_{it-1} + \beta_2\text{Ln}(Expenditures_{it-1}|Expenditures_{it-1} > 0) + \beta X_{it-1} + \varepsilon_{it-1} \tag{4}$$

daily care for parents. As a result, adult daughters more often take the main responsibility of caring for older parents, and providing intensive hours of care (Zeng, 2016).

In principle, the number of adult daughters is exogenous, as parents generally do not have control on the gender of their children. Because the CLHLS is an ongoing nationwide survey collecting extensive data on a much larger population of oldest-old with a comparative sub-sample of younger elders, more than 96% of the study sample is aged 80 and over. Although selective abortion ratios started to rise in the early 1980s due to the one-child policy, this effect is not large enough to influence the gender distribution of adult children in our study sample, as most CLHLS participants had completed their fertility before 1980 (Zeng, 2016). However, a potential concern is that those who are healthy, financially well off and well-educated are more likely to find a partner, and have more resources to create a larger family (McArdle et al., 2006). Therefore, having more surviving adult daughters may indicate better health and socioeconomic status of older people, which may influence health care utilisation. To address this issue, we control for health-related variables and socioeconomic variables in all models, such as self-rated health, income and education. Another potential challenge to our identification strategy is that the number of surviving daughters may influence the amount of monetary transfers older people receive, which may influence their decision to seek health care. Therefore, we control for monetary transfers received from daughters and their spouse in the models.

Due to the fact that the number of surviving adult daughters does not change across waves for most older people in our sample, variation in the instrument comes primarily from between-individual variations,

where β_1 captures the impact of one additional hour of informal care in the previous wave on the log of health care expenditures in the following wave among health care users. We present results as marginal effects for each model.

3. Results

Fig. 1 shows the relationship between informal care in the previous wave and health care utilisation in the following wave. Fig. 1– and 1-2 show that there is no clear relationship between informal care in the previous wave and the probability of using overall health care in the following wave, but a positive relationship between informal care and total health care expenditures among health care users. We observe a similar relationship between informal care in the previous wave and outpatient care utilisation in the following wave (Fig. 1-3 and 1-4). However, Fig. 1-5 and 1-6 suggest that there is a positive relationship between informal care in the previous wave and the probability of using inpatient care in the following wave, while there is not a clear relationship between informal care and inpatient care expenditures.

Table 2 reports the results of models to test for the validity of our instrument. Column 2 shows that our instrument has a significant and positive association with hours of informal care received in the first-stage regression. Column 3 indicates that the instrument has a strong predictive power regarding hours of informal care received. Column 4 shows the modified Wu-Hausman test of the exogeneity of informal care for each of the two-part model. In the first-part model, informal care is endogenous to the utilisation of total health care, outpatient care and
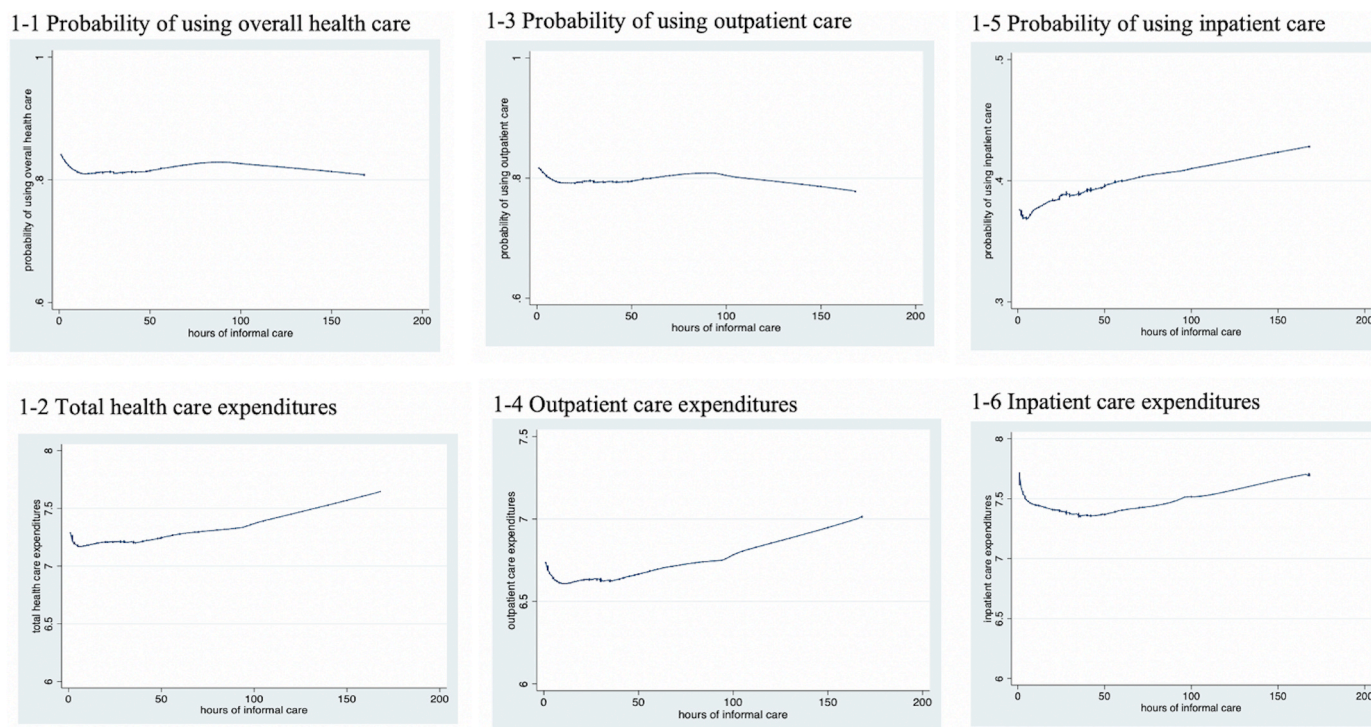
Fig. 1. LOESS curve of the relationship between informal care in the previous wave and health care utilisation in the following wave among older people, CLHLS, 2011–2018.

