China's Migrant and Left-behind Children: Correlation of Parental Migration on Health, Cognitive and Non-cognitive Outcomes

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Abstract:

With rapid urbanization, millions of people from rural areas have migrated to major cities for employment, leaving their young children at home or bringing their children to urban areas. Whether this labor migration creates substantial mental, physical and educational challenges for these left-behind and migrant children should be considered. This paper uses data from a 9824 students sample from a survey conducted by the authors in Beijing, Suzhou, Anhui and Henan. This study establishes OLS models for identifying the correlation of non-left-behind children, left-behind children and migrant children on health, cognitive and non-cognitive performance. Our empirical findings reveal that the migration of adult household members negatively affects the health status, cognitive and non-cognitive performances of left-behind children and only cognitive performance for migrant children. The effects are particularly prominent for rural children, when the mother migrates out of province.

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ABSTRACT

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Keywords: Migration; Left-behind; Rural China; Health; Cognitive; Non-cognitive

1. Introduction

The transfer of surplus rural labor to cities has become a crucial facilitator of China's economic growth. The National Bureau of Statistics (NBS, 2017) estimated that in 2016, 281.71 million Chinese farmers were engaged in non-agricultural labor, which has increased by 1.5 percent than the previous year. Of these farmers, 112.37 million were domestic workers (39.9%), and 169.34 million were migrant workers (60.1%). Migration for work is the main form of non-agricultural activity for farmers. However, only a few part of farmers migrated with the entire family. Some migrant workers have left their children in rural areas while others have brought them to urban areas. Therefore, the number of left-behind and migrant children is high.

A national survey reported , the number of migrant children rose from 19.8 million in 2000 to approximately 35.8 million, or 12.8 percent of China's child population, in 2010 (UNICEF, 2014). The survey also reported that in 2010, the number of Chinese children impacted by migration reached 106 million, accounting for 38 per cent of the total child population in China. The majority of rural migrants in cities do not possess a local household registration (*hukou*), and based on a report of migrant children, by the end of September of 2015 the number of migrant people has reached 247 million, one in every six people is migrating (Annual report on education for China's migrant children, 2016). As a result, a significant proportion of migrant children is thus excluded from the public education system and has to enter the so called "migrant schools", which started as informal schools by migrants themselves.

The number of left-behind children rose from 22.9 million in 2000 to an estimated 69.7 million, or 25.0 percent of China's child population, in 2010 (UNICEF, 2014). Data from the annual report on education for China's migrant children of 2016 revealed the total number of left-behind children and migrant children is about 100 million. No other developing country has such a high proportion of left-behind children.

Adverse impacts of parental migration on children's health are also found in several empirical studies. The first is the physical outcomes. Labor migration to major cities may yield large remittances for households. Thus, the health of left-behind children may benefit from the increased family income invested in improving nutrition, housing, health insurance, and health care (Case, Lubotsky, & Paxson, 2002; Currie, 2009; Zhu, Wu, Peng, & Sheng, 2014). However, inappropriate consumption could cause conflicting effects on children's physical health. For example, an increased intake of high-fat, high-calorie food results in children becoming overweight (Du, Mroz, Zhai, & Popkin, 2004), and substituting family care with medical services adversely affects children's immune systems (Kiros and White, 2004). Ning and Chang (2013) found heterogeneous effects of the parental migration on the children's nutrition. The likelihood of inadequate energy and protein intake is significantly and positively associated with the parental migration, whereas the parental migration has a negative impact on the risk of the fat over-nutrition for the left-behind children. And Hildebrandt and McKenzie (2005) investigate the impact of international migration on child health outcomes in Mexico and conclude that children in migrant households are found to have lower rates of infant mortality and higher birth weights.

