Does Taking Care of Grandchildren Affect Grandparents' Cognition?

Shangyi Mao*

Abstract

Using the China Health and Retirement Longitudinal Study (CHARLS) baseline data, we explore to what extent grandparental care influences grandparents' cognition, by considering two dimensions of cognitive ability. In order to address the endogeneity of providing childcare, we adopt an instrumental variable approach. We find no evidence to suggest that care of grandchildren has a positive effect on grandparents cognitive ability. On the contrary, for one of the considered dimensions, episodic memory, we find a substantial negative effect.

Keywords: grandparents, cognition, childcare

*National School of Development, Peking University, Beijing, China
e-mail: m.cherish@gmail.com

1 Introduction

Looking after grandchildren is a common activity for grandparents gloablly. Estimates suggest that at least 40 % of grandparents in the United States provide some type of childcare and 15 % provide extensive childcare in the previous month of the survey time (Fuller-Thomson and Minkler 2001). European research find that 57 % of grandparents take care of a grandchild aged 15 or younger during the previous year of the survey time(Hank and Buber 2009). Similarly, in 2008, 660,000 Australian children were under grandparental care, including day-long care and after-school care (Jenkins 2010). In China, grandparental care is a general phenomenon since womens labor force participation rates are extremely high. Even in rural areas, women undertake multiple work activities (Entwisle and Chen 2002).

The effect of caring for grandchildren on the health of grandparents remains an important question to be studied. Theoretically, both positive and negative health effects of grandparents caring for grandchildren are plausible. For grandparents who provide care of grandchildren, on one hand, the expectations and responsibilities can bring high stress and limit their own leisure time; on the other hand, they could benefit from the emotional reward. Empirical research on the consequences of grandparents childcare on the health of grandparents has been inconclusive (Chen and Liu 2012; Ku et al. 2012).

Closely linked to health, cognition declines with age. Cognitive ability is important for extending working life, managing chronic illness, maintaining social relations, and making financial decisions. We need to identify ways to preserve cognitive abilities of the elderly population. Adding knowledge on cognitive functioning of Chinese elderly is extremely important since the cognition levels of these elderly are low. Furthermore, it has been argued that cognition is a superior measure to compare the burden of aging across countries. Compared with other indicators, Skirbekk et al. (2012) propose an indicator based on age variation in cognitive functioning.

Providing childcare makes grandparents interact with their grandchildren (e.g., answering questions). This may result in an increase of grandparents' vitality. In addition, grandparental care may lead to healthier lifestyle (e.g., reduced smoking or drinking) (Hughes et al. 2007). Kalmijn et al. (2002) show that such choices have a positive affect on cognitive functioning in middle and old age. However, the effect of grandparental care on grandparents cognition is not definitely positive. Providing childcare may have a negative effect on grandparents cognition. It may make grandparents feel physically tired and emotionally drained (Jendrek 1993). Moreover, taking care of grandchildren may reduce grandparents' free time and restrict their social activities (Pruchno 1999).

Mainly due to the absence of relevant data for China, a few research focuses

on the cognitive skills of older populations in China. In this paper, we investigate the determinants of the cognitive skills of China's elderly population. We are particularly interested in determining if providing childcare has any impact on the grandparents' cognition. For the best of our knowledge, no previous research has analyzed this effect on Chinese grandparents. In the process of answering this question we will discern some of the other important determinants of cognitive functioning of grandparents?

Using data from the 2011 Chinese Health and Retirement Longitudinal Survey (CHARLS), we find that conditional on socioeconomic and demographic characteristics, compare to providing no childcare, providing childcare has a positive effect on grandparents' cognitive ability from OLS regression. When we restrict the sample only to grandparents who provide some childcare, the intensity of providing childcare has a similar result as the former one. The OLS results show that spending more time on caring for grandchildren has a positive effect on grandparents' mental health. Since grandparents with better cognition are more likely to providing childcare, this may cause reverse causation problem. In view of this positive effect might be affected by an inadequate treatment of the endogeneity of grandparental care, we implement an instrumental variable (IV) approach, the IV regression results do not show any evidence that providing childcare has a positive effect on grandparents' cognition. On the contrary, we find that a negative effect of providing childcare on grandparents' mental health. When we consider the sample only to grandparents who provide some childcare, we find that the positive effect disappears when we use the IV method. Moreover, we find there is a negative effect of grandparental care on grandparents' episodic memory.