Table 2
Coefficient and strength of the instrumental variable and exogeneity of informal care.

Dependent variable	Coefficient of the instrument	Strength of the instrument	Hausman exogeneity test
Total health care			
Whether use or not	1.307 (0.457) ***	F = 11.16 ***	5.10 **
Expenditures	1.030 (0.362) ***	F = 10.51 ***	2.42
Outpatient care			
Whether use or not	1.258 (0.329) ***	F = 10.07 ***	4.68 **
Expenditures	1.038 (0.372) ***	F = 8.44 ***	1.08
Inpatient care			
Whether use or not	1.060 (0.370) ***	F = 9.37 ***	5.35 **
Expenditures	1.254 (0.572) **	F = 10.54 ***	4.22 **

Notes: The instrument is number of surviving adult daughters. Cells in column 2 represent coefficient (robust standard errors). ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

inpatient care. In the second-part model, informal care is endogenous to the amount of inpatient care expenditures. Based on existing studies, when endogeneity is detected in one but not both parts of a given model, both parts are estimated using instrumental variables (Van Houtven and Norton, 2004, 2008). Thus, we report instrumental variable results for all models, and present the first-stage regression results in Appendix 1-3.

Table 3 shows estimates of the impact of informal care in the previous wave on total health care utilisation in the following wave using our IV approach. After controlling for the endogeneity of informal care, informal care in the previous wave has a strong negative impact on the probability of using health care in the next wave, but not on health care expenditures among health users. Specifically, a 10-h increase in informal care in the previous wave reduces the probability of using health care in the next wave by 11 percentage points.

Table 4 shows results on the impact of informal care on outpatient care utilisation. Informal care in the previous wave significantly reduces

the probability of outpatient care utilisation in the next wave, but it does not have an impact on outpatient care expenditures among outpatient care users. Specifically, a 10-h increase in informal care in the previous wave reduces the utilisation of outpatient care by 10 percentage points in the next wave.

Table 5 reports the impact of informal care on inpatient care utilisation. Informal care significantly increases the utilisation of inpatient care, and leads to a significant increase in inpatient health care expenditures among inpatient care users. In particular, a 10-h increase in informal care in the previous wave increases the utilisation of inpatient care in the next wave by 11 percentage points, while increasing inpatient care expenditures by 26% among inpatient care users. Given that mean inpatient care expenditure is around RMB7,000 (US$1103.80) among users, a 10-h increase in informal care would lead to around RMB1,820 (=7000 × 26%) (US$287) increase in inpatient care annual expenditures among users.

