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How far is Chinese left-behind parents' health left behind?☆

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ABSTRACT

Using data from the four waves of the China Health and Nutrition Survey (CHNS), this paper assesses the impacts of adult children migration on the health of their parents left behind. We employ the endogenous treatment effects model to address the selection bias and infer the causal effects of children migration on parental health. We find that children migration significantly impairs the health of their elderly kin. Moreover, children migration has remarkably differentiated locality, gender, age, and employment impacts, with rural, female, old-aged, and unemployed parents being more likely to suffer from poor health than their urban, male, middle-aged, and employed counterparts.

1. Introduction

Population aging and migration have posed potential challenges on the old-age support system in less developed countries that lack institutional support mechanisms. Yet, the welfare impact of children migration on the elders left behind has been studied primarily in the context of international migration (Antman, 2010; Ozden & Schiff, 2007). An emerging literature has begun to explore this linkage in the internal migration streams (Kuhn, Everett, & Silvey, 2011). However, such work remains scarce and has not yet explored the linkage within a broad spectrum of settings. In particular, there have been few studies investigating the association of the elderly dependents' well-being with children migration in China, where both the massive internal migration and rapid aging population are unique experiences in the human history (Cai & Wang, 2008).

In this paper, we infer the causal effect of adult children migration on their left-behind parents' health in the Chinese unique institutional context, where migration with family is restricted by the precepts of a national household registration (or *hukou*) system and the rapidly aging population continues to experience limited access to public services. The effect of adult children migration on the well-being of their left-behind parents is of special interest in the Chinese context for several reasons.

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First, Chinese internal migration, which is spurred by the tremendous industrialization and urbanization process, has become one of the most significant phenomenon in the last several decades. For the past few years, about 9 million people have been moving into cities every year. Consequently, a vast migrant population, including the urban-born children of recent migrants from the countryside, has now made up more than one-third of the urban total of 730 million (The Economist, 2014). They comprise about 40% of urban labor and the majority of China's workforce in manufacturing and service sectors (Miller, 2012). However, most migrants cannot change their *hukou* and are not fully entitled to welfare benefits and public services in the destination areas. Consequently, the internal migration usually remains temporary, resulting in a large left-behind population consisting of children, spouses, and parents.

Second, China is rapidly getting older. The number of people aged over 60 has reached 185 million, or 14% of the total population.[1] Moreover, its aging process would continue at a remarkable pace in the next few decades. It is predicted that China will become the world's most aged society in 2030. By 2050, the Chinese elderly would increase to 454 million or 33% of total population.[2]

Third, China is unique in encountering this serious problem of aging at a relatively early stage in its development. With limited coverage and insufficient amount of benefits provided by the public pension and health insurance system, the well-being of the elderly, rural elderly in particular, still relies heavily on family supports. The recent survey carried out by Charls Research Team (2013) finds that 88.7% of the elderly who require assistance with daily activities receive it from family members. However, the shrinking potential caregivers induced by the strict family planning policy and the massive migration of young population for employment opportunities have threatened to erode this traditional system of care inside the family. To the extent of the elderly's reliance on the adult children for old age supports, the growing prevalence of internal migration may dramatically affect the living of Chinese elderly.

Despite the momentous policy implications, there are few studies investigating the association of the elderly dependents' well-being with children migration in China. Most researchers look at the effects of migration on children or spouses left behind, with a focus on outcomes related to education, health, or labor supply (for example, see Chen, 2013; De Brauw & Rozelle, 2008; De Brauw & Mu, 2011; Hu, 2012; Mu & van de Walle, 2011). In regards to the impacts of children migration on the parents left behind, the limited amount of researches has found mixed evidences. Chang, Dong, and Macphail (2011) demonstrated that the left-behind elderly and children increased their time spent on farming and domestic work in response to migration of household members. Based on 32 life history interviews, Liu (2014) argued that it was the breakdown of the webs of interdependence and reciprocity rather than the event of migration that would adversely affect the seniors stay behind. Using the data of the 2004 General Social Survey in China, Ma and Zhou (2009) showed that the positive impact of children migration induced by higher level of income transfer to the elderly parents might dominate the negative impact arising from reduced physical care. However, besides the narrow data coverage, the issue of endogeneity and self-selection bias has not been fully addressed in these studies.

Employing data from the China Health and Nutrition Survey (CHNS), this paper tries to address three questions: (1) What is the overall effect of children migration on parental health? (2) Which groups of left-behind parents suffer most from children migration? (3) How important is it to control the endogeneity concern in understanding the selection and outcome processes?

We measure parental health with a multidimensional construct that includes self-assessed health (SAH), self-rated life satisfaction (SRLS), and body mass index (BMI). SAH, defined as "an individual's or group's perceived physical and mental health over time" (Centers for Disease Control Prevention, 2000), is not only associated with changes in daily-life functional ability (Idler & Kasl, 1995) but also a powerful predictor of mortality and morbidity (Idler & Benyamini, 1997). SRLS, defined as a cognitive "judgement of one's life as a whole" (Diener, 1994), is an important health concept due to its positive association with longevity, SAH, and good health behaviors, but negative association with psychiatric morbidity, and all-cause, disease-specific and injury mortality (see for example, Koivumaa-Honkanen et al., 2000; Strine, Chapman, Balluz, Moriarty, & Mokdad, 2008). BMI, calculated as the ratio of weight (kg) to the square of height (m^2), is widely used to gauge personal fitness and predict health outcomes.

Since migrants are not randomly selected from the general population and some unobservable factors may determine the children migration and parental health simultaneously, we employ the endogeneous treatment effects model where the children migration is instrumented with the town-level migration network to address the endogeneity concern. We find that the presence of migrant children significantly impairs the health of their parents left behind. The parents with migrant children are more likely to perceive their health as fair or poor and their life as bad or very bad, although the negative impact of children migration could be offset to some degree by the positive impact of parental education. The prevalence of low SAH and SRLS is higher for the rural, female, unemployed, and old-aged parents than are their urban, male, employed, and middle-aged counterparts. Taking the residency as an example, rural parents with migrant children are 5% and 8.7% more likely to evaluate their health as poor and fair while their urban counterparts are only 1.7% and 3.5% more likely to do so, implicating the health inequality across regions.