This research contributes to the literature in three ways. First, we provide an analysis of the determinants of the Chinese elderlys cognition. Due to the deficiency of research on older populations in China, this paper is a helpful supplement. Second, to control for unobserved selection into grandparental care we employ IV method, that allows us to describe a distinct causality. Third, we provide insights for policy makers and professionals to improve their perceptions and understanding of grandparental care.

The remainder of this paper is organized as follows. Section 2 provides a literature review. Section 3 describes the baseline CHARLS data used in this paper and discusses the instrumental variable approach. Empirical results are presented in Section 4. Section 5 concludes.

2 Related Literature

Many Literature on grandparental care focus on the effect on children and grandchildren. For example, Arpino et al. (2012), Nyland et al. (2009) and Posadas

and Vidal-Fernández (2012) show that grandparental care could free mothers from childcare burden and pursue working career. Aassve et al. (2012) and García-Morán and Kuehn (2013) show that that availability of grandparenting play an important role in individuals fertility decision. Terrell (2000) and Monserud and Elder (2011) study the effects of grandparental care on grandchildren's outcomes, such as school performance, cognitive skills. Some literature focus on the different pattern of grandparental care (Luo et al. 2012; Hank and Buber 2009; Ko and Hank 2012; Thomese and Liefbroer 2013).

The other strand of literature focus on the effect of grandparenting on grandparents. Silverstein and Cong (2013) study the reason why grandparents serve as caregiver for their grandchildren. Wang and Marcotte (2007) analyze the effect of caring for grandchildren on grandparents' working decision. Using a sample from the Health and Retirement Study, Hughes et al. (2007) find no evidence to support that grandparental care has dramatic and widespread negative effects on grandparents health and health behavior.

Arpino and Bordone (2012) use the Survey of Health, Ageing and Retirement in Europe (SHARE), restricting their sample to women aged 50-80 and living apart from their grandchildren. They use IV method to overcome the endogeneity of grandchild care. Their empirical results do not show evidence that grandparental care has a negative effect on grandparents cognitive functioning and suggest that grandparental care has a positive effect on verbal fluency. [1].

Reinkowski (2013) also uses the sample from SHARE, restricting her sample to females aged 45-90 and having at least one grandchild aged 16 or younger. She find small but statistically significant positive correlation between grandparental care and physical health , cognition and reducing depression index. Applying the panel character of the data and IV method, she finds no statistically significant positive effects.

Despite grandparent caregiving is common in China, little is known about the health effects of caring for grandchildren on grandparents. Chen and Liu (2012) use six waves of the China Health and Nutrition Survey (CHNS) and conclude that grandparents providing fewer than 15 hours of care per week experience a slower health decline than non-caregivers, but providing higher than 15 hours of care per week has a negative effect. Using four saves of the Survey of Health and Living Status of the Elderly in Taiwan, Ku et al. (2012) use person fixed effects panel data methods and find that caring for grandchildren has positive effect on grandparents' health. IV analysis shows that grandparental care has a positive effect on reduction of mobility limitations.

Arpino and Bordone (2012), Ku et al. (2012) and Reinkowski (2013) all use IV approach to tackle the endogenous issue of grandparental care. Arpino and

[1]Verbal fluency means naming as many animals as possible within in 1 minute

Bordone (2012) use whether having grandchildren as the IV. Ku et al. (2012) use the number of ever-married children and grandchildren as their IVs. These instruments base on the assumption that children make their fertility decision without considering whether their parents can provide childcare or not. However, Aassve et al. (2012), García-Morán and Kuehn (2013) and Mathews and Sear (2013) show that children do take the availability of grandparenting into account. Our IVs may also have the similar question, but China has a different fertility culture, thus this question may not exist in China. Reinkowski (2013) use the gender of the firstborn child as IV, but China has a long-standing social norm that a son is favored over a daughter, thus the gender of the firstborn child may be the outcome by parents' sex selection and it may not be exogenous.[2]

Due to the lack of relevant data for China, a few research focus on the cognitive skills of older populations in China. Using the CHARLS pilot survey, Huang and Zhou (2012) and Hu et al. (2012) examine effects of education and social activities on the elderly's cognitive functions. Lei et al. (2012) use the pilot of CHARLS and Lei et al. (2013) use the baseline of CHARLS to study gender differences in cognition.