The second is the mental outcomes. It is well established in U.S. studies that the quality of parenting is one of the strongest predictors of children's emotional wellbeing. However, the fundamental point holds—that in rural China, adults left behind by labor migrants were significantly more vulnerable to psychological distress as measured by depressive symptoms (Lu et al., 2012), which should increase the risk of depression among their children. Moreover, children living with neither of parents (or either migrating parent) are more likely to results in poorer psychological well-being (Graham and Jordan, 2011), which can be devastating for children (Ye and Lu, 2011). In rural areas, left-behind children who were brought up by grandparents, or having poor economic status, bad relationship and low frequency of communication with parents were prone to encounter more as well as more severe loneliness (Jia & Tian,

2010). Ren and Treiman (2016) conclude that children being left behind with neither of parents (or being sent to live with someone other than at least one parent) are less happy and more depressed. Chan (2009) cites four Chinese language studies that found that left-behind children were more likely than other rural children to feel depressed, emotional, anxious, frightened, become easily irritated and intransigent, and have lower self-esteem. Similarly, Wang et al. (2014), in a review of 15 school-based studies, reported that, in general, the left-behind group had a lower score [on a measure of positive] self-concept and more psychological problems than the control group. Another review, by Wang and Mesman (2015), also reported that on the whole left-behind children show poorer emotional and social functioning than rural children residing with both parents.

A large number of studies conclude negative effects of parental migration on children's education. Migration has been found to significantly impact children's educational outcomes. Parental rural to urban migration has a significantly negative impact on children's school performance (Zhao et al., 2014), younger children seem to be especially susceptible to the disruptive effect of parental out-migration (Lu, 2012). Wang and Mesman (2015) report that seven of eight studies they reviewed showed that left-behind children performed more poorly on standardized tests than did children living with both parents. Another study shows significant adverse effects of the absence of both parents on the cognitive achievements of children left-behind, reducing their contemporary test scores by 5.4 and 5.1 percentile points in math and Chinese, respectively (Zhang et al., 2014). Moreover, parental migration also has negative effects on children's enrollment. Left-behind children are less engaged in school (Zhang et al., 2014). In one study, left-behind children (defined as rural children whose parents had migrated) had a 37-percentage point lower probability of being enrolled in school than their peers (defined as rural children with no migrant parents), and they are more likely to discontinue their education after middle school (Lee, 2011).

However, numerous studies mainly pay attention to the health status, cognitive

and non-cognitive indices respectively of these children. Very little is known about the results after together comparing these three types of indices. Moreover, these studies have focused on the characteristics of left-behind children in rural areas, and have compared them with non-left-behind children. It's quite unknown about migrate children, and the difference between migrate, left-behind and non-left-behind children.

The contribution of this study to the literature on rural children in China is twofold. (1) We cast light on migrant children who have moved to urban areas with at least one migrating parent, and compare the migrant children with both children in rural areas without migrant parents and left-behind children in rural areas. (2) We use non-cognitive indices, such as esteem, grit and depression to attempt to identify the impact of parental migration on children's non-cognitive performance, which help to provide comparable evidences on health status, cognitive and non-cognitive performance of different types of children. In summary, this study examines whether the effect of parental migration on migrate children is positive or negative, determines whether there are differences between migrant, left-behind and non-left-behind children, and identifies whether there is a diversity between the three types of children on non-cognitive performance, except for health status and cognitive performance.

The rest of the paper is structured as follows. Section 2 describes the data and main variables. Section 3 outlines our main results, with discussions on identification issues and potential threats to our findings. Section 4 concludes the paper.

2. Data and variables

2.1 Data

Sampling

This paper draws on a cross-section dataset, which was collected among 11889 primary school students in 60 rural primary schools in Anhui and Henan provinces and

59 urban primary schools in Beijing and Suzhou in China in 2017. Each school only requires one class of grade three and four respectively. Sampling took place from April to June 2017.

We created our sampling frame in four steps. First, we selected Beijing and Suzhou city (located in Jiangsu) as our first-stage targeted cities, and after that, we selected 30 primary schools for Beijing and 30 for Suzhou, each school was required one class of grade three and one of grade four. Second, as we conducted our survey in Beijing and Suzhou, we already knew that over 40% of students we surveyed in Beijing come from Henan Province while almost half of students in Suzhou come from Anhui province, so we targeted our sampling frame to Henan and Anhui province as our second-stage sampling. Third, we selected 5 counties of Anhui province where most student in Suzhou come from, and 5 counties of Henan province where most student in Beijing come from, for each county, we selected 6 rural primary schools from 6 different towns. Forth, we selected one class of grade three and one of grade four for each sample school. In the end, our sample included 9824 students. As shown in Table1, there are 5462 migrant children, 4669 left-behind children and 1758 non-left-behind children, aged 9 to 13 years old. All students in each sample class participated in our survey.

