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https://doi.org/10.5109/4363561

出版情報：九州大学大学院農学研究院紀要. 66 (1), pp.135-143, 2021-03-01. Faculty of Agriculture, Kyushu University
バージョン：
権利関係：

J. Fac. Agr., Kyushu Univ., **66** (1), 135–143 (2021)

How Does Adult Children Migration Affect Parental Health in Rural China: a Mediating Effect of Two–way Income Transfer

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(*Received October 30, 2020 and accepted November 4, 2020*)

This study examines two–way income transfers to gauge how adult children migration affects the multidimensional health of the parents by using a mediation model. We focus on the two–way income transfer effects, which equal remittances from migrant children minus the economic supports that adult children receive from their parents, and discuss whether the impact on parental health of one–way income transfer from migrants is overstated. Results indicate that children migration increases net income transfers, but positive remittances cannot make up for the negative impact of labor loss from migration. Using self–assessment, physical and mental checks to ascertain the health of parents left behind, child migration exerts, in fact, a negative impact. Compared to the two–way income transfer, the positive effects on parental health of children's remittances may be overestimated, and the negative impact of child migration on parental health may be significantly underestimated. The findings indicate that two–way income transfers should be taken into consideration in examining this causal effect of migrant children on parental health.

Key words: Adult children migration, parental health, two–way income transfer, mediation analysis, instrumental variable model

INTRODUCTION

China, with the world's largest aging population of over 200 million[1], is at a crucial stage of socioeconomic transformation and demographic transition. Accordingly, the only child has become the major force to take the responsibility of elderly care. In this critical period, adult children migration significantly changes the traditional support system for the elderly in China. In particular, the easing labor mobility restrictions since the late 1980s have stimulated the flow of migrant workers from rural areas to cities. According to the China Statistical Yearbook, the number of rural labor migration increased from 102.51 million in 1990 to 171.85 million in 2017. However, most rural migrants, compared to urban residents, are still bogged in inferior institutional, economic and social positions (deBrauw and Mu, 2011). For instance, household registration (the current national hukou) system prevents the moving of entire households to cities. The long–time separation between caregivers and their vulnerable parents makes it difficult for the elderly to acquire traditional support (He and Ye, 2014).

The changed home–based caring system for the aged has posed risks for the health of left–behind parents. Previous studies have evaluated the effect of adult children migration on their parental health (Antman, 2010; Strauss *et al*., 2010; Du, 2013; Evandrou *et al*., 2017). Some studies indicate that the migrant adults of elderly parents can remit money back home (i.e., income transfer), which benefits parents' physical and mental health. Ultimately, such income from migrants can compensate for the adverse effects of labor loss (Beard and Kunharibowo, 2001; Kahn *et al*., 2003; Kuhn *et al*., 2011; Yi *et al*., 2019). Other studies also find such an income–enhancing effect, but they indicate those left–behind parents are often faced with more housework and emotional suffering, which, in turn, leads to poorer physical and mental health (Gibson *et al*., 2011; Sharma, 2013). Although the effect of migration on parental health is ambiguous, there is evidence that verifies the importance of the income transfer from migrants; that is, financial contributions can play a positive role in mitigating the negative impact of migration on parental health.

It should be noted that research on adult migration often focuses on parental health through adult children's income transfer of to parents. However, the economic intergenerational relationship is more complicated in China. Due to limited human capital and high living costs, adult migrants have to bear more pressure of housing, education, medical care, etc (Cutler and Lleras–Muney, 2010). Adult migrants providing economic support to parents may also receive income from parents. If the transferred income from parents is taken into account, the income contribution of adult children migration (two–way income transfer) may not necessarily play a positive role. Under such a circumstance, the net economic impact of children migration on parental health is uncertain. Therefore, this study examines whether and how the overall health of the elderly in China is affected by adult children migration when the factor of the two–way income transfer is considered.

This study contributes to the existing literature by examining the relationship between migration and left–

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behind parents. The impact mechanism of migration on the health of left–behind elderly has not been explicitly examined as the past literatures only focused on the effect of one–way income transfer from migrants. However, adult children are likely to receive financial support from their parents when they live apart (Lundberg *et al.*, 2007). Thus, the economic transfer to left–behind parents may be overstated. Unlike previous studies, this study examines for the first time how adult children migration affects parental health through the two–way income transfer. Then we will gauge whether the one–way income transfer exaggerates the positive health effect of financial support, and underestimates the negative impact of migration on parental health. In addressing these questions, we will test the mechanism of economic support by using mediated effect measures. The information collected by China Health and Retirement Longitudinal Study (CHARLS) on income transfer from the two generations of adult children and elderly parents is used in our research.