3 Data and Methods

3.1 Chinese Health and Retirement Longitudinal Survey (CHARLS)

The China Health and Longitudinal Study (CHARLS) is a nationally representative longitudinal survey of the elderly population in China, based on a sample of households with members aged 45 and above. The respondents of CHARLS will be followed every other year. Before beginning with the national survey, CHARLS research team start with a pilot survey in two provinces (Gansu and Zhejiang) in 2008. The national baseline survey of CHARLS was conducted in 2011-2012, it covers 150 counties/districts, 450 villages/urban communities, randomly chosen across China. 28 provinces in mainland of China, excluding Hainan, Ningxia and Tibet, are represented in the data. Sample size is 17,708 individuals in 10,257 households.[3]

We use data from the baseline survey of CHARLS, CHARLS baseline data contains detailed information of respondents and their living spouses. The information includes demographics, family networks, health status, cognitive condition, employment, and economic status etc.

[2]The detailed discussion about IVs can be seen in Section 3.4.

[3]For a detailed description of the CHARLS survey, see Zhao et al. (2013).

We restrict our sample to people aged 45-80. In the CHARLS questionnaire, only the respondent who claim to have grandchildren under 16 are asked whether they and their spouse provided grandchild care, thus we merely focus on these grandparents. Since anti-cancer drugs, stroke, as well as Parkinson have negative effect on cognitive abilities, following Engelhardt et al. (2010), we exclude respondents who reported to have ever been diagnosed with cancer, malignant tumor, stroke or memory-related disease (eg, Alzheimer, Parkinson etc). Excluding cases with missing values for analytic variables, the final sample size is of 6,932 individuals ranging from 45 to 80 years old.[4] Table 1 details the mean and standard deviation of the variables used in this study.

3.2 Depend Variables

Following Lei et al. (2012) and Lei et al. (2013), there are two cognitive abilities measured in this paper. The first is mental status, which measures the intactness of individuals. In CHARLS, mental status questions include the following items: naming today's date (including year, month, day and season), the day of the week, serial 7 subtraction from 100 (up to five times), and redrawing the same picture of two pentagons overlapped. Answers to these questions are added up to a single mental status score, ranging from 0 to 11. As Table 1 shows, the mean of the total sample is 8.08, it implies that most grandparents have good mental status.

Our second cognitive measure is episodic memory based on immediate and delayed word recall. The interviewer first reads a list of ten Chinese nouns, and then asks the respondent to recall as many of the words as they can in any order (immediate recall). A few minutes later, at the end of the cognition and depression module, the respondent is asked again to recall as many the original words as possible (delayed recall). For our purposes, the measure of episodic memory is the average of immediate and delayed recall scores. Thus, the episodic memory scores range from 0 to 10. According to Table 1, the mean of the total sample is 3.18, it indicates that most grandparents have poor episodic memory.

3.3 Independent Variables

Our interested variables are the provision of grandparental childcare and the intensity of grandparental childcare. Respondents who have any grandchildren under 16 are asked whether they and their spouses provided childcare during last year, and if they did, how many weeks and how many hours per week. Using

[4]Dependent variables have different missing observations, we restrict sample to people who answered episodic memory questions in Table 1.

this information, we construct a binary variable (providing childcare) equal to 1 if people have provided childcare and 0 otherwise. We also get the total hours of providing childcare last year and use it to describe the intensity of grandparental chidlcare. In Table 1, we separate the total sample into two categories by providing childcare and display their mean and standard deviation. About 47% of our sample provide grandparental childcare. The average time of providing childcare is about 2,288 hours.[5]

The choice of other independent variables is motivated by previous literature. Given the nonlinear decline of cognitive functioning with age, we control for age using a set of dummy variables: 45-49 (reference group), 50-54, 55-59, 60-64, 65-69, 70-74 and 75-80. Since across all ages, Chinese man have higher cognitive ability scores than their female counterparts (Lei et al. 2013), we include the binary variable "male" (1 = male; 0 = otherwise) in our regressions. We also include a binary variable "marital status" (0 = separated, divorced, widowed and never married; 1 = otherwise). Education is known to be strongly associated with cognitive ability (Arpino and Bordone 2012; Lei et al. 2013), we divide the sample into five mutually exclusive groups: "Illiterate" those who can neither read nor write (reference group); "Did not finish primary" including those who did not finish primary school but were capable of reading or writing, or those who were reported to have been in *Sishu*[6]; "Primary school" those who have graduated from primary schools; "Middle school" those who have graduated from middle schools; and "High school and above" those who have graduated from high schools, vocational schools, colleges, or post-graduate.