Our paper contributes to the existing literature studying the relationship between migration and left-behind family in three aspects. First, this paper attempts to comprehensively assess the impact of internal migration on the health of a rapidly aging population for the world's highest populated country that is still lack of well-functioning social safety net. Studying the impact of children migration on the health of their elderly kin in Chinese settings is not only important for establishing its universality but also helps determine which particular combination of institutional factors contributes to this form of linkage, hence making it possible to formulate effective public policies targeted for specific migrant populations. Second, unlike previous studies, we use the data constructed from the four waves of the China Health and Nutrition Survey (CHNS) conducted in the time of 1997 to 2006, a data set measuring various

[1] The figure is from the website of National Bureau of Statistics, available at http://www.stats.gov.cn/english/newsandcomingevents/t20120120_402780233.htm.

[2] The elderly is defined as the population aged 60 and over by the Chinese government. The data are retrieved from the World Population Prospects, the 2012 Revision. See http://esa.un.org/unpd/wpp/Excel-Data/Interpolated.htm.

dimensions of health that can be linked to changes in residence over time. Employing such data that represent a third of the country's population in nine provinces, we are released from the limitation of using data from a small, geographically restricted region that may be unrepresentative of the larger setting. Moreover, the massive size of the data could reduce the concern about selection biases. Third, this paper uses the endogeneous treatment effects model to derive the causal effect of children migration on the health of their left-behind parents. The combination of large-scale data and solid methodological framework enables our research to achieve greater causal certainty.

The rest of this paper proceeds as follows. Section 2 outlines our empirical strategy, Section 3 describes the data used in this study, Section 4 presents our empirical findings, and Section 5 concludes with policy implications.

2. Empirical strategy

In evaluating the impact of migration on family members left behind, there are a number of important methodological challenges that need to be acknowledged. First, children migration cannot be treated simply as an exogenous determinant of parental health because we could hardly know the health condition of the parents in the absence of children migration. A common approach to solve this challenge is to estimate the counterfactual health of the left-behind elderly kin and hence to assess the impact of children migration. Second, migrants are not randomly selected and some unobservable factors may determine children migration and parental health simultaneously. As summarized by Antman (2013), "Since migration is generally not random and migrants self-select, it is generally acknowledged that migration is likely to be correlated with the same factors that influence outcomes for family members left behind. Thus, it becomes difficult to determine whether migration is causing the outcome of interest or whether it is some other lurking variable that is correlated with both migration and the outcome of interest." For example, a genetically inherited deficiency or family-specific value may influence the migration decision of the children as well as the health of the parents (Antman, 2010). For this reason, an appropriate method is needed to address the possible self-selection bias in deriving the causal effect of children migration. Third, reverse causation wherein the health of the parents is actually causing the migration decision of the children, rather than the other way around, is the other potential source of endogeneity. For instance, children may respond to the infirmity of a parent by migrating to raise money for medical service or staying home to take care of their ailing parents. Giles and Mu (2007) found that younger adults with sick parents are much less likely to migrate in China. Hence, the direct effect of children migration is difficult to sign a priori.

These methodological challenges have given rise to a number of innovative approaches, including instrumental variables, counterfactual framework, and randomized or quasi-randomized experiments. Recognizing that migration is probably not randomly assigned, even conditioning on observable covariates, a number of studies have attempted to find instruments for migration. A valid instrument is a variable that predicts whether or not people migrate, but doesn't otherwise affect the left-behind families. The historical migration rates (for example, see Hildebrandt, Mckenzie, Esquivel, & Schargrodsky, 2005; Mckenzie & Rapoport, 2011), ecological variables like distance to key destination sites, as well as economic and social conditions in destination areas (see for example, Amuedo-Dorantes, Georges, & Pozo, 2010; Antman, 2011; Cortes, 2015; Yang, 2008) are the most popular instruments that have been employed to identify selection into migration.

An alternate approach is the counterfactual framework that estimates parental health in a hypothetical "without migrant children" scenario based on the observed covariates. The resulting counterfactual parental health is then compared with actual parental health measures. In the counterfactual approaches, the propensity score matching (PSM) developed by Rosenbaum and Rubin (1983), appropriate for analyzing non-experimental data, has recently attracted intensified research interests in the studies of migration (for example, see Acosta, 2006; Jimenez-Soto & Brown, 2012; Quinn & Rubb, 2005; Wong, Palloni, & Soldo, 2007). In these studies, the PSM estimators have been constructed to pair each treated observation of migration with a similar control observation of non-migration on the basis of their propensity scores, enabling the comparison of migrant households with non-migrants households who are similar in terms of their observed characteristics and hence the calculation of average treatment effects.

An emerging research effort has explored the benefit of randomized trial as the solution to endogeneity. Mergo (2011) utilized the Diversity Visa lottery program to study the effects of Ethiopian migrants to US on the source families. Gibson, Mckenzie, and Stillman (2011) exploited the randomization elicited from the New Zealand immigration ballot to address the selectivity issues. In a randomized experimental study of the effects of migration on wages, Gibson et al. (2011) compared the experimental coefficients with those derived from the OLS estimation, a number of instrumental variable (IV) models and the PSM approach, and concluded that PSM outperformed OLS or IV using a generic instrument.

In this paper, we employ the endogenous treatment effects model[3] to address the endogeneity concern and self-selection bias. Under this framework, we have an outcome equation and a treatment equation where the treatment is binary and the outcome is ordered discrete. The outcome equation describing parental health can be expressed as:

$$y_i = \begin{cases} 1 & y_i^* < \mu_1 \\ 2 & \mu_1 < y_i^* < \mu_2 \\ \vdots & \vdots \\ J & y_i^* > \mu_{J-1} \end{cases} \tag{1}$$

[3] See Imbens (2004); Cameron and Trivedi (2005), chap. 2.7; Imbens and Wooldridge (2009); and Wooldridge (2010), chap. 21 for more detailed discussions of treatment effects model.

where y_j^* is the latent outcome variable defined as

$$y_i^* = \alpha_0 + X_i\alpha_1 + T_i\alpha_2 + D_p + \varepsilon_i. \tag{2}$$

In Eq. (2), X_i is a set of observable covariates describing individual characteristics like the number of children, age, gender, years of schooling, marriage, annual personal net income, employment status, availability of health insurance, and household registration (*hukou*). D_p is a vector reflecting regional-specific shocks. ε_i is an idiosyncratic error term. T_i is the treatment variable representing children's migration decision as follows:

$$T_i = \begin{cases} 1, & \text{if } X_i\beta_1 + Z_i\beta_2 + u_i > 0 \\ 0, & \text{otherwise} \end{cases} \tag{3}$$

where $T_i = 1$ denotes the selection of migration and $T_i = 0$ the otherwise; Z_i is instrument used to model the treatment assignment. The error terms ε_i and u_i are bivariate normal with mean zero and covariance matrix of

$$\begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix} \tag{4}$$

where ρ measures the correlation between the treatment errors and the outcome errors. Both Z_i and X_i are assumed to be exogenous and unrelated to the error terms.