----------Insert Table1----------

Survey Administration and Variable Generation

In total, we administered two surveys. Our first survey, administered in May 2017 in Beijing and Suzhou, consisted of two blocks, which will be described in more detail below. All students participated in the three blocks, a standardized math test, a personal information questionnaire and a set of non-cognitive evaluations. Math teachers, class teachers and head teachers also participated in the second block. Our follow-up survey, administered in June 2017 in Anhui and Henan, is the same procedure of our first survey.

In the first block, all sample students (11889) were given a standardized math test. The test we used has 30 items, including four grade types (14Algebra items, 7 Geometry items, 2 Probability items and 7Application items for grade three; 15 Algebra items, 6 Geometry items, 1 Probability items and 7 Application items for grade four). The math test given with each student consisted of different questions of the same overall academic level (as well as the same grade level and grade type breakdown). During the examination, the students were closely proctored to prevent cheating. A time limit of thirty minutes was strictly enforced. To generate a performance variable that could be used in our analysis, we also standardized the test scores using the score distributions at each survey. We generated the variable *Standardized math*, which we present in terms of standard deviation.

In the second survey block, all students in our sample were asked to answer a series of questions about their individual and family characteristics. At the same time, the math teachers and class teachers of each sample class and the head teacher of the sample school were asked to respond to several questions about teacher and school characteristics. During the break time, each student was asked to measured their height and weight. The questionnaire and procedure are the same during all two surveys. From these questionnaires, we generated variables for individual student gender (1=boy, 0=girl), age (years), and migrating status (0=in rural areas with neither migrating parents, 1=in rural areas with at least one migrating parents, 2=migrating to urban areas). We also generated variables to describe family characteristics, including father's education yeas (years), mother's education years (years), father's age (years) and mother's age (years). Teacher and school characteristics were also collected in order to allow us to control for the impact on student performance in subsequent analysis, such as school ID (number).

In the third blocks, we evaluated the non-cognitive skills of all sample students. All non-cognitive variables consist simply of the relevant score for each evaluation scale (see below for scoring details). In the third block, all students (11889) in our

sample were evaluated for non-cognitive skills using both the Big Five personality traits scale (BFI), the Esteem scale, the Depression scale and the Grit scale.

2.2 Dependent variables

We study the determinants of seven aspects of health status, cognitive and non-cognitive performance, to determine whether residence type affects the children behavior. The variables we study include.

BMI. The body mass index (BMI) or Quetelet index is a value derived from the mass (weight) and height of an individual. The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m2, resulting from mass in kilograms and height in meters.

HAZ. This index is height-for-age, a indicator of children's health status.

Cognitive. To measure cognitive skill in this study, we used the standardized math test. The score of the standardized math test which was given to each child. The full score is 30, for each item score for one point. To generate a performance variable that could be used in our analysis, we also standardized the test scores using the score distributions at each survey. We generated the variable *Standardized math*, which we present in terms of standard deviation.

Depression. We constructed a scale consisting of six items adapted from the widely used CES-D scale (Radloff, 1991), which is one of the most widely used in the world to measure depressive symptoms and has been validated for studies of Chinese adolescents (Chen et al., 2009). For each item, respondents were asked how often they felt this way during the past week: five to seven times a week, three or four times a week, once or twice a week, or never. The response categories were scored from 1 ("never") to 5 ("five to seven times a week"). The scale was constructed by standardizing each item, whose score is above 17 is defined to be depress (=1), and below 17 is defined to be normal (=0).

Esteem. The RSES scale, compiled by Rosenberg, was originally used to assess teenagers' overall feelings about self-worth and acceptance (Rosenberg, 1965). At present, the scale is one of the most widely used self-esteem measurement tools in psychology. The original version consists of five forward scoring and five reverse scoring questions and each question is divided into four levels. We use the questionnaire after adjusting from the China Family Panel Studies (CFPS, 2012), including 14 questions; each question was divided into five grades: absolutely disagreed, disagreed, neither agreed nor opposed, agreed and absolutely agreed. For question 1, 2, 4, 6, 7 and 12, we score from 1 (“absolutely disagreed”) to 5 (“absolutely agreed”). For rest of the questions, we score from 1 (“absolutely agreed”) to 5 (“absolutely disagreed”). The full score is 70, the higher the final score, the higher the degree of self-esteem.