Social activity may benefit cognitive functioning of the elderly by reducing rates of cognitive decline (Hu et al. 2012; Hsu 2007; Wang et al. 2002). In CHARLS, Social Activities include participating in one of the following activities: interacting with friends; playing Mahjong, chess, or cards, or going to a community club; providing help to family friends, or neighbors who do not live with you and who did not pay for the help; attending a sporting event or other kind of club; taking part in a community related organization; doing voluntary or charity work; caring for a sick or disabled adult who does not live with the respondent and who does not pay for the help; attending an educational or training course. We define a dummy variable "any social activity" to indicate if a respondent is involved in at least one of the above activities. Since literature show that retirement has a negative effect on cognitive functioning (Bonsang et al. 2012; Mazzonna and Peracchi 2012), we control "work status" (1 = employed; 0 otherwise) in our regressions.[7] In developing countries, consumption expenditures represent the best

[5]The intensity of childcare is divided by 100 in all regressions.

[6]Sishu is an old, private Chinese education style that before the 20th century taught young children reading, writing, and other fundamental skills.

[7]For the peasant, if they still do agricultural work, we treat them as employees.

measure of the economic resources available to the family Strauss and Thomas (2008), hence we include log household expenditure per capita (log PCE) in our regressions. Fogel (1994) points that height can serve as a measurement of malnutrition and health, thus we include log height in our model. Furthermore, we also city (urban area) and province dummies in our regressions.

3.4 Endogeneity Issues and the Instrumental Variable Approach

As discussed in Section 2, knowing that grandparents' cognitive ability and whether providing childcare (or intensity of childcare) may both affected by similar factors. It is difficult to determine whether providing childcare affects cognition or whether some unobserved variable is associated with both providing childcare and cognition. Furthermore, reverse causation may be a problem. That is to say, it can be that grandparental care helps elderly people to maintain good cognition or that grandparents with better cognitive functioning have a higher probability to provide childcare.

We propose an IV method to control for the possible endogeneity issue of whether grandparents providing childcare (or intensity of childcare).[8] Our instruments include the number of grandchildren aged 16 and below of an elderly person,[9] and the age of the elderly person's eldest child. Table 1 shows that the average number of grandchildren aged 16 and below is about 3 and the age of eldest child is about 35 years old. In Section 4, we will further use established econometric methods to test whether our instrumental variables violates the identification assumptions.

Proper instrumental variables should satisfy two criteria. First, these variables should be significantly correlated with the endogenous variable. Due to the deficiency of formal childcare centre, grandparents are important childcare providers in China (Chen et al. 2011), thus the bigger number of grandchildren leads to the higher probability of providing grandparental childcare. In addition, grandparents with older children is less likely to provide grandparental childcare since grandchildren aged above 16 with higher probability. As it can be seen in Table 2 and 3, our instruments easily passed the test of relevance in all the analyses.

[8]When the second wave of CHARLS is published, we can focus on grandparents interviewed twice in CHARLS and use a fixed effect approach to deal with the endogeneity problem.

[9]The questionnaire of CHARLS has only the information of providing care of the respondent who has any grandchildren under 16. Moreover, from question CB065 to CB068 of the questionnaire, we can only know the number of grandchildren aged 16 and below, thus we use it as our instrument.

The second criterion is that instrumental variables should not be linked to cognitive functioning through channels other than provision of grandparental childcare. The exogeneity of the number of grandchildren is violated if respondents' children make their fertility decision considering whether their parents can provide childcare or not. Although western literature suggest that children do take the availability of grandparenting into account (Aassve et al. 2012; García-Morán and Kuehn 2013; Mathews and Sear 2013), Chinese couple almost do not think the availability of grandparenting. In China, people still have a traditional concept, "more children more happiness" (duo zi duo fu) and they only consider their own status. Using representative data on Taiwanese married women born over 1933-1968. Chu et al. (2012) indicate that coresidence with husbands' parents delays childbearing, women make their fertility decision base on their occupational development. In addition, Chinese research on desired birth do not consider the status of grandparents (Chen and Deng 2007; Guo 2008; Yang and Zhang 2011). Furthermore, events that affect respondents children's fertility choice are less likely to have a direct impact on respondents cognitive functioning. Therefore we can ignore this question. Since we include age variable in our model, we can treat the age of the eldest child as exogeneity.