THEORETICAL FRAMEWORK

In China, the elderly are often supported and taken care of by family members. However, this traditional mode has been considerably changed after adult children go out to work in other cities, which exerts effects on well–being and support of rural left–behind parents through income contribution and time allocation.

As shown in Fig. 1, the income contribution (net income transfer) exerts a relatively complex effect on parental health, so it is hard to determine the impact of adult children migration on parental health. On one hand, adult migrants in rural China are destined for going comparatively developed areas to seek high income returns. To compensate for the loss of care for their left–behind parents, migrant children will increase the economic transfer to their parents, which will improve the living standard of the elderly (Kuhn *et al.*, 2011). But the elderly may also be economically deteriorated because they have to care for their grandchildren, and the relevant expenditures on grandchildren may not be made up by the money they get from migrant children.

On the other hand, the elderly will pay for their migrant children's living cost before they find jobs and settle down. This study first designs the two–way economic support (rather than one–way economic support) to examine the impact of children migration on the net income transfer of the elderly left behind. If adult migrants give more financial help to their parents, the remittances can support the left–behind parents by minimizing economic risks and overcoming capital constraints (Sharma, 2013). Otherwise, migrant children will receive financial support from their parent. Under the circumstance, the net economic impact of children migration on parental health remains vague (Fig. 1).

Second, the loss of daily care would exert an adverse effect on parental health. The distance accompanying children migration reduces daily care and family support between aged parents and adult migrants. The elderly left behind may face more physical burdens (Du, 2013), such as caring for grandchildren, doing house chores and farm work. Because the loss of care is implied and will be greater, parental health would be negatively affected by adult children migration.

As stated above, children migration has both positive and negative effects on parental health and support. The final sign of child migration effect on parental health depends on whether the positive effect (i.e., net income transfer) can compensate for the negative effect from time allocation (i.e., loss of daily care). This study first investigates the effects of adult children migration on parental health through two–way economic support.

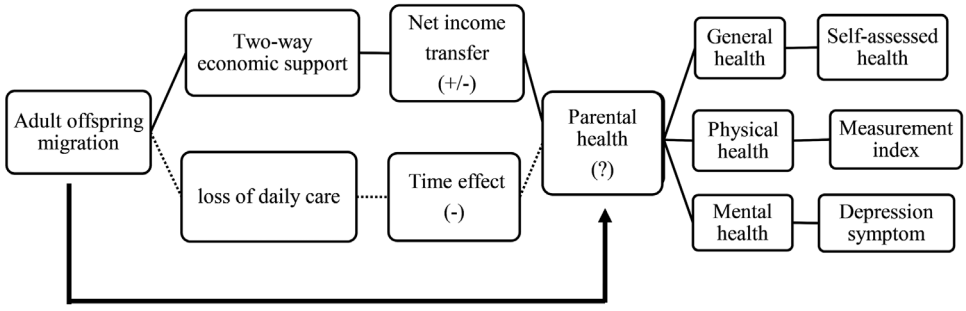

Fig. 1. Conceptual pathways

Notes: A minus sign indicates a negative impact; a plus sign indicates a positive impact; a question mark stands for uncertainty. The dotted line represents the other one of the influencing mechanisms, but we do not estimate the impact path here. According to Yi *et al.* (2019), we estimate the overall impact of children migration on parental health (direct effect) and the influencing mechanism of two–way income transfer (indirect effect). Through these two aspects, we can know the effect of time allocation.

[1] According to data of the National Office on Aging of China, the number of people aged over 60 in 2017 has reached 241 million, or 17.3% of the total population. By 2050, Chinese elderly will grow to 487 million.

DATA AND KEY VARIABLES

Data source

The data in this study are derived from the CHARLS conducted by the National School of Development at Peking University. The survey collects a high quality nationally representative sample of Chinese residents aged 45 and older to serve the needs of scientific research on the elderly. Since the baseline national wave of CHARLS is being fielded in 2011, this analysis carries out in 2011, 2013 and 2015. This survey covers 28 provinces, 150 counties/districts and 450 villages/resident committees, with a total of 4400 households and 16000 individuals in every survey year. Respondents were asked to provide detailed information about themselves and their household members, such as demographic backgrounds, health status and functioning, health care and insurance, work and retirement, income and expenditures, etc.