In line with the existing migration studies (Chen, Jin, & Yue, 2010; Hu, 2012), we instrument the children migration with the town-level migration network.[4] The role of social network in spreading job information at the destination, moderating the migration cost and facilitating the migration of other households in the same town, has been widely recognized in the literature (for example, see Du, Park, & Wang, 2005; Hare & Zhao, 2000; Mallee, 2000; Meng, 1996). The ratio of migrants to all respondents in the same town is hence constructed to represent the migration network which is expected to exert positive effects on the migration activity but no effects on the health of left-behind parents. Following Aakvik, Heckman, and Vytlacil (2005) and Gregory (in press), we estimate Eqs. (1)–(3) with the maximum likelihood approach.[5]

3. Data and summary statistics

3.1. Data source

The data used in this paper come from an ongoing, open cohort longitudinal study—China Health and Nutrition Survey (CHNS), which is a collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention. Nine waves of survey have been conducted since 1989 on 4,400 households with a total of 26,000 individuals in nine Chinese provinces (Liaoning, Heilongjiang, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, and Guizhou) that vary substantially in geography, economic development, public resources, and health indicators. Counties in all provinces are stratified by income, and a multistage, random cluster process is then adopted to select four counties out of each province. The sample is made up of 36 suburban neighborhoods and 108 towns. Since migration data were collected from 1997 onward, our analysis limits to waves starting from that year. CHNS respondents were asked questions regarding individual and household demographics, education, health and nutrition, occupations and labor force participation, income, use of health services, housing and asset ownership, time use, etc. The characteristics of the households in the sample were found to be comparable to the national averages (Chen, 2005). The variables used in this study are constructed from the answers for these questions and are listed in Table 1.

3.2. Measurement of children migration and parental health

Although CHNS was not originally designed to study migration behavior, we could identify the migration status of family members from the household roster. From the 1997 wave on, whenever a family member including spouse, children, grandchildren etc., was in a previous wave of survey but not in the current wave, the head of household would be asked the question whether this family member still lives in his (her) household (coded 1 = yes; 2 = no, gone to school; 3 = no, military service; 4 = no, sought employment elsewhere; 5 = no, gone abroad; 6 no, other; 9 unknown). This question records the reason for family members being absent and hence allows us to distinguish children migration for employment purpose from other motives such as marriage, military service, schooling, etc. In our paper, those parents whose answer is "4" for their absent children are regarded as having migrant children.

The parental health, which is our main outcome variable of interest, is first gauged by their self-assessed health (SAH) relative to people of their age. In the CHNS, a respondent's SAH status is measured by the answer to the question, "Right now, how would you

[4] The historical migration rate is not adopted as the instrumental variable in this study due to the concern of weak instruments. The rapid and dramatic economic and social transformations China experienced in the last three decades have tremendously changed the migration-related infrastructure like railroads and highways. Therefore, the linkage of historical migration rates with current migration pattern might have diminished considerably over time.

[5] The estimation is implemented by the stata code "treatoprobit" developed by Gregory (in press).

Table 1
Description of variables.

Variable	Notation	Description
Self-assessed health	*SAH*	4 = excellent, 3 = good, 2 = fair, 1 = poor
Self-rated life satisfaction	*SRLS*	4 = excellent, 3 = good, 2 = fair, 1 = poor
Body mass index	*BMI*	Mass(kg)/height^2(m^2)
Having migrant children	*childout*	1 = yes, = no
Number of children	*childnum*	Unit: person
Age	*age*	Unit: year
Gender	*gender*	1 = male, 0 = female
Marital status	*married*	1 = married, 0 = otherwise
Working status	*employment*	1 = working, 0 = otherwise
Access to health insurance	*hinsurance*	1 = with health insurance, 0 = otherwise
Years of education completed	*education*	Unit: year
Personal income	*income*	Unit: RMB 10,000 earned per year
Urban household registration	*urbanhukou*	1 = urban, 0 = rural
Town migration network	*mignet*	Number of migrants/total respondents in the same town

Data source: China Health and Nutrition Survey, 1997-2009.

describe your health compared to that of other people your age?" (Coded 1 = excellent, 2 = good, 3 = fair, and 4 = poor). This question hence describes an individual's general state of health at the time of interview. We reverse the scale to be an increasing ordinal so that 1 represents "poor health" while 4 for "excellent health". However, CHNS does not ask this question after 2009. Therefore, our analysis on the parents' health gauged by SAH runs only from 1997 to 2006 wave.

As a subjective measure, SAH may be susceptible to perception bias because the knowledge of one's health would be related with personal values, beliefs, and information. However, several studies (see for example, Idler & Benyamini, 1997; Franks, Gold, & Fiscella, 2003; Van Doorslaer & Jones, 2003) have proved that subjective measures of health have substantial value in predicting objective health outcomes, including morbidity and mortality. Moreover, Benjamin, Brandt, and Fan (2003) demonstrated that SAH does a good job of forecasting subsequent mortality in the CHNS data. Thus, SAH should be a valid and reliable measurement of health status.

In addition, we evaluate the impacts of children migration on left-behind parents' self-rated life satisfaction (SRLS), the other important health concept that is closely related with longevity, health behaviors, morbidity, and mortality. In the CHNS, from the 2006 wave on, the respondents were asked the question "How do you rate your life at present?" (Coded 1 = very good, 2 = good, 3 = OK, 4 = bad, and 5 = very bad). In our sample, only 21 respondents rated their life as "very bad", accounting for 1.74% of full sample. We therefore combine this group of respondents with those reported their life as "bad" and reverse the scale so that 4 represents "very good" and 1 "very bad or bad".

Table 2
Descriptive statistics.