4 Results

According to Table 1, the average cognitive ability between those who provide grandparental childcare and those who do not shows the first performing significantly better. However, this positive result could be due to children choose grandparents with better cognitive functioning to provide childcare. Table 1 shows that "providing childcare grandparents" are, on average, younger, more likely to be female, more likely to be involved in social activities and employed, poorer, and more likely to live in urban area than the their counterparts.

Table 2 and 3 present the results from the regression analyses, each considering one of the two previously described cognitive measures as outcome. Each table reports results from Ordinary Least Squares (OLS) regression and from the second stage of a Two-Stage Least Squares (IV) regression. In Table 2, OLS results show that providing childcare is positively and significantly associated with both two measures of cognitive skills, older people have lower cognitive scores, educational level, any social activity, Log PCE, Log height and urban area have significantly positive effect on mental status and episodic memory. Interestingly, being male is positively and significantly associated with mental status, but it is negatively and significantly associated with episodic memory. These findings are accordance with Lei et al. (2013). The variables' effects on cognitive abilities of IV regression are very similar to those of the OLS, excluding providing childcare.

IV results indicate that providing childcare is negatively associated with cognitive abilities, particularly, providing childcare has a significantly negative effect on mental status. These findings are not accordance with Arpino and Bordone (2012), but are similar to Reinkowski (2013).

For checking the validity of the different instrumental variables, the bottom panel of Table 2 and 3 show the results of our first stage regression and statistical tests on the validity of our instrumental variables. As we have more instrumental variables than the potentially endogenous variable, we can conduct over-identification test by a Hansens J statistic incorporated in Statas ivreg2 package (Baum et al. 2010). Our instrumental variables are all significantly correlated with providing childcare and intensity of childcare at 1% confidence level. The F-test statistic in all the implemented analyses overcomes the threshold of 10 usually considered acceptable. As all the P values of Hansens J statistics are bigger than 0.1, we cannot reject the joint null hypothesis that the instruments are valid instruments. These tests provide support for the validity of our instrumental variables. With IVs that passed the tests of strength and validity, in the last test of endogeneity we rejected the null hypothesis ($p < 0.1$) that providing childcare and intensity of childcare are exogenous.

To assess if the effect of grandparenting depends on its intensity, we restrict our sample to people who providing grandparental childcare. Table 3 displays the results. Although OLS results show that intensity of childcare is positively and significantly associated with mental status, IV results show that intensity of childcare have negative effect on cognitive skills (not significant). Other variables have similar effect on the two measures of cognition as Table 2.

Then we focus on the effects of intensity of childcare and separate our sample into two categories by gender and residential area, Table 4 and 5 display the IV results respectively. According to Table 4, in the female group, spending more hours in taking care of grandchildren can weaken respondents' episodic memory significantly. In terms of Table 5, in the rural group, intensity of childcare has a significantly negative effect on grandparents' episodic memory. In general, female and rural grandparents have heavier burden of childcare than their counterparts. Comparing with grandfather, grandmother play a more important caregiving role. (Chen et al. 2011). In rural area, due to the working migration of young parents and the lack of formal childcare institution, grandparents are the main childcare provider. Therefore, the intensity of childcare has more significant impact on these people.

5 Conclusion

In this paper, using China Health and Retirement Longitudinal Study (CHARLS) 2011-12 baseline data, which is part of the international network of Health and Retirement Surveys (HRS) around the world, we examine the determinants of cognition among people aged 45-80 in China, especially we focus on the effect of grandparental care.

In a context of ageing societies, it becomes more and more important to find ways to preserve cognitive abilities of the elderly population. In China, grandparents provide informal childcare is a general phenomena, no previous China research has study it's effect on grandparents' cognitive ability, now we investigate the correlation between grandparental childcare and the cognition of grandparents.

Our multivariate analysis indicate that providing childcare can increase grandparents' cognitive abilities, however, our further analysis show that grandparent caregiving is endogenous to the two measures of cognition. Using an IV method, our findings do not support the OLS results. None of the cognitive measures is significantly positively affected by providing childcare. Particularly, providing childcare has a significantly negative effect on grandparents' mental status and the intensity of childcare almost has a negative effect on grandparents' episodic memory at 10% confidence level.