To investigate how parental health is associated with adult children migration, the samples are narrowed to those adults over 45 years old with at least one child in rural areas. The respondents cover 28856 rural old people, including 9867, 9546, and 9443 elderly adults in 2011, 2013 and 2015, respectively.

Key variables

Health measures

Parental health should be measured from multiple dimensions (Antman, 2010), because it may be inaccurate to discuss health outcome with a single index. To ensure robust estimates, parental health is measured with the following three dimensions: general health, physical health and mental health.

The parental health, the main outcome variable of interest, is first measured by self–assessed health (SAH). As a subjective measure, SAH may be a susceptible perception bias because health–related knowledge involves personal values, beliefs, and information (Idler and Benyamini, 1997; Van *et al*., 2003). However, several studies have proved that subjective measures of health have substantial value in predicting objective health conditions, including morbidity and mortality (Miilunpalo *et al*., 1997; Franks *et al*., 2003). In the CHARLS, a respondent's SAH outcome is gauged by five options. We reverse the scale to be an increasing ordinal so that 1 indicates "poor", while 5 for "excellent".

We evaluate the anthropometric indicator as objectively physical health. The body mass index (BMI) is calculated as the ratio of weight (kg) to the square of height (m^2). A BMI less than 18.5 may indicate underweight, while a BMI greater than 25 is considered as overweight. Thus, BMI has been widely used to gauge the fitness of adults (Li *et al*., 2020).

A 10–item version of the Center for Epidemiologic Studies Depression (CES–D10) is one of the most common screening tests for helping respondents to determine the depression quotient. The quick selftest measures depressive feelings and behaviors during the last week. The options given were "< 1 day (1 point)", "1–2 days (2 points)", "3–4 days (3 points)", and "5–7 days (4 points)". The aggregate depression score is used to gauge individual mental health. Obviously, a high score of mental health implies worse mental health.

Migration measure

The survey enquired about the place of residence of each adult child living apart from the parents, with seven response options. Migration was defined as having a migrant child living in another county/city in the same province, or in another province (Evandrou *et al*., 2017). Therefore, whether the elderly has at least one migrant adult child is considered as the key explanatory variable.

Mediator

The impacts of migrant children on parental health can be affected through two–way income transfer. Due to the two–way economic mobility, adult children providing financial support to their parents may also receive financial help from their parents. Economic support is often exchanged through gifts and remittances between two generations. Therefore, net income transfer in the study equals remittances the migrants send home minus parents' financial assistance of adult children.

Instrumental variables

To address the possibility of reverse causality, we instrument the children migration with the village–level migration network. The ratio of migrants to all respondents in the same village is expected to exert positive effects on the migration incentives (Huang *et al*., 2016). Owing to the geographical location advantage, factories in local villages will dampen migration activity. Both instrumental variables should have no effects on parental health (Yi *et al*., 2019).

Descriptive statistics

Besides the above variables, parental health can be affected by other factors. In order to avoid bias estimation from omitted variables, this study controls a set of variables in our empirical models. Table 1 presents the descriptive statistics of all variables used in the following empirical results. The control variables include respondents' age, gender, marital status, education level, and working status. Age captures the depreciation of the health capital of the parents. Education is an important contributor to health because a higher educational background may improve health condition. The household characteristics considered are household income, number of children, living arrangement, health condition of spouse, and the average age and education of children. Household income is included to test the sensitivity to individual health status. Adult children (also including son–in–law, and daughter–in–law) living in the same household are possible to help the elderly with chores. Health of spouse may impact whether the elderly should bear more burdens. We also divide the living location into three regions (i.e., the East, the Central and the West) to allow for regional differences.