	Full sample				Having migrant children (Mean)	
	Range	Mean	Median	S.D.	No	Yes
Dependent variables						
SAH	1–4	2.67	3	0.76	2.70	2.58***
SRLS	1–4	2.48	2	0.86	2.56	2.38***
BMI	13.06/43.37	23.08	22.76	3.23	23.23	22.65***
Independent variables						
childout	No/yes	0.26	0	0.44	–	–
Controls						
income	0–62.21	1.74	1.26	1.92	1.84	1.48***
employment	No/Yes	0.71	1	0.45	0.69	0.78***
childnumber	1–7	1.75	2	0.84	1.62	2.15***
age	35–97	49.79	48.27	10.13	49.09	51.82***
gender	0/1	0.48	0	0.50	0.49	0.48*
married	No/yes	0.92	1	0.27	0.92	0.92
education	0–19	6.51	6	4.63	6.87	5.48***
hinsurance	No/yes	0.32	0	0.50	0.33	0.28***
urbanhukou	No/yes	0.38	0	0.49	0.45	0.17***
Instrumental variable						
mignet	0 to 0.23	0.07	0.05	0.06	0.06	0.12***

Notes: 1) Authors' calculation based on the data from China Health and Nutrition Survey, 1997–2009.
2) *SAH*, self-assessed health; *SRLS*, self-rated life satisfaction; *BMI*, body mass index; *childout*, having migrant children; *childnumber*, number of children; *hinsurance*, access to health insurance; *urbanhukou*, urban household registration; *mignet*, town migration network; please refer to Table 1 for the detailed description of each variable.
* Difference in means for the two groups of parents at 10% level of statistical significance.
*** Difference in means for the two groups of parents at 1% level of statistical significance

Furthermore, we assess the impacts of children migration on the body mass index (BMI) of their parents left behind. BMI, the ratio of a person's weight to his (her) height in meters squared, is an index that has been widely used by health agencies to measure the fitness of adults.

3.3. Descriptive statistics

Table 2 reports the descriptive statistics of all variables used in this paper.[6] A simple comparison of means on SAH and SRLS between parents with migration children and those without indicates that geographic separation with children have inevitably negative effects upon the health of left-behind seniors. The former group is more likely to report lower health (2.58 vs 2.70), lower life satisfaction (2.38 vs 2.56), and lower BMI (22.65 vs 23.23).

Table 3 compares the distribution of parental health by their children's migration status. It shows that the health of the parents having migrant children is shifted left from that of parents without migration children. This implies that parents with migrant children are more likely to rate their health as poor or fair and their life as very bad, bad, or OK, while parents without migrant children are more likely to report their health as good or excellent and their life as good or very good.

4. Empirical results

This section presents the empirical results estimated by ordered Probit regression and endogenous treatment effects model.

4.1. Ordered Probit regression results

As a baseline, Table 4 reports the ordered Probit regression results. We don't find any significant relations between children migration and the SAH of their left-behind parents. This might be due to the unsolved endogeneity problem of children migration.

Other interesting correlations show that education, employment, and urban *hukou* are positively and significantly associated with parental health. This implies that people with better education attainment, jobs, and urban *hukou* tend to have higher probability of reporting good health. Age is found to be negatively associated with the SAH of parents left behind.[7] Neither marriage nor the number of children has any sizable effects on the parental SAH.

The ordered Probit regression result indicates that women are more likely to report poor health. To examine the potential differentiated impact of children migration on male and female parents, we divide the sample into two groups by the gender and report the regression results in columns (2) and (3), respectively. However, no significant relations between children migration and parental SAH are discovered.

Because the effects of children migration on parental health may vary by the age, we divide the parents into two groups of below 60 years old and equal to or above 60 years old. The estimation results are presented in columns (4) and (5). However, children migration is not significantly associated with the SAH for the parents of both age cohorts.

The regression on the full sample implies that employment is positively and significantly associated with parental health and hence might play an important role in moderating the adverse impacts of children migration. This chimes with the existing research on employment and subjective health (Böckerman & Ilmakunnas, 2009; Mathers & Schofield, 1998). However, the regressions on the two separate groups of employed and unemployed parents listed in column (6) and (7) do not find any significant relations between *childout* and parental SAH.

Considering the widely acknowledged urban-rural health disparity in China (for example, see Zimmer, Kaneda, & Spess, 2007; Zimmer, Kaneda, Tang, & Fang, 2010; Zimmer, Wen, & Kaneda, 2010), we divide the parents into two groups by their *hukou* status. The regression results listed in columns (8) and (9) indicate that only the urban parents' SAH is negatively associated with children migration at 10% of statistical significance.

4.2. Endogenous treatment effects regression results

This section reports the estimation results of the endogenous treatment effects model described in Section 2. We present first the estimated coefficients and then the marginal treatment effect.

4.2.1. Estimated coefficients

Tables 5 and 6 report the estimates of the parameters of the treatment equation and the outcome equation. Consider first the parameters related to the determinants of having migrant children. As expected, the town migration network (*mignet*) is found to significantly increase the probability of having migrant children. Moreover, the parameter on the instrumental variable is significant at 1% level, indicating the strong predictive power of town migration network. Female and married parents are more likely to have migrant children as are parents with more children, lower level of income, jobs, or rural *hukou*. This is consistent with the background of

[6] To minimize the impact of data errors and outliers, we also winsorize all parent characteristics at the 1st and 99th percentiles and re-do the regression analysis. The empirical results are similar and available upon request.

[7] We have tried to include the age squared in the regression and found that the turning point is around 35 years old which is the minimum value of the parental age. Therefore, it is not necessary to put it in the regression.

Table 3
Parental SAH and SRLS by children's migration status.

	Self-assessed health (SAH)				Self-rated life satisfaction (SRLS)		
	Having migrant children				Having migrant children		
	No	Yes	Total		No	Yes	Total
Poor	5.9%	7.4%	6.3%	Very bad/bad	10.2%	12.2%	11.0%
Fair	30.8%	36.7%	32.3%	OK	39.5%	47.3%	42.8%
Good	50.8%	46.3%	49.6%	Good	34.8%	30.4%	33.0%
Excellent	12.5%	9.6%	11.8%	Very good	15.5%	10.1%	13.2%

Notes: Authors' calculation based on the data from China Health and Nutrition Survey, 1997–2009.

