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More children, more blessings?
The effect of children on depression symptom in old age

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Abstract

China has entered a stage of deep population aging, and it has brought great challenges to the country and society. With the aggravation of aging, the physical and mental health problems of the old adults and the subsequent elderly-care problems have been concerned by all sectors of society. With the development of economy and society and the change of fertility concept, especially in recent years, after the change of the fertility policy, whether the number of children has a protective effect on the mental health of the old adults has been widely concerned by the society. This study using the Chinese health and retirement longitudinal study (CHARLS) data, established instrument variable regression models with an instrument variable chosen according with the Chinese fertility preference, and then deeply analyzed the causal effect of the number of children on the depressive symptoms of the old adults.

The results of the study showed that, (1) Chinese people had a common fertility preference for boys; (2) and the fertility preference for boys was quite steady among generations. (3) The Naïve Probit regression indicated that, the number of children could significantly increase depressive symptoms in old age, however, the regression of instrumental variable showed that the number of children had no significant effect on the depressive symptoms in old age.

Using CHARLS 2018 data, and also using an instrument variable regression, this study made a series of classification analysis according to the respondents' factors like age, gender, marital status, places of residence (urban or rural areas), and education levels, and moreover, we used the data of CHARLS 2011 made the stability test, and all the results were consistent. This study illustrated that to improve depressive symptoms in older adults by increasing the number of children only was not feasible, and these conclusions will provide theoretical reference for the management of depression status in the old age and the social care for the old adults in China.

Key Words: Number of Children, Sex Composition of Children, Depression Symptoms, Instrumental variable

I INTRODUCTION

In China, the aging population faces unique challenges as the country undergoes a profound demographic shift. By 2022, the number of old people aged 65+ had reached 209.78 million, accounting for 14.9% of the total population. The ratio of the aged to working-age individuals has increased from 13.1% in 2013 to 21.8% in 2022 [1]. With the declining birth rate, the youth demographic has diminished, intensifying further the social stress of elderly-care. According to forecasts, by 2050, this ratio could reach 53.2%, implying that one out of every two youths would be supporting an elder[2]. This has undoubtedly brought to the forefront societal concerns regarding the mental wellness of the emerging elder cohort and their familial support systems.

Age-related depression plays a significant role among the problems of old adults' mental health and is viewed as a widespread social health issue that negatively impacts their lifestyle and mental well-being. Some researches even indicated that it was associated with cognitive decline, dementia, and various chronic conditions [3][4]. The World Health Organization (WHO) also has identified it as a significant suicide predictor [5]. Unfortunately， a study found that China was facing the heaviest societal burden brought by age-related depression, because of the higher detection rate coupled with inadequate social support [6]. A recent research indicated that the rate of needs for psychological intervention in elderly-care in certain regions in China has escalated to 40.57% [7]. Therefore, addressing elder depression is crucial for China's healthy aging strategy.

Given China's aging population and associated elderly-care challenges, China has gradually liberalized the birth policy. However, more comprehensive empirical researches are required to better understand the correlation between having additional children and the improvement of mental well-being of older adults. While the perceived impact of the number of child on older adults' mental health remains a subject of debate.

As many scholarly studies indicated, bearing additional children seemed to enhance mental

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health during an individual's twilight years. For example, a research conducted in Europe revealed that individuals without progeny and those possessing only one child in eastern European nations showed heightened levels of depressive symptomatology in advanced age [8]. Similarly, in the United States, a study using an instrumental variable approach demonstrated that the quantity of children serves as a protective factor against psychological disorders amongst older female cohorts [9]. Numerous studies within China also supported this viewpoint. For instance, a investigation focusing on rural population, indicates that, when compared with having multiple children, having single child significantly impeded the health of rural elders [10]. And a study discovered a robust correlation between the number of children and enhanced life satisfaction among the old population, and when contrasted with parents, the life satisfaction of non-procreative individuals was notably diminished [11]. Another study discovered that in rural, parents with two or more children showed superior psychological status when compared to those with just only one child [12].