Table 1. Variables and measurements

Variable	Measurements	Mean	S.D.
Health measures			
SAH	Self–assessed health, 5=excellent, 4=very good, 3=good, 4=fair, 5=poor	2.490	1.040
BMI	Body mass index (kg/m^2)	23.525	3.864
Depression	Aggregate depression score (points) in logarithm	2.868	0.328
Mediator			
Net income transfer	Two–way income transfer, which equals remittances from migrants minus parental economic support for adult children in logarithm	4.811	3.854
Migration measure			
Childout	Having migrant children, 1=yes, 0=no	0.439	0.496
Individual characteristics of elderly person			
Age	Age	60.231	9.452
Gender	1=male, 0=female	0.454	0.498
Married	Having a spouse, 1=yes, 0=no	0.865	0.342
Education	Years of education completed	4.440	3.815
Employment	Having work last year, 1=yes, 0=no	0.745	0.436
Household characteristics			
Income	Total household income (yuan/year) in logarithm	6.716	3.640
Childnum	Number of children	3.876	1.684
Living arrangement	At least one adult (son–in–law, daughter–in–law, or adult child) living in the same household, 1=yes, 0=no	0.444	0.497
Health of spouse			
Spouseless	No spouse, 1=yes, 0=no; reference group	0.188	0.391
Spouse healthy	A healthy spouse, 1=yes, 0=no	0.381	0.486
Spouse unhealthy	An unhealthy spouse, 1=yes, 0=no	0.431	0.495
Childage	Average age of children	27.965	10.813
Childedu	Years of average education of children	7.216	3.689
Living location			
The East	1=yes, 0=no; reference group	0.381	0.486
The West	1=yes, 0=no	0.258	0.438
The Central	1=yes, 0=no	0.361	0.480
Instrumental variables			
Outratio	Migration ratio in the same village (%)	31.116	45.745
Factory	Number of factories in the resident village	5.344	16.538

Data source: CHARLS, 2011–2015.

Table 2. Test of difference in parental health between two cohorts

Health measure	Cohort without migrant children		Cohort with migrant children		Difference
	Mean	S.E.	Mean	S.E.	
SAH	2.513	0.008	2.461	0.009	–0.052***
BMI	23.625	0.031	23.396	0.034	–0.229***
CES–D	18.374	0.051	18.875	0.060	0.501***

Note: ***$p < 0.01$.

Table 2 compares the difference in parental health between two cohorts with migrant children and without migrant children. We found a significant difference for SAH, BMI, and depression scores between left–behind and non–left–behind elderly. It shows that the health of left–behind parents seems significantly worse than that of parents without migrant children.

EMPIRICAL STRATEGY

Estimating a causal effect between migration and parental health is naturally plagued by problems of self–selection bias and endogeneity (Giles and Mu, 2007; Antman, 2010). The reasons may be that, first, there is

the issue of reverse causation, which may result in a biased estimator. Parental health may influence adult children's propensity to migrate, i.e., adult children will be likely to migrate if elderly parents are in good health. On contrary, children migration may influence parental health conditions. Second, children migration cannot be treated simply as an exogenous determinant of parental health, because we can hardly know the health outcome of the left–behind parents with migrant children. Third, migratory activity is not randomly selected and some unobservable factors may determine children migration and parental health simultaneously (Antman, 2010).

To resolve these methodological challenges, we employ the instrumental variable (IV) models and propensity score matching (PSM) method to address the endogeneity concern and self–selection bias. Then, to apportion the direct effect and the indirect effect (through two–way income transfer), the mediation models are applied to identify the influencing mechanisms.

Baseline model

In line with existing migration studies (Li *et al*., 2020), we employ IV models as the solution to endogeneity, which can be expressed as:

$$Migration_i = \delta_0 + \delta_1 IV_i + \delta_2 X_i + \omega_i \quad (1)$$

$$Health_i = \alpha_0 + \alpha_1 Migration_i^* + \alpha_2 X_i + \mu_i \quad (2)$$

where $Migration_i$ represents adult child migration decision. The IVs are the migration rate to all respondents in the same village (*Outratio*), and the number of factories in the resident village (*Factory*). X_i is a vector of household and individual characteristics defined in Table 1. $Health_i$ is measured with a multidimensional construct that includes self–assessed health (*SAH*), body mass index (*BMI*), and mental health (*Depression*) for individual i. $Migration_i^*$ denotes the fitted $Migration_i$ calculated by Eq. (1).

The outcome equation in Eq. (2) measures the overall effect of children migration on parental health, which is also the first step of the mediated effect measures used in our subsequent analysis to gauge the influencing mechanism. Crucially, it is important to examine whether the coefficient α_1 is significant to determine whether children migration has an impact on parental health.