Government should extend public childcare and decline the childcare burden of the elderly. With the lighter burden, grandparents can have more free time and enjoy playing with their children. Thus we can have a win-win prospect, without heavier burden, taking care of grandchildren can not only relieve the childcare pressure of the young couple but also slow down the decline trend of the elderly's cognitive functioning.

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Tables

Table 1: Descriptive Statistics

Variable	Providing Childcare: Yes ($n = 3,241$)	No ($n = 3,691$)	All ($n = 6,932$)
Mental Status	8.14	8.03	8.08
	(2.378)	(2.437)	(2.410)
Episodic Memory	3.31	3.07	3.18
	(1.816)	(1.823)	(1.824)
Age	58.11	59.92	59.07
	(6.549)	(8.100)	(7.469)
Male	0.43	0.48	0.45
	(0.494)	(0.499)	(0.498)
Marital status	0.91	0.88	0.90
	(0.285)	(0.322)	(0.306)
Illiterate	0.28	0.29	0.29
	(0.450)	(0.453)	(0.452)
Did not finish primary	0.22	0.20	0.21
	(0.415)	(0.398)	(0.406)
Primary school	0.23	0.24	0.24
	(0.418)	(0.430)	(0.425)
Middle school	0.19	0.18	0.18
	(0.391)	(0.385)	(0.388)
High school and above	0.08	0.09	0.09
	(0.274)	(0.285)	(0.280)
Any social activity	0.50	0.48	0.49
	(0.500)	(0.499)	(0.500)
Work status	0.74	0.71	0.73
	(0.437)	(0.453)	(0.446)
Log PCE	8.39	8.46	8.43
	(0.738)	(0.855)	(0.803)
Log Height	5.06	5.06	5.06
	(0.051)	(0.054)	(0.053)
Urban area	0.36	0.31	0.33
	(0.479)	(0.461)	(0.470)
Instruments			
Number of grandchildren	2.94	2.64	2.78
	(1.904)	(1.912)	(1.915)
Age of eldest child	34.04	35.93	35.05
	(6.155)	(8.150)	(7.346)

Table 2: Providing Childcare on Cognition

Independent Variables	Mental status OLS	Mental status IV	Episodic memory OLS	Episodic memory IV
Providing childcare	0.165***	-0.789*	0.198***	-0.409
	(0.049)	(0.415)	(0.042)	(0.328)
Age 50-54	-0.048	0.037	-0.257***	-0.200**
	(0.089)	(0.098)	(0.079)	(0.086)
Age 55-59	0.164**	0.254***	-0.143*	-0.084
	(0.083)	(0.092)	(0.074)	(0.081)
Age 60-64	0.126	0.153*	-0.133*	-0.114
	(0.087)	(0.090)	(0.076)	(0.078)
Age 65-69	0.009	-0.029	-0.272***	-0.295***
	(0.100)	(0.102)	(0.086)	(0.088)
Age 70-74	-0.184	-0.358**	-0.598***	-0.706***
	(0.126)	(0.150)	(0.102)	(0.119)
Age 75-80	-0.265	-0.531**	-0.766***	-0.940***
	(0.171)	(0.210)	(0.140)	(0.170)
Male	0.205***	0.161**	-0.206***	-0.233***
	(0.070)	(0.073)	(0.060)	(0.062)
Marital status	0.255***	0.274***	0.140**	0.152**
	(0.087)	(0.090)	(0.069)	(0.070)
Did not finish primary	1.347***	1.372***	0.419***	0.435***
	(0.080)	(0.082)	(0.060)	(0.061)
Primary school	2.086***	2.092***	0.790***	0.795***
	(0.077)	(0.079)	(0.061)	(0.062)
Middle school	2.550***	2.586***	1.141***	1.163***
	(0.081)	(0.084)	(0.070)	(0.072)
High school and above	2.847***	2.872***	1.593***	1.606***
	(0.091)	(0.094)	(0.088)	(0.089)
Any social activity	0.305***	0.328***	0.299***	0.313***
	(0.048)	(0.050)	(0.041)	(0.042)
Work status	-0.008	-0.018	0.082	0.076
	(0.063)	(0.064)	(0.054)	(0.054)
Log PCE	0.136***	0.087**	0.111***	0.080**
	(0.032)	(0.039)	(0.028)	(0.032)
Log Height	4.479***	4.466***	1.315**	1.316**
	(0.659)	(0.682)	(0.559)	(0.565)
Urban area	0.403***	0.460***	0.184***	0.220***
	(0.058)	(0.065)	(0.050)	(0.055)
Significance of exclusion restrictions in first stage equation				
The number of grandchildren		0.034***		0.034***
Age of the eldest child		-0.012***		-0.012***
F-test of excluding instruments		55.7***		58.8***
Hansen's J statistic, for overidentification of all instruments (P-val)		0.5929		0.1030
Endogeneity test (P-val)		0.0167		0.0710
Observations	6,940	6,939	6,933	6,932

[1.] Robust standard errors in parenthesis.
[2.] Control variables for provincial residence have been included in all regressions but are not reported.
[3.] *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.
[4.] Instrumented variables regression results are generated using the Baum et al. (2010), ivreg2 command for Stata.