However, the results of some studies refuted the claim that having more children contributes to better mental health in old age. Kruk and Reinhold (2013)[13] conducted a survey of elderly individuals from 13 European countries, and revealed that while having more children might negatively impact the mental health of mothers, while it did not significantly affect that of fathers. In a separate study conducted in the United Kingdom [14], it was found that while having two children did not necessarily lead to lifelong depression, but having three or more children did increase the likelihood of developing depression. In China, numerous studies had also shown that the number of children negatively affected the mental health of old adults. A study found a negative correlation between the number of children and the self-assessment score of elderly parents, and even the number of children was positively associated with depression in older parents [15]. Similarly, A study of Geng Dewei (2013)[16], used data of a survey from urban areas in Shanghai, Wuhan, and Xi'an to test the relationship between the number of children and the self-assessment physical condition of parents, and observed a negative correlation as well. Additionally, studies of Shi Zhilei (2015)[17], Li Shuzhuo, and Zhang Dan (2022)[18] also found a negative correlation between the number of children and the mental health of the old adults in rural areas in China.

Likewise, certain studies had concluded that there was no straightforward, linear relationship between the number of children and the mental health in old age, nor was there a definitive correlation. As supported by Zhao Yifan's (2022) [19]findings, in rural areas, the actual number of children was not necessarily the sole indicator of the elderly happiness, instead, the ideal number of children exerted a certain influence on it, suggesting that the ideal number of children had a substantial role in the rural elders' mental health. Furthermore, Chen Yili's (2016)[20] research has indicated that the number of children did not have a significant impact on the mental health of both young and elderly parents.

In conclusion, despite three prevalent perceptions noted above, several studies had delved deeper into the influence of number of children and parental mental health, acknowledging that the link here were significantly intertwined with other factors, such as children's genders, age, and urban-rural differences. For instance, a study conducted in Mexico [21] found that the number of children significantly affects elderly parents' mental health in different age groups, with the impact being more pronounced in the 75+ age group. Similarly, a study of Kruk and Reinhold (2013) [13]in Europe and another study of Broek (2020)[9] in the United States suggested that the number of children had a different impact on mental health of elderly mothers and fathers. In China, studies had also shown that the impact of the number of children on elderly parents' mental health varied across urban and rural areas. For instance, Wang Bihan's (2022)[22] study indicated that there were significant urban-rural differences in the impact of the number of children on old parents' self-rated well-being and emotional well-being.

The current research conclusions on the relationship between the number of children and the mental health of old adults were inconsistent. Some of the reasons for the differences in research results may be due to the influence of demographic factors. For example, the occurrence and influencing factors of old-age depression vary significantly in different countries, regions, and populations. This means that even if the same method is used, the results may vary according to factors such as region, ethnicity, age, and gender. Another more important reason is that most of the current studies on this subject were generally flawed in research methods

Previous research on the link between the number of children and mental health often utilized traditional descriptive methods [9].

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Unfortunately, these methods are prone to biases due to unmeasured external factors (e.g., familial socioeconomic status and individual physique) that can potentially influence reproductive behavior along with individual mental health in late life. Thus, previous research results were potentially biased, and might not accurately represent the true relationship. More importantly, traditional approaches may overlook important differences in the correlation between the two variables based on several key factors, including education level, childbearing age, religious beliefs, etc.， and right these overlooked factors could potentially influence the direction of the relationship between the number of children and mental health.Therefore, the results from previous studies were prone to selective bias， and furthermore, traditional research methods did not consider potential reverse causation.