Table 4
Children migration and parental SAH: ordered Probit regression.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SAH	Full sample	Male	Female	Age < 60	Age≥60	Employed	Unemployed	Urban	Rural
childout	−0.030	−0.021	−0.041	−0.018	−0.088	−0.026	−0.056	−0.084*	−0.009
	(0.023)	(0.034)	(0.032)	(0.026)	(0.058)	(0.027)	(0.047)	(0.050)	(0.026)
income	0.008*	0.007	0.009	0.013**	−0.006	0.010	0.009	0.007	0.012
	(0.005)	(0.007)	(0.007)	(0.005)	(0.009)	(0.006)	(0.009)	(0.007)	(0.008)
employment	0.115***	0.146***	0.095***	0.101***	0.284***	–	–	0.158***	0.103***
	(0.025)	(0.041)	(0.032)	(0.028)	(0.061)	–	–	(0.039)	(0.034)
childnumber	−0.010	−0.003	−0.017	−0.010	−0.022	−0.011	−0.007	0.006	−0.022
	(0.013)	(0.018)	(0.018)	(0.015)	(0.027)	(0.015)	(0.023)	(0.025)	(0.015)
age	−0.023***	−0.021***	−0.024***	−0.024***	−0.019***	−0.023***	−0.022***	−0.018***	−0.026***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
gender	0.204***	–	–	0.206***	0.206***	0.220***	0.162***	0.161***	0.229***
	(0.022)	–	–	(0.024)	(0.055)	(0.025)	(0.042)	(0.035)	(0.028)
married	0.013	−0.032	0.049	0.082*	−0.067	0.012	0.026	0.043	0.004
	(0.038)	(0.064)	(0.047)	(0.048)	(0.062)	(0.050)	(0.056)	(0.058)	(0.050)
education	0.011***	0.017***	0.006	0.010***	0.020***	0.014***	0.007	0.010**	0.012***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.006)	(0.003)	(0.005)	(0.004)	(0.004)
hinsurance	−0.059***	−0.048	−0.065**	−0.074***	0.024	−0.053**	−0.071**	−0.080**	−0.046*
	(0.020)	(0.029)	(0.028)	(0.022)	(0.051)	(0.025)	(0.033)	(0.031)	(0.027)
urbanhukou	0.059**	0.022	0.096***	0.029	0.271***	0.034	0.096**	–	–
	(0.025)	(0.035)	(0.035)	(0.027)	(0.062)	(0.030)	(0.041)	–	–
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.049	0.044	0.046	0.035	0.034	0.043	0.041	0.047	0.052
Observations	14584	7060	7524	12259	2325	10362	4222	5534	9050

Notes: 1) Authors' estimation based on the data from China Health and Nutrition Survey, 1997–2006. Standard errors are given in parenthesis.
2) *SAH*, self-assessed health; *childout*, having migrant children; *childnumber*, number of children; *hinsurance*, access to health insurance; *urbanhukou*, urban household registration (*hukou*); please refer to Table 1 for the detailed description of each variable.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

most internal migrants. They come from countryside and a low-income family, move to cities to seek job opportunities with higher pay. The probability of children migration is increasing with parental age.

Table 6 summarizes the endogenous treatment effects regression results on the parental SAH. The estimated correlation coefficients between the treatment errors and the outcome errors reported at the lower part of the table (atanh ρ) are statistically significant in most regressions, indicating that unobservables that determine children migration tend to move with unobservables that affect parental health.[8] Therefore, addressing endogeneity issue is of critical importance to infer the causal effect of children migration on parental health. Column (1) shows the regression result on the full sample. Comparing with the ordered Probit regression presented in Table 4, the estimated parameter on *childout*, our main interest variable, is now not only statistically significant but also large in size, implying that the parents with migrant children have a greater likelihood of reporting poor health, or migrant children significantly impair the health of their left-behind parents. The coefficients on *education* and *employment* are significantly positive, hinting that higher level of education and employment help to alleviate the negative impacts triggered by the children migration.

To comprehend the different impacts of children migration on the male versus female parents, we divide the sample into two groups by gender and report the regression results in columns (2) and (3), respectively. The coefficient on *childout* is around 3 times larger in magnitude for the female group than that for the male group, suggesting that female parents tend to suffer more from the children migration than male parents. This might be due to the reality that women, especially those living in rural

[8] In the maximum likelihood estimation, the correlation coefficient between the treatment errors and the outcome errors, ρ, as defined in covariance matrix (4) is not estimated directly. Rather, we report the value of atanh ρ which is calculated as atanh $\rho = 0.5 \ln[(1+\rho)/(1-\rho)]$.

Table 5
Selection equation results: determinants of children migration.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
childout	Full sample	Male	Female	Age < 60	Age≥60	Employed	Unemployed	Urban	Rural
mignet	8.679***	8.721***	8.654***	9.158***	8.045***	8.977***	8.072***	7.601***	9.153***
	(0.230)	(0.333)	(0.318)	(0.261)	(0.569)	(0.282)	(0.423)	(0.417)	(0.284)
income	−0.060***	−0.062***	−0.061***	−0.055***	−0.204***	−0.032***	−0.126***	−0.046***	−0.059***
	(0.010)	(0.015)	(0.014)	(0.010)	(0.030)	(0.009)	(0.027)	(0.016)	(0.011)
employment	0.287***	0.380***	0.232***	0.197***	0.364***	–	–	0.049	0.392***
	(0.035)	(0.059)	(0.045)	(0.039)	(0.081)	–	–	(0.065)	(0.044)
childnumber	0.315***	0.317***	0.310***	0.312***	0.239***	0.316***	0.314***	0.351***	0.310***
	(0.017)	(0.024)	(0.023)	(0.019)	(0.041)	(0.021)	(0.032)	(0.035)	(0.020)
age	0.026***	0.030***	0.023***	0.059***	−0.006	0.041***	0.002	0.015***	0.029***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.007)	(0.002)	(0.003)	(0.003)	(0.002)
gender	−0.082***	–	–	−0.092***	−0.076	−0.082**	−0.093*	−0.056	−0.088***
	(0.027)	–	–	(0.031)	(0.071)	(0.032)	(0.056)	(0.053)	(0.033)
married	0.142***	0.000	0.221***	−0.011	0.062	0.065	0.095	0.050	0.162**
	(0.052)	(0.086)	(0.065)	(0.067)	(0.083)	(0.070)	(0.080)	(0.089)	(0.064)
education	0.003	0.012**	−0.006	0.001	0.026***	0.006	0.000	0.001	0.006
	(0.003)	(0.005)	(0.005)	(0.004)	(0.009)	(0.004)	(0.006)	(0.006)	(0.004)
hinsurance	0.085***	0.078**	0.094**	0.093***	0.140*	0.063*	0.186***	0.060	0.103***
	(0.027)	(0.039)	(0.037)	(0.029)	(0.072)	(0.033)	(0.049)	(0.045)	(0.034)
urbanhukou	−0.485***	−0.519***	−0.443***	−0.507***	−0.361***	−0.575***	−0.272***	–	–
	(0.033)	(0.048)	(0.046)	(0.037)	(0.086)	(0.044)	(0.055)	–	–
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC	12817.9	6108.7	6724.1	10387.3	1956.2	9276.0	3329.9	3319.1	9473.3
BIC	12962.0	6232.2	6848.7	10528.1	2065.5	9406.5	3444.2	3438.3	9601.3
Log–likelihood	−6389.9	−3036.4	−3344.0	−5174.6	−959.1	−4620.0	−1647.0	−1641.6	−4718.7
Observations	14584	7060	7524	12259	2325	10362	4222	5534	9050