Table 3: Intensity of Grandparental Childcare on Cognition

	Mental status		Episodic memory	
Independent Variables	OLS	IV	OLS	IV
Intensity of childcare/100	0.003**	-0.023	-0.001	-0.020
	(0.002)	(0.015)	(0.001)	(0.012)
Age 50-54	0.027	0.031	-0.363***	-0.362***
	(0.140)	(0.145)	(0.119)	(0.121)
Age 55-59	0.257**	0.264**	-0.248**	-0.244**
	(0.129)	(0.134)	(0.110)	(0.112)
Age 60-64	0.188	0.181	-0.315***	-0.324***
	(0.140)	(0.144)	(0.114)	(0.116)
Age 65-69	-0.027	-0.103	-0.459***	-0.522***
	(0.165)	(0.177)	(0.135)	(0.144)
Age 70-74	-0.105	-0.204	-0.456***	-0.527***
	(0.213)	(0.232)	(0.174)	(0.182)
Age 75-80	-0.188	-0.193	-0.779**	-0.769**
	(0.414)	(0.435)	(0.316)	(0.317)
Male	0.255**	0.211*	-0.202**	-0.235**
	(0.107)	(0.111)	(0.092)	(0.095)
Marital status	0.104	0.107	0.046	0.047
	(0.137)	(0.142)	(0.112)	(0.113)
Did not finish primary	1.437***	1.401***	0.545***	0.516***
	(0.118)	(0.122)	(0.088)	(0.092)
Primary school	2.232***	2.193***	0.840***	0.811***
	(0.118)	(0.123)	(0.094)	(0.097)
Middle school	2.639***	2.591***	1.418***	1.385***
	(0.121)	(0.128)	(0.106)	(0.109)
High school and above	2.905***	2.897***	1.607***	1.605***
	(0.137)	(0.144)	(0.135)	(0.137)
Any social activity	0.210***	0.170**	0.285***	0.254***
	(0.073)	(0.081)	(0.063)	(0.070)
Work status	0.003	-0.033	0.060	0.033
	(0.098)	(0.103)	(0.083)	(0.086)
Log PCE	0.162***	0.127**	0.052	0.026
	(0.052)	(0.057)	(0.042)	(0.045)
Log Height	3.715***	3.830***	1.159	1.197
	(1.010)	(1.039)	(0.852)	(0.870)
Urban area	0.377***	0.348***	0.343***	0.319***
	(0.088)	(0.092)	(0.074)	(0.077)
Significance of exclusion restrictions in first stage equation				
The number of grandchildren		1.573***		1.567***
Age of the eldest child		-0.411***		-0.422***
F-test of excluding instruments		16.0***		16.5***
Hansen's J statistic, for overidentification of all instruments (P-val)		0.3798		0.5429
Endogeneity test (P-val)		0.0636		0.1040
Observations	2,967	2,966	2,981	2,980

[1.] Robust standard errors in parenthesis.
[2.] Control variables for provincial residence have been included in all regressions but are not reported.
[3.] *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.
[4.] Instrumented variables regression results are generated using the Baum et al. (2010), ivreg2 command for Stata.