3.1. Robustness check

We perform three sets of supplementary analysis to examine the robustness of our results. We re-incorporate older people who use formal home- and community-based care in our sample. Appendix 4-6 show the full results, which show that our results are insensitive to including these participants. We replace overall health care expenditures (i.e., health care expenditures regardless of insurance reimbursement) with OOP payments in health care (i.e., health care expenditures after insurance reimbursement, thus paid by respondents themselves). Results, summarised in Appendix 7-9, are in line with our main models: a unit increase of informal care reduces utilisation of overall and outpatient health care, but increases the utilisation of inpatient care and inpatient care expenditures among inpatient care users. Finally, we replace the two-part model with a Heckman Selection Model (HSM). We do this because the two-part model assumes that the decision to seek health care and the choice of how much to spend are two independent decisions, yet these two decisions may be influenced by both observable and unobservable factors (O'Donnell et al., 2007). HSM considers the correlation

Table 3
Impacts of informal care on total health care utilisation among older people.

Variables	Lagged model with IV approach	
	Utilisation	Expenditures
Hours of informal care	−0.011 (0.002) ***	0.038 (0.086)
Age	0.003 (0.001) ***	−0.014 (0.014)
Gender		
Female	Ref	Ref
Male	−0.014 (0.015)	0.016 (0.091)
Self-rated health		
Bad	Ref	Ref
Fair	0.030 (0.015) *	−0.319 (0.183) *
Good	0.021 (0.025)	−0.470 (0.169) ***
Number of chronic diseases	0.025 (0.011) **	0.222 (0.056) ***
Number of ADL limitations	0.124 (0.020) ***	−0.518 (0.646)
Cognitive function	−0.002 (0.001)	0.024 (0.018)
Smoking		
No	Ref	Ref
Yes	0.008 (0.014)	−0.121 (0.115)
Drinking		
No	Ref	Ref
Yes	−0.004 (0.016)	−0.022 (0.099)
Household per capita income last year (Ln)	0.003 (0.004)	0.065 (0.045)
Education		
Illiteracy	Ref	Ref
Elementary school	−0.011 (0.016)	0.154 (0.097)
Middle school and above	−0.010 (0.034)	−0.172 (0.259)
Marital status		
Other	Ref	Ref
Widowed	−0.000 (0.032)	0.226 (0.202)
Married	−0.057 (0.036)	0.788 (0.386) **
Living with family members		
No	Ref	Ref
Yes	0.055 (0.017) ***	−0.133 (0.267)
Money transfers received from daughters and daughters' spouse	−0.011 (0.006) *	0.017 (0.023)
Having medical insurance		
No	Ref	Ref
Yes	0.009 (0.017)	-.115 (.127)
Residence		
City	Ref	Ref
Town	-.094 (0.031) ***	−0.076 (0.491)
Rural	-.061 (0.019) ***	−0.364 (0.325)
Utilisation/Expenditures in last wave	0.022 (0.035)	0.155 (0.063) **
N	6348	5080

Notes: ADL = activities of daily living. Cells represent marginal effects (robust standard errors). ***p < 0.01, **p < 0.05, *p < 0.1.

between the two errors in the decision to seek health care and the choice of how much to spend (see Appendix 10 for more details). Appendix 11-13 show the full results, which are in line with our main findings: a 10-h increase in informal care reduces the utilisation of outpatient care by 10 percentage points, but increases the utilisation of outpatient care by 8 percentage points, increases the inpatient care expenditures by 24% among inpatient care users.

4. Discussion

This study examines the impact of informal care from adult offspring on health care utilisation among older people in China. After controlling for endogeneity of informal care, we find that the impact of informal care is different by types of health care. More hours of informal care reduce the utilisation of overall and outpatient health care, whereas

Table 4
Impacts of informal care on outpatient care utilisation among older people.