Grit. Grit is defined as perseverance and passion for long-term goals by Duckworth in 2007. Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress (Duckworth et al., 2007). Individuals high in grit characteristically do not swerve from their goals, even in the absence of positive feedback (McClelland, 1985). The Short Grit Scale (Grit–S) retains the 2-factor structure of the original Grit Scale (Duckworth, Peterson, Matthews, & Kelly, 2007) with 4 fewer items and improved psychometric properties. Our questionnaire includes 8 questions; each question was divided into five grades: very much like me, mostly like me, somewhat like me, not much like me and not like me at all. For question 2, 4, 7 and 8, we score from 1 (“not like me at all”) to 5 (“very much like me”). For the rest of questions, we score from 1 (“very much like me”) to 5 (“not like me at all”). Add up all the points and divide by 8. The maximum score on this scale is 5 (extremely gritty), and the lowest score on this scale is 1 (not at all gritty).

2.3. Independent variables

Parental migration status. Our key independent variable is the living circumstances of the child, which we label "Status". We distinguish seven categories of children, based on where they live, with whom they live, and their registration status.

1. Rural children living with both parents (hereafter, children living in intact rural families) are children who reside in rural areas, have local *hukou*, and live with both parents, which are also defined as non-left-behind children in this paper. We do not distinguish between those with agricultural and nonagricultural *hukou* on the ground that it is the place of residence rather than the place of registration that affects children's emotional wellbeing.

2. Left-behind children living with neither of parents are those who live in rural areas with local *hukou*. Both of their parents have gone out for work, and send them to live with other caregivers, relatives or grandparents. (labeled "Rural-both migrant")

3. Left-behind children only living with mother, are those who live in rural areas with local *hukou*. Their father has gone out for work, and left them living with other caregivers, relatives or grandparents. (labeled "Rural-father only")

4. Left-behind children only living with father, are those who live in rural areas with local *hukou*. Their mother has gone out for work, and left them living with other caregivers, relatives or grandparents. (labeled "Rural-mother only")

5. Migrant children living with both of parents are children who reside in urban areas, without local *hukou,* and live with both migrating parents. As with rural children living with both parents, we do not distinguish between those with agricultural and non-agricultural *hukou* on the ground that it is the place of residence rather than the type of registration. (labeled "Urban-both in cites")

6. Migrant children only live with father, are children who have moved to urban areas with migrating father but who lack local registration (*hukou*). (labeled "Urban-father only")

7. Migrant children only live with mother, are children who have moved to urban areas with migrating mother but who lack local registration (*hukou*). Children who lack local *hukou* are not eligible for various benefits such as health care and, in some places still, free schooling and are likely to be marginalized in other ways discussed earlier. (labeled "Urban-mother only")

Our control variables include age, gender, weight, height, father's age, mother's age, father's education years and mother's education years. And in our OLS model, the control group is always the non-left-behind children. We estimated the association between control group and other six categories on health status, cognitive and non-cognitive performance

2.4 Statistical analysis

Our statistical analysis is comprised of three parts. First we perform a simple descriptive analysis to describe the overall variation of health status, including body mass index (BMI) and height-for-age (HAZ), among our sample children. We also describe the variation in cognitive and non-cognitive skills across our sample. Second, we examine the correlates of different types of children and family characteristics with health status, cognitive and non-cognitive skills. To identify these correlations, we estimate a multiple linear regression model:

$$Y_i = \alpha_0 + \alpha_1 C_i + \alpha_2 S_i + \alpha_3 F_i + \tau + \mu_i \qquad (1)$$

Where Y_i is a vector of health status or cognitive or non-cognitive skills (BMI, HAZ, math, cognitive scores and scale scores) of children *i*; C_i is the different groups of children; S_i is a vector of children characteristic variables (see above for a detailed list of all variables); and F_i is also a vector of family characteristic variables that includes family characteristics. We also include school dummy variables to control the effects (represented by τ in the equation).

Table 2 presents the descriptive statistics of the health status. BMI and HAZ

reflect the children's height and weight, relative to the standard value of the same gender–age group. The normal range is between −3 and 3, with an average at zero. Higher values indicate a more satisfactory health status. The statistics reveal that in our survey, BMI and HAZ of more than half of the children, 54.47% and 56.92% respectively, range from -1SD to 1 SD. Both the BMI and HAZ of the left-behind children are lower than those of the rural children without migrant parents. And the average of BMI and HAZ of migrant children is higher than non-left-behind children. The left-behind children are in the most disadvantageous situation with the highest retardation of 9.81% (BMI) and 9.06% (HAZ) beyond the average retardation.