Notes: 1) Authors' estimation based on the data from China Health and Nutrition Survey, 1997–2006. Standard errors are given in parenthesis.
2) *childout*, having migrant children; *mignet*, town migration network; *childnumber*, number of children; *hinsurance*, access to health insurance; *urbanhukou*, urban household registration (*hukou*); please refer to Table 1 for the detailed description of each variable.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

poverty-stricken areas, have less decision-making power at home and less chance of receiving education, nutrition, and health care in China (World Bank, 2006). Moreover, most farm work has fallen to women when other household members leave the town for the job opportunities (Mu & van de Walle, 2011).

Considering the reality that health usually declines with age, we divide the parents into two groups to see how the effect of children migration differentiates between middle-aged and old-aged parents. The estimation results presented in columns (4) and (5) imply that the impact of children migration on the health of the parents equal to or more than 60 years old is more than 5 times larger in size than that on the parents less than 60 years old, hinting that the adverse health effect of children migration is much more sever for the old-aged parents who are usually more infirm and have more needs for health care. This is in line with the reality that quite a lot of Chinese elderly people still rely heavily on their adult children for the old age supports and physical care, thanks to the limited access to the welfare benefits and public services. Children migration hence imposes a big challenge for the health of their left-behind elderly kin.

In line with the regression on the full sample, the regression results on the two separate groups of employed and unemployed parents reported in columns (6) and (7) show that the SAH of unemployed parents are more susceptible to the adverse impact of children migration.

Place of residence has long been regarded as an important health determinant. This is especially true in China, where the urban and rural disparities are tremendous due to legal designations implemented by the *hukou* system and the differentiated economic, population, social, and health policies applied to the two sectors. Most advantages including insurance coverage and health services accrued to urban areas and residents. The regression results presented in columns (8) and (9) indicate that the negative impact of children migration is more acute on the SAH of the rural parents than that on the urban parents. This might be due to the reality that the elderly living in rural area relies more heavily on their children for old age support than the urbanites due to the limited access to the public pension and health insurance system. Children migration would unavoidably hurt the health of rural parents much more than that of urban parents.

4.2.2. Marginal treatment effect

Of particular interest in this study is the marginal treatment effect (MTE), i.e., the average health effects of children migration for the parents who are on the margin of indifference between having a migrant child ($T_i = 1$) or not ($T_i = 0$). We follow Aakvik et al. (2005) and Gregory (in press) approach to estimate the marginal treatment effect.

Table 6
Children migration and parental SAH: endogeneous treatment effects regression.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SAH	Full sample	Male	Female	Age < 60	Age≥60	Employed	Unemployed	Urban	Rural
childout	−0.317***	−0.156*	−0.453***	−0.171**	−0.950***	−0.289***	−0.420***	−0.142	−0.377***
	(0.061)	(0.091)	(0.081)	(0.066)	(0.112)	(0.071)	(0.124)	(0.160)	(0.069)
income	0.005	0.006	0.004	0.011*	−0.025*	0.008	0.000	0.006	0.006
	(0.005)	(0.007)	(0.007)	(0.006)	(0.015)	(0.006)	(0.010)	(0.007)	(0.007)
employment	0.139***	0.161***	0.124***	0.111***	0.357***	–	–	0.159***	0.145***
	(0.024)	(0.037)	(0.031)	(0.026)	(0.061)	–	–	(0.037)	(0.032)
childnumber	0.023	0.012	0.030	0.006	0.069**	0.019	0.033	0.012	0.024
	(0.014)	(0.021)	(0.019)	(0.016)	(0.031)	(0.017)	(0.028)	(0.029)	(0.017)
age	−0.020***	−0.020***	−0.020***	−0.021***	−0.018***	−0.019***	−0.021***	−0.018***	−0.021***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
gender	0.193***	–	–	0.200***	0.174***	0.209***	0.150***	0.161***	0.210***
	(0.020)	–	–	(0.022)	(0.051)	(0.023)	(0.037)	(0.032)	(0.026)
married	0.023	−0.032	0.071	0.081*	−0.058	0.017	0.032	0.043	0.025
	(0.036)	(0.060)	(0.046)	(0.049)	(0.056)	(0.050)	(0.054)	(0.057)	(0.047)
education	0.012***	0.018***	0.006*	0.010***	0.023***	0.015***	0.007	0.010**	0.014***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.006)	(0.003)	(0.004)	(0.004)	(0.003)
hinsurance	−0.049**	−0.044	−0.049*	−0.069***	0.054	−0.041	−0.058	−0.080***	−0.017
	(0.021)	(0.030)	(0.029)	(0.022)	(0.051)	(0.026)	(0.037)	(0.030)	(0.030)
urbanhukou	0.009	−0.002	0.027	0.004	0.108*	−0.013	0.049	–	–
	(0.025)	(0.036)	(0.034)	(0.027)	(0.064)	(0.032)	(0.041)	–	–
atanh ρ	0.192***	0.089	0.279***	0.103**	0.648***	0.177***	0.237***	0.034	0.254***
	(0.038)	(0.055)	(0.053)	(0.041)	(0.096)	(0.045)	(0.076)	(0.087)	(0.046)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC	44419.4	21348.4	23098.2	36894.3	7015.5	31203.4	12984.2	15445.6	28932.2
BIC	44730.5	21616.1	23368.3	37198.3	7251.3	31486.0	13231.7	15703.8	29209.5
Log–likelihood	−22168.7	−10635.2	−11510.1	−18406.2	−3466.7	−15562.7	−6453.1	−7683.8	−14427.1
Observations	14584	7060	7524	12259	2325	10362	4222	5534	9050

Notes: 1) Authors' estimation based on the data from China Health and Nutrition Survey, 1997–2006. Standard errors are given in parenthesis.
2) *SAH*, self-assessed health; *childout*, having migrant children; *childnumber*, number of children; *hinsurance*, access to health insurance; *urbanhukou*, urban household registration (*hukou*); atanh $\rho = 0.5 \ln[(1+\rho)/(1-\rho)]$; please refer to Table 1 for the detailed description of each variable.
* p < 0.1.
** p < 0.05.
*** p < 0.01.