PSM method

The PSM method as a robustness check consists of the following steps. First, a conventional probit or logistic migration equation is used to calculate the propensity score.

$$p(X) = \Pr(M = 1 \mid X) = \frac{\exp(\beta X)}{1 - \exp(\beta X)} \quad (3)$$

where M indicates the propensity to be a migrant household; X is a set of observable covariates describing individual and household characteristics.

Second, once the propensity scores are estimated, the subject who has the closest propensity score in the control group (non–migrant) is matched with a subject in the treatment group (migrant) using matching algorithms (Park *et al*., 2016). Balance is achieved by identifying propensity blocks within which the treatment and control propensity scores are statistically similar. If either the propensity score or the covariates are imbalanced (i.e., significantly different) within any of the propensity blocks, the matching is failed (Becker and Ichino, 2002). On the basis of these scores, we can calculate the average treatment effect on the treated subjects (ATT). ATTs are obtained by comparing the mean outcomes between the control and treatment groups.

$$ATT = E\left[(Health_1 - Health_0) \mid X, M = 1\right] \quad (4)$$

where $Health_1$ and $Health_0$ are the potential health outcomes in the two cohorts: cohorts with a migrant child and without a migrant child.

Mediation regression equation

To gauge how children migration affects parental health through the two–way income transfer, this study constructs a mediation model proposed by Baron and Kenny (1986). The path can be expressed in the form of three regression equations including Eq. (2):

$$Remit_i = \beta_0 + \beta_1 Migration_i + \beta_2 X_i + \varepsilon_i \quad (5)$$

$$Health_i = \gamma_0 + \gamma_1 Migration_i + \gamma_2 Remit_i + \gamma_3 X_i + \vartheta_i \quad (6)$$

where $Remit_i$ represents the two–way income transfer, which equals remittances the migrants send home minus parental economic support of adult children. The coefficient α_1 in Eq. (2) is the estimate of the total effect of $Migration_i$ on $Health_i$. β_1 is the estimate of the effect of $Migration_i$ on $Remit_i$. γ_1 is the estimate of the direct effect of $Migration_i$ on $Health_i$ adjusted for $Remit_i$, and γ_2 is the estimate of the effect of $Remit_i$ on $Health_i$ adjusted for $Migration_i$.

If $Remit_i$ is considered as a mediator, the following causal–step process should be satisfied:

(i) The total effect of $Migration_i$ on $Health_i$ (α_1 in Eq. (2)) must be significant.

(ii) The effect of $Migration_i$ on $Remit_i$ (β_1 in Eq. (5)) must be significant.

(iii) The effect of $Remit_i$ on $Health_i$ controlled for $Migration_i$ (γ_2 in Eq. (6)) must be significant.

Models meeting all three steps are called fully (or partially) mediated models, whatever the direct effect of $Migration_i$ on $Health_i$ adjusted for $Remit_i$ (γ_1 in Eq. (6)) is significant or not. If at least one coefficient (β_1 and γ_2) is not significant, the Sobel test should be performed on the two coefficients. The statistic for this test is, $Z = \beta_1 \gamma_2 / \sqrt{\beta_1^2 S_{\gamma_2}^2 + \gamma_2^2 S_{\beta_1}^2}$, where standard errors of β_1 and γ_2 are represented, respectively, by S_{β_1} and S_{γ_2}. If the Z–statistic is greater than 0.97, it indicates that it is significant at the 5% level (MacKinnon *et al*., 1995), and the mediation effect is said to have occurred.