----------Insert Table 2----------

Cognitive and non-cognitive performance of different types of children is presented in Table 3. All of the variables have been standardized and the value is the mean of each standardized variable. Higher values of the first four variables indicate a better performance. On contrary, higher values of *Depress* indicate a poorer performance. As shown below, the difference value between left-behind children and migrant children is bigger than with non-left-behind children. The value of the first four variables of left behind children if minus and is the lowest compared with the other two types of children. The value of the last variables of left behind children if plus (0.101) and is the highest, which means left-behind children perform poorer.

----------Insert Table 3----------

Table 4 exhibits the summary statistics for the other variables specified in the analysis. In Table 4, columns 1-4 present the means of each characteristic of the total sample, left-behind children, migrant children and non-left-behind children, respectively. However, we do not report the means individually because we focus on the differences in characteristics between the child groups.

----------Insert Table 4----------

First, we identify the differences in characteristics between left-behind children and non-left-behind children (column 5 in Table 4). On average, the left-behind children are elder (0.096 years), have a lighter weight (0.592 kg) and lower height (0.269 cm). However, the two groups exhibit no significant difference in gender. Regarding parental characteristics, both the fathers and mothers are younger (1.962 and 1.957 years, respectively) and have more education years (0.155 and 0.211 years, respectively). However, the parents' education years do not differ significantly. With respect to cognitive and non-cognitive outcomes, left-behind children have a lower score of math, grit and esteem (1.045, 0.442 and 1.212 respectively) and a higher rate of being depressed (5.8) and the difference is significant.

Second, we examine the differences between the migrant children and non-left-behind children (column 6 in Table 4). On average, the migrant children are elder (0.121 years). We observe no significant difference in height. The fathers and mothers of the migrant children are relatively younger (0.283 and 0.914 years, respectively) and have more education years (0.871 and 0.945 years, respectively). The difference is significant except the father's age. In terms of cognitive and non-cognitive performance, left-behind children have a lower score of math (0.427) and a higher score of grit and esteem (1.219, 0.017 and 0.347 respectively). They also have a lower rate of being depressed (3.2). However, the two groups exhibit no significant difference in esteem and grit.

3. Results

3.1 Cognitive performance

----------Insert Table 5----------

Table 5 presents regression estimates of educational outcomes. For the children living in rural areas with both migrant parents, the coefficient on standardized math

score is the lowest in left-behind children, -0.118, which suggests that when other variables are kept constant, both parental migration does have a significant negative impact on a child's school performance. The magnitude of this coefficient provides evidence that the presence of both parental migration leads to a marginal decline of standard deviation of 0.118 in math test rankings within the sample. The influence decreases for children with one of migrant parents. The coefficients on left-behind children only with migrating father (-0.064) are lower for those with migrating mother (-0.232). Therefore, the effect of labor migration on left-behind children is more prominent. This implies that children living with mother perform better on math tests. The insignificance of the *father only* coefficient indicates that there are no systematical differences for cognitive performance between the students who had more or less siblings.

In terms of migrant children, our results indicate that the standardized math score of migrant children living with both of the parents and only with mother, which is shown by the coefficient being 2.029 and 1.940 respectively and statistically significant. This implies that children living in urban areas with both of parents or mother only perform better on math tests. However, the situation of only the father migrating is more unfavorable than only the mother migrating.

3.2 Non-cognitive performance

----------Insert Table 6----------

Consider depression first. Left-behind children are not very likely to exhibit depressive symptoms, with a coefficient of 0.057 for left-behind children with both migrating parents, 0.081 for left-behind children only living with father on a scale ranging from 0 to 1. The absence of at least one of the parents leads to a marginal increase of 5.7% and 8.1% respectively in being depressed within the sample. But children left behind with father are likely to exhibit significantly more depressive symptoms than children living with mother. These effects are not large. Finally,

migrant children do not differ significantly from rural children living in intact families.