The estimated MTE presented in Table 7 provides a similar qualitative picture as the regression results reported in Table 6. Children migration is found to yield remarkably negative impact on their parental health. The estimation results for the full sample indicate that having a migrant child increases the probability for a parent to report poor health by 4.1% and fair health by 7.4% while lowers the probability for them to feel good or excellent health by 6.2% and 5.4%, respectively. Rows (2) and (3) show the MTE for male and female parents, respectively. Comparing with the fathers, the mothers with migrant children have higher probability of reporting poor

Table 7
Marginal treatment effect (MTE) of children migration.

		Poor	Fair	Good	Excellent
(1)	Full sample	0.041	0.074	−0.062	−0.054
		[0.014, 0.083]	[0.034, 0.087]	[−0.098, −0.001]	[−0.092, −0.019]
(2)	Male	0.017	0.038	**−0.025**	−0.031
		[0.006, 0.037]	[0.024, 0.043]	**[−0.048, 0.009]**	[−0.050, −0.011]
(3)	Female	0.069	0.101	−0.104	−0.066
		[0.030, 0.128]	[0.030, 0.124]	[−0.138, −0.039]	[−0.112, −0.022]
(4)	Age < 60	0.022	0.040	**−0.032**	−0.030
		[0.007, 0.045]	[0.019, 0.047]	**[−0.053, 0.004]**	[−0.052, −0.010]
(5)	Age ≥ 60	0.156	0.187	−0.191	−0.152
		[0.066, 0.295]	[0.003, 0.251]	[−0.264, −0.058]	[−0.256, −0.046]
(6)	Employed	0.033	0.071	**−0.055**	−0.049
		[0.011, 0.067]	[0.043, 0.081]	**[−0.091, 0.005]**	[−0.086, −0.018]
(7)	Unemployed	0.070	0.089	−0.090	−0.069
		[0.034, 0.121]	[0.028, 0.112]	[−0.122, −0.034]	[−0.110, −0.028]
(8)	Urban	0.017	0.035	**−0.025**	−0.027
		[0.006, 0.034]	[0.020, 0.039]	**[−0.043, 0.003]**	[−0.043, −0.010]
(9)	Rural	0.050	0.087	**−0.074**	−0.063
		[0.016, 0.103]	[0.033, 0.103]	**[−0.117, 0.003]**	[−0.111, −0.020]

Notes: Authors' estimation based on the data from China Health and Nutrition Survey, 1997–2006. 90% confidence intervals are reported in brackets. The results in bold are statistically insignificant.

(6.9% vs 1.7%) and fair health (10.1% vs 3.8%) while lower probability of reporting excellent health (−6.6% vs −3.1%). Rows (4) and (5) present the MTE for different age cohorts. Old-aged parents having children working out of town are more likely to evaluate their health as poor or fair. For example, the parents aged equal to or more than 60 years old are 15.6% and 18.7% more likely to report poor and fair health while parents below 60 years old only have 2.2% and 4.0% of probability of saying so. Rows (6) and (7) compare the MTE of children migration on employed and unemployed parents. The unemployed parents might suffer more from children migration because they are more likely to evaluate their health as poor and fair than the parents with jobs. The MTEs presented in rows (8) and (9) indicate that the prevalence of poor/fair SAH is higher for rural parents with migrant children, compared with their urban counterparts.

4.3. Children migration, parents' life satisfaction and body mass index

Tables 8 and 9 present the endogeneous treatment effects regression results for parents' SRLS and BMI. The statistically significant correlations between the treatment errors and the outcome errors (atanh ρ) imply the necessity of using treatment effects model to address the endogeneity concern. Children migration significantly impair parental life satisfaction. The prevalence of suboptimal life satisfaction is higher for female and old-aged parents compared with their male and middle-aged counterparts. Consistent with our expectations, education and income are proven to be important factors to boost the happiness of respondents. Moreover, parents with migrant children are found to have lower weights relative to their heights, especially for the female, old-aged, and unemployed parents.

5. Conclusion

Using the China Health and Nutrition Survey data, this paper employs the endogeneous treatment effects approach to study the impact of adult children migration on the health of their parents left behind. We find that children migration significantly lower their parental health after controlling the factors of age, gender, income, the number of children, years of education, availability of health insurance, household registration, etc. Moreover, children migration has strikingly differentiated locality, gender, age, and employment effects with the health reduction being greater for rural, female, old-aged, and unemployed parents, than that for urban, male, middle-aged, and employed parents.