A growing body of evidence suggests that the relationship between the number of children and mental health might be bidirectional, and even further, the direction of the relationship potentially differing from what was typically assumed [9][13]. Therefore, it is crucial to control for these endogenous factors when examining the relationship between the number of children and mental health [16]. To address these issues, this study utilized the instrumental variable method, which allows for the control of endogenous factors, to estimate the causal relationship between the number of children and depressive symptoms in old age. The instrumental variable used in this study were the gender compositions of the first two children. This approach allows for the examination of the causal relationship between the number of children and depression symptoms while controlling for potential biases due to unmeasured factors. So this study used the data of CHARLS 2018 to investigate the impact of the number of children on depressive symptoms of older adults, and to ensure the robustness of the findings, this study conducted sensitivity tests based on the old parents' age, gender, marital status, residence (urban and rural areas), and other factors. Additionally, the study used the data of CHARLS 2011 to conduct a robustness test. The findings of this study surely have important implications for understanding the mental health of the elderly population and developing effective interventions to improve their well-being.

II. DATA & METHODS

A. Date

The data used for the current analysis was draw from the CHARLS (Chinese Health and Retirement Longitudinal Study) database (See: http://charls.pku.edu.cn/zh-CN). CHARLS is a nationally representative, large-scale longitudinal study of Chinese adults aged 45 and over, focusing on factors influencing their health and well-being. Given that the instrumental variable used in this study were the gender structures of the first two births, the study selected the elderly group with at least two biological children and over the age of 60 as the research objects. The research feasibility is based on the fertility preference for boys. Therefore, after excluding the respondents who were missing key variables and whose second child was not a singleton, a total of 4,900 people were selected from the 17,708 respondents included in the CHARLS data in 2018.

B.Variables

The explained variable was depressive symptoms of older adults. Depressive symptoms were assessed in the CHARLS surveys in 2018, using the CESD-10 scale. According to the criteria (DS), a score above 20 represents depressive symptoms [23].

The explanatory variable was the number of biological children. And whether there where boys within the respondents' first two births was employed as an instrumental variable to predict the explanatory variable. It should be noted that the instrumental variable under consideration is dichotomous in nature, as it distinguishes between respondents of whom the two firstborn children have boy/boys (son-son, son-daughter or daughter-son) and respondents of whom the two firstborn children have no boy (daughter-daughter). Since the gender of children is determined by natural selection and is random, the instrumental variable is considered exogenous, and there is no need to consider other potential confounding covariates.

C. Analytical Approach

Within the field of economics, scholars often utilize the gender structure of children as a instrumental variable to measure fertility [24][25]. This study utilizes the Chinese fertility preference. As researches have already detected that, for Chinese individuals have a strong preference for boys [26][27]. It has been observed that individuals who do not have boys in their first two births tend to have more children. This observation can be utilized as an instrumental variable to predict the impact of the number of children on depression symptoms in old age. Therefore, this study utilizes the

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presence or absence of boys in the first two children as the instrumental variable for the number of children.

In view of the fact that children's genders are naturally random and exogenous, although certain observed or unobserved prerequisites for mental health problems such as age at first conception, specific personality traits, and socioeconomic status, etc., may be correlated with the actual number of children, but they are not systematically associated with fertility differences between the two groups of fertility cohorts differentiated by the instrumental variable. This opens the door for estimating the causal effects of the number of children using the sex composition of the children as an instrumental variable. By utilizing this random allocation, we quantified the effect of increased number of children on depressive symptoms in old age through a two-stage approach. The first-stage model is represented by equation (1):

$$X_i = \alpha_0 + \alpha_1 Z_i + \varepsilon_i \quad (1)$$

In the first stage, we regressed the number of children X of individual i onto an exogenous fertility instrumental variable Z, which denotes whether there is a boy/are boys within the first two births of the individual i. And a_1 indicates the additional number of children due to the preference for boys. The number of children of parents without boys in the first two births is higher than that of parents with boys in the first two births. As shown in equation (2), these two exogenous fertility differences are then used in the second stage to assess the potential impact of an increase in the number of children on depressive symptoms in old age. In the second stage of probit regression, the probability of depressive symptoms Y for individual i is regressed on $\hat{X}$, which is represents the number of children as predicted in the first stage.

$$\Pr(Y_i = 1) = \Phi(\beta_0 + \beta_1 \hat{X}_i + u_i) \quad (2)$$

III. RESULTS

A. Descriptive statistical analysis

Descriptive statistics of the sample are seen in Table 1. The parents in the sample had an average of 3 children. The result aligns with some research findings that have previously suggested there was a preference for having boys, particularly when it comes to parents who do not have boys in the first two births [28]. These parents tend to have more children overall, and they also have a lower detection rate of depression symptoms.