The coefficients for the esteem score of rural children with both migrating parents and only migrating father are -0.831 and -1.167, respectively, and both of them are statistically significant. This implies that parental migration can weaken the self-esteem of rural children compared with non-left-behind children. The OLS estimates of only the father migrating are negative but smaller than that of only the mother migrating for the non-cognitive indices. According to our argument, mother has a substantial influence on younger children's non-cognitive performance. In addition, left-behind and migrant children do not differ significantly from non-left-behind children on grit.

3.3 Health status

To obtain a clearer understanding of labor migration and left-behind and migrant children's health, we divide the results on the basis of the type of migration and children's living areas. We assume that these two factors varyingly affect left-behind and migrant children's health status. The results are presented in Table 7.

----------Insert Table 7----------

We first divide the results for the different types of migration: only the father, only the mother, and both parents. Then we divide the results for children of different living areas: rural (left-behind children) and urban (migrant children) areas. We compare all the six types of children with children living in rural areas with neither migrating parents (non-left-behind children).

For left-behind children, the OLS estimates of all migration types have a negative effect on BMI and HAZ. Only the mother migrating has a substantially negative effect on HAZ compared with the other migration types. The OLS estimates of only the father migrating are negative but smaller than that of only the mother

migrating. The OLS estimates of both parents migrating are negative and considerably low for left-behind children. That might be because when both parents migrate, the marginal gain from the income effect decreases and marginal loss from time investment increases. In addition, mothers are more critical in the sustenance of children's health than fathers (Cawley & Liu, 2012; De Brauw & Mu, 2011).

However, for migrant children, although the coefficients of BMI and HAZ are negative on children living only with migrating mother and positive on children living only with migrating father or with both migrating parents, the magnitudes are relatively small for only the father migrating, but it's not significant. The OLS estimates of both parents migrating are positive and considerably high for migrant children. This might be attributed to the small sample of children with only the mother migrating in our sample (197 of 3073, or 6.4% of all observations).

4. Conclusion

With an increasing number of laborers migrating to urban areas for employment, the wellbeing of left-behind and migrant children in rural areas has gradually become a concern for both researchers and policymakers. Separated from their parents, left-behind children may experience more disruptions in daily life, which may adversely affect their health status and negate their parents' original intentions of providing their children with more favorable living conditions. Moving to a new place is known to be stressful, migrant children must establish new routines and learn the ins-and-outs of new environments, cope with the destruction of old friendship networks, and make new friends (Ren and Treiman, 2016). Deviating from the methods used by the relevant literature on this issue, this study uses our survey data, which was designed specifically to study left-behind and migrant children. We pay attention to those who have followed the migrating parents to urban areas, and compare the non-cognitive performance with left-behind and non-left-behind children,

except for health status and cognitive performance.

Our empirical results reveal that the migration of adult household members negatively affects the health status, cognitive and non-cognitive performance of left-behind children, which has a significantly negative impact on children's accumulation of human capital in the long run. Furthermore, we divide the children into subgroups on the basis of the number of migrant parents. Migrating to urban areas with mother or both parents has positive effect on school performance; we suspect that this is due to the stress on family life and the better educational resources in urban areas. And there are no differences between the migrant children and non-left-behind children with respect to their emotional wellbeing and health status. The results indicate that the effects are particularly prominent for rural children, when the mother migrates out of province.

This study has several limitations. First, we cannot test mechanisms through which labor migration influences the health status, cognitive and non-cognitive performance of the three types of children. We mainly assume three mechanisms: the care effect, and environment effect. Because there are no accessible data on income, care time, and community and public services in our questionnaire, we cannot test the sign and magnitude of each effect. Second, in our empirical model, data limitations result in numerous uncontrolled variables, such as the number of elderly people and accessibility to public health services. Finally, the sample of different parental migration status is heterogeneous.

Nevertheless, this study provides additional evidence that labor migration negatively affects the health, cognitive and non-cognitive performance of left-behind and migrant children. Family separation affects millions of children in China and as rapid urbanization continues, the results of this study provide valuable policy implications. The government must provide interventions to mitigate the negative effect of labor migration.