Variables	Lagged model with IV approach	
	Utilisation	Expenditures
Hours of informal care	−0.010 (0.004) **	−0.024 (0.047)
Age	0.002 (0.002)	0.011 (0.022)
Gender		
Female	Ref	Ref
Male	−0.026 (0.016)	0.125 (0.194)
Self-rated health		
Bad	Ref	Ref
Fair	0.021 (0.018)	0.076 (0.197)
Good	−0.001 (0.042)	0.027 (0.227)
Number of chronic diseases	0.028 (0.011) **	0.229 (0.072) ***
Number of ADL limitations	0.111 (0.049) **	0.610 (0.946)
Cognitive function	−0.001 (0.002)	−0.013 (0.020)
Smoking		
No	Ref	Ref
Yes	0.005 (0.014)	−0.189 (0.166)
Drinking		
No	Ref	Ref
Yes	0.007 (0.016)	−0.025 (0.116)
Household per capita income last year (Ln)	0.005 (0.004)	0.098 (0.053) *
Education		
Illiteracy	Ref	Ref
Elementary school	0.001 (0.024)	0.079 (0.164)
Middle school and above	−0.015 (0.038)	−0.005 (0.349)
Marital status		
Other	Ref	Ref
Widowed	0.025 (0.038)	0.064 (0.472)
Married	−0.021 (0.057)	−0.035 (0.921)
Living with family members		
No	Ref	Ref
Yes	0.045 (0.026) *	0.437 (0.478)
Money transfers received from daughters and daughters' spouse	−0.004 (0.002) **	−0.014 (0.027)
Having medical insurance		
No	Ref	Ref
Yes	−0.002 (0.017)	−0.054 (0.144)
Residence		
City	Ref	Ref
Town	−0.071 (0.058)	−0.591 (0.512)
Rural	−0.047 (0.031)	−0.566 (0.296) *
Utilisation/Expenditures in last wave	0.049 (0.057)	0.211 (0.069) ***
N	6348	4940

Notes: ADL = activities of daily living. Cells represent marginal effects (robust standard errors). ***p < 0.01, **p < 0.05, *p < 0.1.

more hours of informal care increase the utilisation of inpatient care and amount of inpatient care expenditures among inpatient care users.

Our results suggest that the impact of informal care on outpatient care differs from that on inpatient care, a finding that is in line with some studies (Van Houtven and Norton, 2004; Bolin et al., 2008). Informal care may be a substitute for outpatient care because it reduces the probability of health problems, for example, informal carers support older people in managing their health conditions. In support of this view, studies show that informal carers often provide personal care and monitor medications, leading to better health outcomes of older people (Wang and Yang, 2021). By helping with practical daily care tasks, such as eating and indoor transferring, informal carers provide company and 'keep an eye' on older people, which is particularly important especially

Table 5
Impacts of informal care on inpatient care utilisation among older people.

Variables	Lagged model with IV approach	
	Utilisation	Expenditures
Hours of informal care	0.011 (0.002) ***	0.026 (0.013) **
Age	−0.002 (0.001) ***	−0.027 (0.007) ***
Gender		
Female	Ref	Ref
Male	0.007 (0.023)	0.135 (0.478)
Self-rated health		
Bad	Ref	Ref
Fair	−0.016 (0.018)	−0.372 (0.611)
Good	−0.044 (0.022) **	−0.267 (0.385)
Number of chronic diseases	−0.007 (0.017)	0.119 (0.165)
Number of ADL limitations	−0.126 (0.025) ***	−0.598 (1.864)
Cognitive function	0.005 (0.002) **	0.001 (0.034)
Smoking		
No	Ref	Ref
Yes	−0.017 (0.015)	−0.066 (0.264)
Drinking		
No	Ref	Ref
Yes	−0.005 (0.015)	0.072 (0.179)
Household per capita income last year (Ln)	0.000 (0.005)	0.014 (0.163)
Education		
Illiteracy	Ref	Ref
Elementary school	−0.006 (0.025)	0.484 (0.158) ***
Middle school and above	−0.012 (0.050)	−0.176 (0.544)
Marital status		
Other	Ref	Ref
Widowed	−0.015 (0.042)	0.676 (0.798)
Married	0.075 (0.037) **	1.005 (1.464)
Living with family members		
No	Ref	Ref
Yes	−0.063 (0.017) ***	−0.156 (0.772)
Money transfers received from daughters and daughters' spouse	0.003 (0.002)	0.010 (0.044)
Having medical insurance		
No	Ref	Ref
Yes	−0.028 (0.020)	−0.153 (0.306)
Residence		
City	Ref	Ref
Town	0.108 (0.036) ***	0.110 (1.348)
Rural	0.065 (0.034) *	−0.261 (0.662)
Utilisation/Expenditures in last wave	0.060 (0.074)	0.276 (0.130) **
N	6348	2617

Notes: ADL = activities of daily living. Cells represent marginal effects (robust standard errors). ***p < 0.01, **p < 0.05, *p < 0.1.

for those who are cognitively impaired or severely disabled (Beesley, 2006). By addressing potential endogeneity using IV approach, our results demonstrate significant impact of informal care on outpatient care, and these results are consistent with previous studies, showing that informal care leads to less frequent use of outpatient care (Lin et al., 2014).