B. Naïve probit regression and instrumental variable regression analysis

Table 2 shows the naïve probit regression and IV probit regression for prediction of depressive symptoms in old age. The results from the naïve probit regression model for predicting depressive symptoms in old age illustrates a significant positive correlation between the number of children and depressive symptoms, indicating that the number of children can significantly exacerbate the depressive symptoms in old age. However, it is important to note that this result may be an illusion, as the assumption that the number of children is an exogenous variable may be too bold. It is possible that unobserved factors may be biasing the results, leading to an incorrect estimation of the effect of the number of children on depressive symptoms in late life.

In the first stage of the instrumental variable analysis, each parent with no boys in the first two births had an average of 0.52 more children compared to parent who had a boy/ boys in the first two births. This significant difference between the two groups in terms of the number of children highlighted a preference for sons in Chinese society. There is a strong statistical significance (F=111.07，p<.001), indicating that the instrumental variable used in this first stage of this study was effective in predicting the explanatory variable (number of children). In the second stage, the exogenous fertility difference between the two groups of respondents was used to estimate the effect of the number of children on depression symptoms in old age. The model showed that increasing the number of children did not have a statistically significant effect on depression symptoms in old age. The Wald test was used for the difference between groups (p<0.05), indicating that the instrumental variable regression model was more accurate in terms of satisfying exogenous conditions than the naïve probit regression model.

Furthermore, in order to acquire a more comprehensive understanding of the role of the number of children in influencing depressive symptoms in old age, and whether the results are affected by additional factors such as age, gender, marital status, educational level, and place of residence of the respondents (urban or rural), a series of classification studies were conducted. Table 3 provides the results of the classification study of age. At the same time, we classified the respondents according to their gender (as shown in Table 4), marital status (as shown in Table 5), and place of residence(as

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shown in Table 6). Similarly, we conducted a classification study of the respondents' educational attainment (as shown in Table 7).

C. Robustness test

In order to further confirm and validate the reliability and robustness of our findings, another analysis was performed with the data draw from the Chinese Longitudinal Healthy Ageing Survey of 2011, also using the instrumental variable (having no/having a boy/ boys within the first two children). Within this data set, a total of 17,641 respondents were available. Hereby, 9,950 respondents under 60 were excluded, and 3,784 respondents whom were not the primary respondents, and who had non-biological children, and who had less than 2 children, and who had twin children, and who omitted information for children's gender and birth year, were all excluded. Additionally, 33 respondents were excluded with missing values for depression-related items or with more than 3 missing items. The exclusions listed here resulted in a final analytical sample of 3,874 observations nested in 17,641.

1) Descriptive statistical analysis of older adults with / without boy/boys within the first two children

The results of this descriptive statistical analysis are as detailed in Table 8, applying the instrumental variable of whether there were boys within the first two births. Notably, parents in the sample had 3 children at average. As predicted, given that people tend to have a preference for boys, the number of children for parents without a boy/boys in the first two births was higher than that for parents with a boy/boys in the first two births. Specifically, each parent without boys in the first two births had an average of 0.52 more children than parent with boys in the first two births, which aligns with the findings of the sample of 2018. Furthermore, the descriptive statistics with the instrumental variable of whether there were boys with the first two births, revealed that the detection rate of depression symptoms was higher with more children.