First, as previously stated, barriers to school attendance are crucial factors that prevent children from migrating to cities with their parents. Administrators, particularly those of migrant-receiving cities, must focus on eliminating education barriers by undertaking activities such as building more schools for children of migrant workers, allowing the migrant workers' children with no local *hukou* to be enrolled in local public schools, and cancelling the additional local public school fees for children from other cities. Second, for left-behind children in their rural hometown, the government must take measures to improve their wellbeing and solve their problems. Because one or both of the parents are away from home, the school must more diligently monitor such children. Moreover, the government has established numerous policies for improving the management of left-behind children. These policies are typically implemented in schools and include detailed registers for left-behind children, regular family visits, regular psychological counseling, regular teacher reports on the problems of left-behind children, and facilitating contact of left-behind children with their parents through video or voice chats. Last but not least, the central government must promote economic transformation and build a more balanced economy across provinces and cities, or rural and urban. Thus, rural laborers could find jobs in local areas, rather than travel to other cities. Although such development requires prolonged and continuous efforts, it might be the most effective method of eliminating the social problem of left-behind children.

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Table I. The nature of the datasets

Different types	Number of students				
	Total	Migrant schools		Rural schools	
		Beijing	Suzhou	Henan	Anhui
Migrant children	5,462	2,203	3,259	-	-
Non-left-behind children	1,758	-	-	970	788
Left-behind children	4,669	-	-	2,508	2,161

Source: Authors' survey.

Table II. BMI and HAZ of 3rd and 4th grade students in 2017 (sample size: 9824, unit:%)

	BMI				HAZ			
	Total	Migrant	Left-behind	Non-left-behind	Total	Migrant	Left-behind	Non-left-behind
<=-3SD	1.14	0.68	1.86	0.94	1.18	1.50	0.84	0.94
-3SD--2SD	5.83	3.88	7.95	7.09	7.56	7.45	8.22	6.36
-2SD--1SD	22.21	18.38	26.65	23.98	25.06	25.09	25.72	23.46
-1SD-1SD	54.47	56.33	51.96	54.43	56.92	55.68	57.75	58.92
1SD-3SD	15.92	20.21	11.31	13.04	9.11	10.02	7.34	10.32
>3SD	0.43	0.52	0.27	0.52	0.17	0.26	0.13	0.00
Retardation (<=-2SD)	6.97	4.56	9.81	8.03	8.74	8.95	9.06	7.30

Source: Authors' survey.

Table III. Cognitive and non-cognitive performance of 3rd and 4th grade students in 2017 (sample size: 9824)

Standardized variables	Different types			
	Total	Migrant	Left-behind	Non-left-behind
Math score	0.000	0.024	-0.082	0.117
Esteem	0.000	0.074	-0.114	0.032
Grit	0.000	0.045	-0.069	0.019
Depress	0.000	-0.071	0.101	-0.010

Source: Authors' survey.

Table IV. Definitions and descriptive statistics of variables

Variable	Units	Different types				Difference(T-test)	
		All	Left behind	Migrant	Non-left behind	Mean(2)-Mean(4)	Mean(3)-Mean(4)
		(1)	(2)	(3)	(4)	(5)	(6)
Age	years	10.583	10.585	10.611	10.490	0.096***	0.121***
Boys	the proportion of boys; decimal	0.503	0.485	0.525	0.474	-0.011	-0.050***
Weight	kilogram	32.204	31.066	33.213	31.659	-0.592**	1.554***
Height	centimeter	138.005	137.706	138.235	137.975	-0.269	0.261
BMI	range from -4.85 to 3.88	-0.274	-0.526	-0.053	-0.389	-0.138**	0.335***
HAZ	range from -4.63 to 5.2	-0.509	-0.559	-0.494	-0.441	-0.118**	-0.053
Math score	full score=30	20.193	19.818	20.302	20.729	-1.045***	-0.427**
Math score_std	standardized math score	0.000	-0.082	0.024	0.117	-0.198***	-0.093***
Depress	0=normal ;1=depression	0.410	0.462	0.373	0.405	0.058***	-0.032*
Grit	full score=5	3.251	3.205	3.281	3.264	-0.058**	0.017
Esteem	full score=70	45.403	44.458	46.017	45.669	-1.212***	0.347
Father's age	years	37.652	36.534	38.213	38.495	-1.962***	-0.283
Mother's age	years	35.980	35.172	36.216	37.129	-1.957***	-0.914***
Father's education years	years	9.960	9.634	10.350	9.479	0.155	0.871***
Mother's education years	years	9.311	8.985	9.719	8.774	0.211	0.945***

Source: Authors' survey.