On the other hand, our results show that informal care increases inpatient care, a finding reported in previous studies (Bolin et al., 2008). This suggests that informal care may be complementary –rather than a substitute-for inpatient care. Studies find that adult children may act as enabling agents and assist older people in receiving more advanced care treatments (Chen et al., 2022). For example, they may quickly notice parents' needs, notify doctors, and ensure their older parents receive the treatment they need in the hospital. A study in China find that older people with family carers tend to have longer hospital stays compared

with those who do not have family carers (Yu and Jin, 2018). For those with severe functional or cognitive impairment, children play an important role in making medical decisions, and they help parents to access professional health care for longer period of time or until recovery (Qian, 2017; Van Houtven and Norton, 2004).

Findings from this study have important policy implications for current LTC system in China, where informal care plays a larger role in LTC, and public spending on health care is growing substantially. Research finds that the average number of weekly hours of informal care received rose by 11 h from 2005 to 2014 among the Chinese oldest-old, and nearly 15% of them reported a 70-h increase in care from children/grandchildren during that period (Hu, 2020). Our findings suggest that policies that incentivise informal care may contribute to reduce outpatient health care utilisation which require lower level skills. Although informal care is often regarded as unpaid care, these benefits and the opportunity costs for informal carers should not be ignored in the analysis. An example of a policy that encourages informal care is direct cash payments to informal carers, which have a high take-up in some European countries (Zigante, 2018). Our results suggest that cash-for-care payments may not only compensate for the loss of labour income associated with caregiving, but also result in lower rates of utilisation of health care, which lead to a reduction of public spending on health care. However, it is worth noting that although informal caregiving provides economic benefits to individuals and governments, over-reliance on informal caregiving may have negative consequences for both individuals and governments. Research suggests that providing highly intensive care reduces carers' wages and harms their employment prospects, leading to negative consequences on carers' well-being and a significant net cost to government revenues (Jacobs et al., 2013; Skira, 2015). As a result, governments need to strike a balance between encouraging informal care and increasing the supply of publicly funded formal home- and community-based care.

We also find that informal care increases inpatient care utilisation and costs, which again reinforces the importance of informal care from the perspective of preventing older people from forgoing health care. Support from children/grandchildren may help older people to overcome barriers and improve access to necessary hospital care, for example, by encouraging them to attend hospitals appointments, informing doctors about their needs, taking necessary screening tests, and receiving essential professional care. In addition to incentivising informal caregiving, we emphasise the importance of government policies that support informal carers when the care burden becomes heavy and older people require more skilled assistance. There is a pressing need for the policy makers to consider the burden of informal care on family members, and to balance further reliance on informal care with appropriate supply of formal long-term care services, such as day care, respite care, community care and counselling (Robards et al., 2015).

Our study has several strengths, but some important limitations should be noted.

First, we did not have data on insurance claims, and all information on health care expenditures came from survey self-reports. Inaccurate recall and misreporting may have led to reporting bias. Second, unlike many international datasets, the CLHLS does not provide longitudinal weights. However, as suggested by the CLHLS research team, weights may not be required when performing regression analysis as long as age, gender, and urban/rural residence are controlled for. Third, CLHLS only collects information on care provided by children or grandchildren; it does not collect information on hours of care provided by other sources of care, such as a spouse, sibling or other family members. Future studies should examine how care received from a spouse or family members other than offspring affect utilisation of healthcare. Fourth, our data does not enable a clear distinction between help received inside and outside the household. It is difficult to measure care received inside the household, as individual who co-reside with adult children may not consider help from co-residing children as a source of support. Lastly, we are not able to distinguish specific outpatient or inpatient care services,

for example, screening tests, complex surgeries and rehabilitation services, as this information was not available in our data. Future studies should examine how findings might differ for specific types of care. Despite these limitations, this study produces new and compelling results regarding the impact of informal care on health care utilisation among older people in China.

5. Conclusion

Understanding the impact of informal care receipt on health care utilisation is an important policy question in the context of rising health care spending. Based on an instrumental variable approach, we provide evidence that care from children and grandchildren reduces overall and outpatient health care use, but increases utilisation of inpatient care and expenditures among those who use care. Our findings suggest the policies that encourage the provision of informal care for older people may contribute to reduce outpatient health care costs, but may not reduce costs associated with inpatient care. This may be because outpatient care involves more advanced procedures for which informal care is not a substitute but a complement. Results highlight the need for incorporating health care impacts in the analysis and evaluation of policies that affect informal care provision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2022.115123.

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