2) Naïve probit regression analysis and IV-Probit regression analysis

Table 9 shows the results of both the naïve probit regression model and the instrumental variable probit (IV-Probit) regression model. Similarly, the naïve probit regression model demonstrates a significant positive correlation between the number of children and depressive symptoms among elderly individuals. This suggests that the number of children having a significant influence of exacerbation on symptoms of depression among old parents. As mentioned above, it must be noted that the assumption that the number of children is an exogenous variable may be overly optimistic. It is possible that unobserved factors may be influencing this relationship, leading to misestimation.

As illustrated in Table 9, the results of the first phase of instrumental variable analysis demonstrated that those without a boy/boys in the first two births had on average 0.52 more children per person than those who had boys in the first two births. The disparity between the two groups was statistically significant, and the F-statistic greatly exceeded 10, indicating that the instrument utilized in the first phase of this study (whether there was/were a boy/boys in the first two births) was capable of robustly predicting the explanatory variable (number of children) ($F = 75.19$, $p < .001$). This also indicated that Chinese people had a fertility preference for boys. Furthermore, in the second phase, this exogenous fertility differences between the two groups of respondents were utilized to estimate the effect of the number of children on depression symptoms in old age. Consistent with our previous findings, this model demonstrated that increasing the number of children did not have a statistically significant effect on depressive symptoms in old age. The Wald test was utilized for the difference between groups ($p<0.05$). This implies that the instrumental variable regression model is more accurate than the naïve probit model in terms of satisfying exogenous conditions.

To further probe into the possible influences of age or succession on fertility preferences and instrumental regression outcomes, the sample was regrouped and analyzed relative to the age of the respondents. Table 10 illustrates the impact of the number of children in each age group on depression symptoms in old age .

IV. RESULTS

A. The findings of statistical analysis revealed the research subjects involved in this study were 4,900 respondents from the data of 2018, and 3,874 respondents from the data of 2011 were used for the robustness test of the research results. The descriptive statistical analysis of the two sample studies revealed that the detection rate of depression symptoms in the old adults was 42.5%.

B. The regression analysis of the first stage revealed that: Chinese people had fertility preferences for boys; the fertility preference for

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sons remained consistent across generations; for the subgroup of the sample aged 70 to 79 years from the data of 2018, and the subgroup of the sample aged 60 to 69 years from the data of 2011, the instrumental effects are the strongest, and that is, these two cohorts had the most strongest preference for boys; for the subgroup of the sample aged over 80 years from the data of CHARLS 2018, and the subgroup of the sample aged over 70 years from the data of CHARLS 2011, the instrumental effects were not significant.

C. The naïve probit regression results showed a significant positive correlation between the number of children and the depressive symptoms in old age, that is, the more children, the more serious the depressive symptoms were in old age. The regression using instrumental variable showed that this effect did not exist and there was no significant relationship between the number of children and depressive symptoms in older adults. The robustness test using the sample of 2011 found consistent results with the sample of 2018. In addition, through the classification analysis of age, gender, marital status, residence (urban and rural areas) and education level, we found that the regression results of the instrumental variables were also consistent.

V. DISCUSSION

A. The current research concludes that Chinese individuals have a strong fertility preference for boys. That is consistent with previous studies [29][30][31]. In addition, the research indicates that preference for boys remains relatively consistent across generations.

B. As mentioned above, for the cohort aged 60 to 69 years of the date of 2011 and the cohort aged 70 to 79 years of the data of 2018, the instrumental effects are the strongest. We speculate that it is directly related to China's family planning policy. The family planning had been advocated since 1971, and it was written into the Constitution and was formally implemented from 1978. We speculate that people's reproductive preference would be strongly expressed in reality during this period, and these two cohorts were between 20 and 36 years old and 23 and 39 years old respectively, and were all right in the childbearing age period. The instrumental effect of the cohorts of the oldest from the two samples was not significant because there were generally much more children before family planning. Therefore, this study suggests that the birth policy of "two children" and "three children" is in line with the fertility preference of the Chinese people.