Table V. Relationship between child cognitive performance and parental migration status

Status [c]	Math score [a]						Standardized math score [b]					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Rural												
Both migrant	-0.541***						-0.118***					
	(0.203)						(0.0441)					
Father only		-0.296						-0.0644				
		(0.238)						(0.0519)				
Mother only			-1.067***						-0.232***			
			(0.409)						(0.0891)			
Urban												
Both in cities				9.323***						2.029***		
				(3.037)						(0.661)		
Father only					-3.669						-0.798	
					(4.343)						(0.945)	
Mother only						8.916**						1.940**
						(3.614)						(0.786)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,313	2,600	1,866	5,281	1,786	1,858	4,313	2,600	1,866	5,281	1,786	1,858
R-squared	0.194	0.179	0.236	0.132	0.281	0.248	0.194	0.179	0.236	0.132	0.281	0.248

Notes: [a] The dependent variable is the score of each cognitive performance.

[b] The dependent variable is the standardization of math score.

[c] The independent variable is the different parental migration status and the control group is children who live in rural areas with both of their parents. Rural means child who lives in rural areas and hasn't moved to cities with his migrating parents. Both migrant means both of his parents are migrant workers. Urban means child who has moved to cities with his migrating parents. Both in cities means both of the parents are migrating workers. Father only means only his father is migrant workers. Mother only means only

his mother is migrant workers.

Table VI. Relationship Between Child Non-cognitive Performance and Parental Migration Status

Status[b]	Esteem[a]						Depress[a]						Grit[a]					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Rural																		
Both migrant	-0.831**						0.057**						-0.034					
	(0.364)						-0.022						(0.029)					
Father only		-1.167***						0.029						-0.0292				
		(0.430)						-0.027						(0.035)				
Mother only			-1.013						0.081*						-0.074			
			(0.749)						(0.046)						(0.058)			
Urban																		
Both in cities				4.594						-0.086						-0.018		
				(5.877)						(0.356)						(0.478)		
Father only					12.280						0.610						0.001	
					(7.916)						(0.499)						(0.629)	
Mother only						3.171						-0.327						0.232
						(6.559)						(0.418)						(0.533)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,313	2,600	1,866	5,281	1,786	1,858	4,313	2,600	1,866	5,281	1,786	1,858	4,313	2,600	1,866	5,281	1,786	1,858
R-squared	0.060	0.089	0.102	0.074	0.151	0.146	0.032	0.044	0.055	0.041	0.110	0.085	0.056	0.093	0.092	0.059	0.127	0.152

Notes: [a] Esteem and grit is the score of different non-cognitive performance. Depress is a dummy: 0=normal, 1=depression.

[b] The independent variable is the different parental migration status and the control group is children who live in rural areas with both of their parents. Rural means child who lives in rural areas and hasn't moved to cities with his migrating parents. Both migrant means both of his parents are migrant workers. Urban means child who has moved to cities with his migrating parents. Both in cities means both of the parents are migrating workers. Father only means only his father is migrant workers. Mother only means only his mother is migrant workers.

Table VII. Relationship Between Child Health and Parental Migration Status

Status[a]	BMI						HAZ					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rural												
Both migrant	-0.175***						-0.096**					
	(0.053)						(0.043)					
Father only		-0.061						-0.069				
		(0.066)						(0.051)				
Mother only			-0.252**						-0.132			
			(0.112)						(0.091)			
Urban												
Both in cities				1.044						1.049		
				(0.907)						(0.745)		
Father only					0.266						1.030	
					(1.228)						(0.993)	
Mother only						-0.934						-0.500
						(1.026)						(0.831)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,313	2,600	1,866	5,281	1,786	1,858	4,313	2,600	1,866	5,281	1,786	1,858
R-squared	0.097	0.109	0.113	0.098	0.151	0.144	0.269	0.262	0.274	0.258	0.297	0.295

Notes: [a] The independent variable is the different parental migration status and the control group is children who live in rural areas with both of their parents. Rural means child who lives in rural areas and hasn't moved to cities with his migrating parents. Both migrant means both of his parents are migrant workers. Urban means child who has moved to cities with his migrating parents. Both in cities means both of the parents are migrating workers. Father only means only his father is migrant workers. Mother only means only his mother is migrant workers.