Table 8
Children migration and parental SRLS: endogeneous treatment effects regression.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRLS	Full	Male	Female	Age < 60	Age≥60	Employed	Unemployed	Urban	Rural
childout	−0.598***	−0.580**	−0.673***	−0.560**	−0.674***	−0.885***	−0.205	−0.669*	−0.596**
	(0.187)	(0.269)	(0.260)	(0.274)	(0.242)	(0.244)	(0.332)	(0.345)	(0.239)
income	0.016**	0.019	0.012	0.006	0.025**	0.000	0.095***	0.075**	0.004
	(0.007)	(0.016)	(0.009)	(0.011)	(0.012)	(0.016)	(0.028)	(0.032)	(0.011)
employment	0.130	0.293**	−0.036	0.045	0.201*	–	–	0.024	0.126
	(0.083)	(0.119)	(0.122)	(0.129)	(0.111)	–	–	(0.170)	(0.102)
childnumber	0.053	0.073	0.041	0.042	0.057	0.094*	0.005	0.036	0.071*
	(0.034)	(0.048)	(0.049)	(0.054)	(0.045)	(0.051)	(0.051)	(0.070)	(0.041)
age	−0.009*	−0.007	−0.012*	−0.000	−0.001	−0.013	−0.010	−0.008	−0.016**
	(0.005)	(0.008)	(0.007)	(0.033)	(0.008)	(0.010)	(0.006)	(0.008)	(0.007)
gender	0.046	–	–	0.091	0.033	0.174	0.003	0.135	0.037
	(0.071)	–	–	(0.115)	(0.094)	(0.114)	(0.096)	(0.128)	(0.090)
married	0.059	0.073	0.063	0.025	0.077	0.239	−0.015	−0.129	0.120
	(0.092)	(0.181)	(0.116)	(0.203)	(0.107)	(0.174)	(0.112)	(0.154)	(0.123)
education	0.025***	0.036***	0.014	0.014	0.034***	0.031**	0.015	0.026*	0.017
	(0.009)	(0.012)	(0.014)	(0.015)	(0.011)	(0.015)	(0.011)	(0.013)	(0.013)
hinsurance	0.123*	0.167	0.080	0.065	0.157	0.081	0.048	0.114	0.077
	(0.074)	(0.108)	(0.105)	(0.125)	(0.098)	(0.125)	(0.100)	(0.141)	(0.092)
urbanhukou	−0.146	−0.056	−0.251*	−0.242	−0.108	−0.306*	−0.066	–	–
	(0.089)	(0.128)	(0.129)	(0.149)	(0.117)	(0.174)	(0.114)	–	–
atanh ρ	0.321**	0.267	0.427**	0.294	0.377**	0.599***	0.064	0.265	0.360**
	(0.130)	(0.187)	(0.191)	(0.192)	(0.174)	(0.208)	(0.207)	(0.239)	(0.172)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC	4137.7	2087.7	2093.5	1748.2	2416.5	1776.6	2360.7	1426.7	2722.1
BIC	4346.6	2259.1	2265.4	1920.7	2599.0	1940.6	2538.7	1586.4	2902.9
Log–likelihood	−2027.9	−1004.9	−1007.7	−833.1	−1168.2	−849.3	−1141.3	−674.4	−1322.1
Observations	1205	599	606	496	709	496	709	443	762

Notes: 1) Authors' estimation based on the data from China Health and Nutrition Survey, 2006–2009. Standard errors are given in parenthesis.
2) *SRLS*, self-rated life satisfaction; *childout*, having migrant children; *childnumber*, number of children; *hinsurance*, access to health insurance; *urbanhukou*, urban household registration (*hukou*); atanh $\rho = 0.5 \ln[(1+\rho)/(1-\rho)]$; please refer to Table 1 for the detailed description of each variable.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 9
Children migration and parental BMI: endogeneous treatment effects regression.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
BMI	Full sample	Male	Female	Age < 60	Age≥60	Employed	Unemployed	Urban	Rural
childout	−0.563***	0.014	−0.994***	−0.387**	−1.209**	−0.391*	−0.845**	0.517	−0.401*
	(0.189)	(0.366)	(0.223)	(0.195)	(0.470)	(0.212)	(0.373)	(0.507)	(0.206)
income	0.076***	0.120***	0.033	0.088***	0.005	0.090***	0.028	0.032	0.128***
	(0.022)	(0.034)	(0.028)	(0.025)	(0.034)	(0.031)	(0.031)	(0.021)	(0.048)
employment	−0.516***	−0.427***	−0.619***	−0.472***	−0.587***	–	–	−0.177	−0.559***
	(0.070)	(0.110)	(0.093)	(0.075)	(0.192)	–	–	(0.110)	(0.095)
childnumber	0.170***	0.083	0.239***	0.095**	0.223**	0.115**	0.287***	0.168*	0.087*
	(0.041)	(0.063)	(0.057)	(0.044)	(0.101)	(0.046)	(0.085)	(0.090)	(0.047)
age	−0.009**	−0.022***	0.003	0.013**	−0.064***	−0.009*	−0.012**	0.013**	−0.024***
	(0.004)	(0.006)	(0.006)	(0.006)	(0.015)	(0.005)	(0.006)	(0.006)	(0.005)
gender	−0.411***	–	–	−0.354***	−0.769***	−0.359***	−0.574***	−0.112	−0.634***
	(0.057)	–	–	(0.060)	(0.163)	(0.065)	(0.117)	(0.095)	(0.070)
married	0.287***	0.072	0.511***	0.237*	0.221	0.369***	0.237	0.320*	0.303**
	(0.107)	(0.152)	(0.145)	(0.126)	(0.188)	(0.126)	(0.182)	(0.179)	(0.129)
education	0.013*	0.048***	−0.008	0.006	0.049**	0.020**	−0.002	0.001	0.029***
	(0.007)	(0.011)	(0.010)	(0.008)	(0.019)	(0.009)	(0.014)	(0.012)	(0.009)
hinsurance	0.274***	0.408***	0.122	0.287***	0.183	0.333***	0.207*	0.071	0.419***
	(0.059)	(0.081)	(0.083)	(0.062)	(0.166)	(0.068)	(0.113)	(0.087)	(0.083)
urbanhukou	0.771***	1.012***	0.525***	0.640***	1.564***	0.708***	0.809***	–	–
	(0.073)	(0.110)	(0.103)	(0.077)	(0.203)	(0.089)	(0.128)	–	–
atanh ρ	0.113***	−0.002	0.185***	0.051	0.263***	0.081*	0.153**	−0.033	0.071
	(0.038)	(0.083)	(0.041)	(0.041)	(0.084)	(0.045)	(0.064)	(0.088)	(0.044)
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC	80746.8	37459.4	43110.3	66798.0	13313.6	56541.4	23892.4	29770.5	50793.5
BIC	81047.4	37716.8	43371.3	67091.7	13540.9	56813.9	24131.2	30019.4	51061.0
Log–likelihood	−40333.4	−18691.7	−21517.1	−33359.0	−6616.8	−28232.7	−11908.2	−14847.3	−25358.8
Observations	13572	6468	7104	11404	2168	9618	3954	5157	8415

Notes: 1) Authors' estimation based on the data from China Health and Nutrition Survey, 1997–2006. Standard errors are given in parenthesis.
2) *BMI*, body mass index; *childout*, having migrant children; *childnumber*, number of children; *hinsurance*, access to health insurance; *urbanhukou*, urban household registration (*hukou*); atanh$\rho = 0.5\ \ln[(1+\rho)/(1-\rho)]$; please refer to Table 1 for the detailed description of each variable.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

These empirical findings reinforce our understanding of the role of traditional family support system in the context of massive demographic transition toward urbanization and aging population. Lack of well-functioning social security and health care system, the children migration for employment opportunities hasten the deterioration of parental health. Improving safety nets and reforming current *hukou* system may have considerably beneficial effects for the elderly's welfare in China.

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