C. The instrumental variable method revealed that the number of children did not affect depression symptoms in older adults, and the results were in line with the study of the sample of 2011. Similar findings were also obtained from classification analyses based on age, sex, marital status, education level, and residence areas (urban/rural). Notably, there are a lot of studies indicate that unmarried status is a significant risk factor for depression in older adults, and for this part of people, children are the only source of family support. It is generally believed that one more child would mean there is more support available, but the results of this study showed that the relationship between the number of children and the depressive symptoms not significantly connected, which further indicated that the number of children was not an important factor in the support for depressive symptoms of old adults. In addition, previous research suggested that the association between number of children and depression symptom of older adults would be varied ed by factors such as age, gender, residence areas (urban and rural). However, the study found no correlation between number of children and depression levels of older adults once intervention factors were controlled by using IV-probit model, and the results remained consistent and steady without influences of age, sex, education level or residence areas (urban/rural).

(3)The results of naïve probit regression showed that the number of children could significantly worsen depression symptoms in older adults. But after using instrumental variables to deal with endogenous problems, this effect did not exist. The results of the study suggested that the number of children dis not affect depression symptoms among older people in China. To some extent, this study revealed that the phenomenon of "more children and less happiness" [32] was actually an "illusion." The results obtained by the traditional naïve probit regression method --"the number of children can significantly worsen depression symptoms in older adults" are biased, because there were other potential variables between the two variables. This study used instrumental variable approach to successfully avoid the risk of bias in results due to selection or reverse causality, so the results were unbiased. This study also explains to some extent that having more children may not be more fortunate, confirming that the traditional concept of "more children, more fortunate" is undergoing profound changes in current society [22], which is partially similar to the conclusions of previous studies.

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In addition, The study provides a methodological reference and empirical basis for researches using cross-sectional data to explore the causal relationship between the number of children and depressive symptoms of old adults .

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Table 1 Descriptive Statistical Analysis(CHRALS 2018)

Variables	All sample (n =4900)	Having a boy/boys within the first two children		Having no boys within the first two children	
	M±SD	n	M±SD	n	M±SD
Age	69.61±6.73	3734	69.63±6.76	1166	69.54±6.66
Number of children	3.45±1.48	3734	3.32±1.42	1166	3.84±1.58
depressive symptoms(CES-D≥20)	42.50%	1269	43.10%	472	40.50%

Table 2 Naïve probit regression and IV-Probit regression analysis(CHARLS 2018)

	Naïve probit regression		IV-Probit regression			
			Fist stage		Second stage	
	Coef.	SE	Coef.	SE	Coef.	SE
Number of children	0.06***	0.01			-0.13	0.08
Having no boys						
Having a boy/boys			-0.52***	0.05		
constant	-0.40***	0.05	3.84***	0.04	0.26	0.29

注：**p<0.005, ***p<0.001

Table 3 IV-Probit regresstion classified by ages(CHRARLS 2018)

	60- 69years old(n=2740)				70-79years old(n=1680)				80years old 以上(n=480)			
	Fist stage		Second stage		Fist stage		Second stage		Fist stage		Second stage	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Number of children			-0.17	0.11			-0.10	0.12			0.08	0.42
Having no boys												
Having a boy/boys	-0.53***	0.05			-0.61***	0.08			-0.32	0.19		
constant	3.31***	0.04	0.31	0.32	4.37***	0.07	0.17	0.49	5.13***	0.17	-0.59	2.06

注：**p<0.005, ***p<0.001

Table 4 IV-Probit regresstion classified by genders(CHARLS 2018)

Gender	Male (n=2452)				Female (n=2448)			
	Fist stage		Second stage		Fist stage		Second stage	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Number of children			-0.04	0.10			-0.22	0.15
Having no boys								
Having a boy/boys	-0.60***	0.07			-0.44***	0.07		
constant	3.81***	0.06	-0.28	0.34	3.87***	0.06	0.80	0.51