Table 3. The overall effects of adult child migration on parental health

Variable	Step 1: Logistic equation	Step 2: Health equation		
	(1) Migration	(2) SAH	(3) BMI	(4) Depression
Childout		–0.474***	–2.628***	1.844***
		(0.104)	(0.382)	(0.628)
Outratio	0.476***			
	(0.046)			
Factory	–0.016***			
	(0.002)			
Age		0.002**	–0.079***	–0.031***
		(0.001)	(0.005)	(0.008)
Gender		0.094***	–1.107***	–1.661***
		(0.015)	(0.055)	(0.096)
Married		–0.025	0.261***	–1.713***
		(0.025)	(0.094)	(0.183)
Education		0.009***	0.044***	–0.130***
		(0.002)	(0.008)	(0.013)
Employment		0.296***	–0.551***	–0.801***
		(0.017)	(0.067)	(0.117)
Log(Income)		0.005**	–0.009	–0.068***
		(0.002)	(0.008)	(0.013)
Childnum	0.116***	–0.003	0.036*	0.049
	(0.008)	(0.005)	(0.020)	(0.035)
Living arrangement		–0.005	–0.233***	–0.334***
		(0.017)	(0.061)	(0.103)
Spouse healthy		0.171***	0.133	–0.579***
		(0.025)	(0.090)	(0.158)
Spouse unhealthy		–0.147***	–0.032	0.898***
		(0.024)	(0.088)	(0.160)
Childage	0.026***	–0.015***	0.006	0.087***
	(0.006)	(0.003)	(0.011)	(0.020)
Childage2	–0.0004***	0.0002***	–0.0001	–0.001***
	(0.0001)	(0.0001)	(0.0002)	(0.0003)
Childedu	0.047***	0.019***	0.059***	–0.152***
	(0.004)	(0.002)	(0.009)	(0.015)
The West	0.299***	–0.184***	–0.410***	1.914***
	(0.033)	(0.021)	(0.074)	(0.130)
The Central	0.378***	–0.133***	0.402***	1.053***
	(0.033)	(0.020)	(0.072)	(0.123)

Notes: ***p < 0.01; **p < 0.05; *p < 0.10; Robust standard errors are in parentheses; Model 1 is estimated according to Eq. (1), and Models 2–4 are estimated based on Eq. (2).

RESULTS

Baseline results

Table 3 reports the estimates of the coefficients of the logistic equation and the outcome equation. First, as expected, the coefficients on the two instrumental variables are statistically significant at the 1% level shown in Model 1 of Table 3. Meanwhile, the F–statistic of Model 1 is well above the rule–of–thumb threshold of 10 for weak instruments. The migration decision is positively influenced by village–level migration ratio (*Outratio*) because more information and up–front costs are shared. In addition, the larger the number of local factories (*Factory*) is, the easier it is to absorb the adult labor force, and consequently the less the migration will be. The number of adult children (*Childnum*) and their average education level (*Childedu*) exert significantly positive effects on children migration decision. The older the adult children are, the less likely they will migrate. Compared with the eastern regions, adult children in the central and western regions are more inclined to migrate, which conforms to the rule that rural labor force generally flows from underdeveloped areas to more developed ones.

Second, the results of the health equations in Table

3 (Models 2–4) show that the coefficient on *Childout* is statistically significant, implying that the migrant children significantly impair the health of their left–behind parents as measured by SAH, BMI, and Depression. Regard to other control variables, the coefficients on *Education* and *Log* (*Income*) show significantly positive effects on parental health, hinting that higher level of education and household income help to improve the dietary nutrition, living conditions and medical services, which are good for parental health. The health of the spouse will also affect the health of the respondent. If the spouse is in poor health, it will increase the care burden of the respondent, which will also have a negative impact on their health. There is a significant positive correlation between children's education level and parental health. It may be due to the fact that higher education level would raise adult children's income level and thus make them more capable of feeding their parents.

Robustness check

We also adopt the PSM as a check for robustness. Appendix Table A1 shows the balance check results of covariates used in the estimation of PSM before and after matching. Tests for mean differences in covariates between the treated and control groups become statistically insignificant (Meara *et al*., 2008). All of the percent bias statistics were below 5% after matching. These results indicate that covariate balances were improved in the matched sample and the matching quality was satisfactory.

Table 4 reports the estimated ATT calculated by the most popular matching algorithms that includes the nearest–neighbor matching (n = 4), radius matching (r = 0.001) and kernel matching. As different matching algorithms result in almost identical results in the ATT, we report the results obtained by 1: 4 nearest–neighbor matching to gauge the impact of children migration on parental health.

The empirical result indicates that children migration has significantly negative effects on parental health, which provides a similar qualitative picture as the IV model. Specifically, migration reduces the parents' SAH and BMI by 0.024 points and 0.217 kg/m^2, respectively. In addition, the elderly parents are more likely to suffer from depression when their adult children work in other places. Thus it can be seen that the elderly with migrant children are less healthier than those without migrant children.

Influencing mechanism: children migration and income transfer

Model 1 of Table 5 (Panel B) shows that child migration has a significant impact on net income transfer. Adult migrants with higher incomes increase net income transfer to parents, which exerts a positive impact on parental health as left–behind parents are more likely to have access to better medical services.