Table 4: Intensity of Grandparental Childcare on Cognition, by Gender

	Mental status		Episodic memory	
Independent Variables	Female	Male	Female	Male
Intensity of childcare/100	-0.033	-0.022	-0.054**	0.011
	(0.029)	(0.017)	(0.025)	(0.016)
Age 50-54	-0.057	0.217	-0.404**	-0.486**
	(0.205)	(0.216)	(0.184)	(0.211)
Age 55-59	0.056	0.609***	-0.350**	-0.249
	(0.192)	(0.197)	(0.170)	(0.194)
Age 60-64	0.007	0.481**	-0.386**	-0.477**
	(0.220)	(0.205)	(0.195)	(0.198)
Age 65-69	-0.615*	0.417*	-0.902***	-0.501**
	(0.346)	(0.236)	(0.308)	(0.215)
Age 70-74	-0.725	0.259	-0.701*	-0.720***
	(0.449)	(0.296)	(0.377)	(0.263)
Age 75-80	-0.170	-0.128	-1.350**	-0.598
	(0.630)	(0.615)	(0.550)	(0.507)
Marital status	-0.076	0.405	-0.024	0.160
	(0.173)	(0.277)	(0.159)	(0.223)
Did not finish primary	1.392***	1.374***	0.456***	0.345**
	(0.165)	(0.249)	(0.144)	(0.166)
Primary school	2.206***	2.153***	0.802***	0.587***
	(0.175)	(0.237)	(0.161)	(0.161)
Middle school	2.473***	2.650***	1.424***	1.108***
	(0.191)	(0.241)	(0.182)	(0.177)
High school and above	2.848***	2.919***	1.809***	1.168***
	(0.231)	(0.254)	(0.236)	(0.206)
Any social activity	0.115	0.262**	0.235**	0.293***
	(0.121)	(0.109)	(0.115)	(0.100)
Work status	-0.025	-0.116	0.065	-0.100
	(0.146)	(0.145)	(0.134)	(0.132)
Log PCE	0.123	0.097	-0.036	0.102
	(0.082)	(0.079)	(0.073)	(0.067)
Log Height	3.652**	4.088***	1.339	1.663
	(1.567)	(1.410)	(1.405)	(1.237)
Urban area	0.483***	0.151	0.327***	0.373***
	(0.132)	(0.130)	(0.123)	(0.113)
Observations	1,724	1,242	1,732	1,248

1. Robust standard errors in parenthesis.
2. Control variables for provincial residence have been included in all regressions but are not reported.
3. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

Table 5: Intensity of Grandparental Childcare on Cognition, by Residential Area

	Mental status		Episodic memory	
Independent Variables	Rural	Urban	Rural	Urban
Intensity of childcare/100	-0.025	-0.018	-0.034*	0.002
	(0.022)	(0.018)	(0.019)	(0.015)
Age 50-54	-0.009	0.164	-0.183	-0.576***
	(0.179)	(0.271)	(0.156)	(0.222)
Age 55-59	0.200	0.405	-0.069	-0.466**
	(0.172)	(0.261)	(0.151)	(0.215)
Age 60-64	0.074	0.389	-0.304*	-0.239
	(0.195)	(0.295)	(0.166)	(0.236)
Age 65-69	-0.274	0.211	-0.499***	-0.478
	(0.213)	(0.354)	(0.178)	(0.296)
Age 70-74	-0.190	-0.275	-0.622***	-0.311
	(0.283)	(0.403)	(0.239)	(0.326)
Age 75-80	-0.260	-0.092	-0.725*	-0.836
	(0.537)	(0.704)	(0.416)	(0.516)
Male	0.354**	-0.032	-0.237**	-0.201
	(0.138)	(0.190)	(0.120)	(0.166)
Marital status	-0.028	0.310	-0.085	0.165
	(0.182)	(0.225)	(0.143)	(0.177)
Did not finish primary	1.463***	1.243***	0.654***	0.227
	(0.150)	(0.231)	(0.118)	(0.173)
Primary school	2.308***	1.921***	0.926***	0.544***
	(0.147)	(0.228)	(0.122)	(0.178)
Middle school	2.638***	2.438***	1.378***	1.361***
	(0.158)	(0.233)	(0.142)	(0.197)
High school and above	3.135***	2.555***	1.706***	1.475***
	(0.192)	(0.248)	(0.203)	(0.221)
Any social activity	0.093	0.291**	0.155*	0.416***
	(0.103)	(0.126)	(0.089)	(0.110)
Work status	-0.008	-0.027	0.107	-0.062
	(0.154)	(0.144)	(0.128)	(0.121)
Log PCE	0.171**	0.058	0.021	0.020
	(0.072)	(0.095)	(0.061)	(0.076)
Log Height	2.881**	5.603***	1.395	1.256
	(1.273)	(1.804)	(1.121)	(1.535)
Observations	1,896	1,070	1,908	1,072

1. Robust standard errors in parenthesis.
2. Control variables for provincial residence have been included in all regressions but are not reported.
3. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.