注：**p<0.005, ***p<0.001

Table 5 IV-Probit regression classified by marital status(CHARLS 2018)

Marital status	Single (n=1514)				In marriage (n=3386)			
	Fist stage		Second stage		Fist stage		Second stage	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Number of children			-0.21	0.16			-0.08	0.10
Having no boys								
Having a boy/boys	-0.52***	0.10			-0.53***	0.05		
constant	4.30***	0.09	0.80	0.60	3.65***	0.05	-0.02	0.31

注：**p<0.005, ***p<0.001

Table 6 IV-Probit regression classified by residence places(CHARLS 2018)

Residence places	Urban (n=1155)				Rural(n=3745)			
	Fist stage		Second stage		Fist stage		Second stage	
	Coef.	(SE)	Coef.	(SE)	Coef.	(SE)	Coef.	(SE)
Number of children			-0.08	0.20			-0.12	0.09
Having no boys								
Having a boy/boys	-0.44***	0.09			-0.56***	0.06		
constant	3.40***	0.08	-0.19	0.62	3.99***	0.05	0.30	0.32

注：**p<0.005, ***p<0.001

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Table 7 IV-Probit regression classified by education level (CHARLS 2018)

	Illiterate (*n*=1375)				Below primary school(*n*= 1193)				Primary school (*n*=1150)				Middle school 中学毕业(*n*=741)				High school and above (*n*=441)			
	Fist stage		Second stage		Fist stage		Second stage		Fist stage		Second stage		Fist stage		Second stage		Fist stage		Second stage	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Number of children			-0.08	0.15			-0.31	0.18			-0.20	0.20			0.02	0.19			0.09	0.38
Having no boys																				
Having a boy/boys	-0.54***	0.10			-0.51***	0.10			-0.48***	0.10			-0.58***	0.11			-0.41***	0.12		
constant	4.29***	0.09	0.38	0.57	3.81***	0.09	1.00	0.63	3.82***	0.08	0.41	0.68	3.47***	0.10	-0.47	0.58	3.17***	0.10	-1.00	1.08

注： ** p<0.005, *** p<0.001

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Table 8 Descriptive statistical analysis(CHARLS 2011)

Variables	All sample (n =3874)	Having a boy/boys within the first two children		Having no boys within the first two children	
	M±SD	n	M±SD	n	M±SD
Age	68.85±6.92	3004	68.96±6.97	870	68.50±6.67
Number of children	3.82±1.58	3004	3.70±1.51	870	4.22±1.71
depressive symptoms(CES-D≥20)	42.5%	1269	42.2%	376	43.2%

Table 9 Naïve probit regression and IV-Probit regression (CHARLS 2011)

	Naïve probit regression		IV-Probit regression			
			Fist stage		Second stage	
	Coef.	SE	Coef.	SE	Coef.	SE
Number of children	0.08***	0.01			-0.04	0.08
Having no boys						
Having a boy/ boys			-0.52***	0.06		
Constant	-0.50***	0.05	4.22***	0.05	-0.38	0.35

注：$^{*}p<0.01$, $^{**}p<0.005$, $^{***}p<0.001$

Table 10 IV-Probit regresstion classified by age (CHARLS 2011)

	60-69years old(n=2287)				70-79years old(n=1264)				80years old 及以上(n=323)			
	Fist stage		Second stage		Fist stage		Second stage		Fist stage		Second stage	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Number of children			-0.00	0.09			0.29	0.29			0.06	0.35
Having no boys												
Having a boy/boys	-0.70***	0.07			-0.31**	0.11			-0.51	0.27		
constant	3.90***	0.06	-0.20	0.31	4.58***	0.09	-1.48	1.25	5.36***	0.24	-0.30	1.75

注：$^{*}p<0.01$, $^{**}p<0.005$, $^{***}p<0.001$

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