To further examine the mediating effect of net income transfer, we introduce children migration and net economic support into the health equation (Models 2–4 of Table 5). Results show that net income transfers do not have a significant impact on left–behind parents' SAH, although they do improve parental BMI and depression. The Sobel test is needed for the SAH equation. The results indicate that the Z–statistic is smaller than the value at the 5% significant level, and mediation is not considered to be present. It may be that SAH is

Table 4. The impact of children migration on parental health (PSM approach)

Items	General health	Physical health	Mental health
	(1)SAH	(2)BMI	(4)CES–D10
Nearest–neighbor matching	–0.024*	–0.217***	0.243**
Radius matching	–0.013	–0.176***	0.254***
Kernel matching	–0.014	–0.177***	0.248***

Notes: ***p < 0.01;**p < 0.05;*p < 0.10; All models include a series of covariates (X) shown in table1; Samples are matched using nearest–neighbor matching.

Table 5. Mediated effect test of net income transfer

Panel	Variable	(1) Net income transfer	(2) SAH	(3) BMI	(4) Depression
A. Previous literatures: Income transfer	Income transfer		0.002	0.045***	–0.004***
	Childout		–0.484***	–2.782***	0.126***
B. Our study: Net income transfer	Net income transfer		0.001	0.044***	–0.004***
	Childout	3.998***	–0.535***	–2.992***	0.133***
	Sobel test	Z=0.70 < 0.97		–	–
	Mediated effect	No		Yes	Yes

Notes: Income transfer means one–way economic contribution only from migrant children, while net income transfer implies two–way income transfer between the two generations; Model 1 is estimated according to Eq. (5), and Models 2–4 are estimated based on Eq. (6); ***p<0.01.

more subjective, which leads to measurement errors due to erroneous judgement. After controlled for the influence of net income transfers, the coefficient of children migration is smaller but still significant, indicating that adult children migration negatively affects parental health in rural China, even though net income transfer can partly compensate for the adverse effect.

More importantly, when net income transfer is not considered (Panel A), the positive effect on parental health of migrant remittances may be overestimated, while the negative impact of child migration on parental health may be significantly underestimated. For example, in the case of SAH, the coefficient of *Childout* (0.535) in Panel B is greater than that (0.484) in Panel A.

CONCLUSION

This study gauges for the first time the relationship among adult children migration, two–way income transfer, and parental health by using mediation models. Results show that adult children migration exerts a negative impact on the self–assessment, physical and mental health of the parents left behind. Even though children migration increases net income transfer, positive remittance cannot make up for the negative impact of labor loss. If the transfer of net income is not considered, the positive effect the migrant remittance exerts on parental health may be overestimated and the negative impact of child migration on parental health may be significantly underestimated. For this reason, we recommend that, the two–way income transfer should be considered.

With the outflow of the young and middle–aged workforces, it is certain that there will be more seniors in rural China. The health and old–age care of left–behind parents bear on not only their own welfare and quality of life, but also affect the success or failure of the new countryside construction in China. As shown in the conclusion of this study, the loss of daily care due to migration dominates among the factors affecting parental health. Thus, the government should focus on old–age support and burden reduction in future policy reform. First, in economic transformation, the problem of left–behind parents will exist for a long time as a large number of adult children choose to work far from hometowns. In the long run, it is necessary to establish rational healthcare insurance systems, rural community medical services, and elderly people's associations to guarantee better living conditions of the left–behind old people. Second, the institutional barriers of household registration and education shall be lowered to make migrant workers better integrate into cities. Third, the priority policy shall be implemented for land transfer of the elderly left behind. Thus, when the elderly are incapable of tilling land, they can transfer the land, which will lower their farm work burden, and increase their incomes.

AUTHOR CONTRIBUTIONS

Conceived and designed the methodology: Beibei WU, Koshi MAEDA, and Xuejun WANG. Analyzed the data: Xuejun WANG and Beibei WU. Wrote the paper: Beibei WU, Xuejun WANG, Harry M. KAISER and Koshi MAEDA.

ACKNOWLEDGEMENTS

The study was supported in part by the National Natural Science Foundation of China (71703071), the Fundamental Research Funds for the Central Universities (KJQN201845, SKYC2020004). The authors are also grateful for the support from Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD), and China Center for Food Security Studies in Nanjing Agricultural University.

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