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Parental migration, educational achievement, and mental health of junior high school students in rural China

Fang Chang[a], Yuxi Jiang[b], Prashant Loyalka[b], James Chu[b], Yaojiang Shi[a,*], Annie Osborn[b], Scott Rozelle[c]

[a] Center for Experimental Economics in Education, Shaanxi Normal University, Xi'an, China
[b] Stanford University, Stanford, CA, USA
[c] Rural Education Action Program, Freeman Spogli Institute for International Studies, Stanford University, Stanford, CA, USA

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ABSTRACT

China's rapid development has led to an unprecedented increase in migration rates as an ever-growing number of rural residents migrate to urban areas to seek better job opportunities and help alleviate family poverty. Economic pressures and structural restrictions force many of these migrant workers to leave their children behind in their rural homes, which has led to the emergence and expansion of a new subpopulation in China: left-behind children (LBCs). This study examines the impacts of parental migration on the educational outcomes (specifically math achievement) and mental health (specifically anxiety) of LBCs using data covering 7495 children in a prefecture of Shaanxi Province (from three surveys conducted between 2012 and 2014). We distinguish between "both parents migrating," "one parent migrating," "only a father migrating," and "only a mother migrating." We also explore the impacts on male versus female LBCs. We find no significant impact of parental migration on the math achievement of LBCs. In terms of mental health, however, our results indicate that left-behind girls were negatively affected by one parent migrating, especially if the migrating parent was the father. The findings suggest that it may not be necessary for policy makers to design special programs to improve educational outcomes of LBCs in general. However, local committees, schools, and parents should pay particular attention to left-behind girls living with only one parent, as they may be more vulnerable to mental health problems than their peers.

1. Introduction

Since the 1980s, China's rapid development, enabled by the Open Door Policy and an increasing trend of globalization, has resulted in unprecedented growth of economically-driven rural to urban migration (Taylor, 2002; Zhang, 2004). More and more rural residents are migrating to urban areas to seek better job opportunities and thus alleviate family poverty (de Janvry, Sadoulet, & Zhu, 2005; Zhou et al., 2015). Because the majority of migrant workers take low-paying jobs, and because China's place-based public resource distribution policies in urban areas largely prevent migrant children from accessing basic public goods such as education and healthcare, many workers cannot afford to bring their children to cities (Chen, 2001). Consequently, a new subpopulation has emerged in China: left-behind children (LBCs), who stay at home while one or both of their parents relocate elsewhere to work for a

* Corresponding author at: Center for Experimental Economics in Education (CEEE), Shaanxi Normal University, West Chang'an Road No. 620, Chang'an District, Xi'an 710119, China.
E-mail address: shiyaojiang7@gmail.com (Y. Shi).

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significant length of time (Biao, 2007; Jia, Shi, Cao, Delancey, & Tian, 2010). The estimated number of LBCs in 2013 was sixty-one million, three times higher than the number estimated in 2000 (All-China Women's Federation, 2013).

As the number of LBCs swells rapidly, researchers and policy makers have turned their attention to the educational development and mental health of this population. International scholarship has recognized both positive and negative impacts of parental migration. Démurger (2015) find that most of the benefits of migration come from remittances sent by the migrating parent. These remittances can ease liquidity constraints, which may increase family investments in the education of LBCs. On the other hand, parental migration can also cause disruptions in the lives of LBCs, which may negatively impact mental health and education. In addition, parental migration may increase the burden of domestic and farm work for LBCs (Chang, Dong, & MacPhail, 2011; McKenzie & Rapoport, 2011). In China, the results from the existing literature on the impacts of urban migration on LBCs are not clear-cut: while some studies have underscored detrimental effects on education and mental health due to family disruption (Zhou, Murphy, & Tao, 2014), others have considered urban migration as a household strategy which may significantly improve socio-economic circumstances and thereby help LBCs perform at least as well as non-LBCs on various child outcomes (Lu, 2012).

One reason for the mixed nature of the literature is the heterogeneity of LBCs as a population (Démurger, 2015). To better understand the differences in outcomes between various groups of LBCs, we divided studies of LBC outcomes into two groups by age. The first group is studies of primary school students; the second group is studies of secondary school students. Next, we examined how outcomes in each group vary based on household wealth.

When we examine the literature on primary school LBCs, we find that these studies, like the literature as a whole, has considerable variation in outcomes. Looking more closely, clear patterns emerge based on wealth. Students in poorer areas enjoy rising academic outcomes when their parents live and work in the city as migrants. In contrast, students in wealthier areas see negative impacts (Bai et al., 2016; Bai et al., 2016; Chang et al., 2017). The interpretation of this pattern is that when parents leave home and children stay behind, there is both a positive income effect and a negative absence-of-care effect, a dynamic that has been widely discussed in the literature (Démurger, 2015; Lu, 2012; McKenzie, 2005). When households are poorer, the income effect appears to dominate, and students improve their academic performance. When households are not poor, however, the income effect may be weaker, and the care effect may begin to dominate; as a result, the academic performance of students suffers.

In contrast, mental health outcomes of primary school LBCs have the opposite pattern to that of academic performance. Although primary school students overall show worse mental health outcomes when parents migrate (Chang et al., 2017; Su, Li, Xu, & Zhu, 2012;He et al., 2012; Jia et al., 2010), several studies have found that the impacts of parental migration on mental health are worse for poor students compared to wealthy students (He et al., 2012; Jia et al., 2010). This suggests that decreased care is the main factor impacting mental health outcomes for primary school LBCs.

This fairly consistent set of patterns of the impact of migration on left-behind children disappears when looking at samples of adolescent LBCs. One of the reasons for this may be that there are much fewer studies of adolescent LBCs than of primary school-aged LBCs. When we examine the literature on academic performance among adolescent LBCs, we find that one study shows a slightly negative impact of parental migration on the academic performance of adolescent LBCs (Li, Wang, & Nie, 2017); one study shows a slightly positive impact (Luo et al., 2015; Zhou et al., 2015); and one study shows no impact (Lu, 2012). These patterns, however, cannot be ascribed to baseline wealth levels, mainly because each of these studies uses data from mixed-income samples and do not examine the effects of wealth on academic performance.

Regarding the literature on mental health, only one study has examined the mental health of adolescent LBCs (Gao et al., 2010). Though this study found a negative impact of parental migration, it also is unclear how wealth mediates this impact, as this study examined students in a middle-income area of rural Guangdong and did not examine the role of wealth in affecting mental health. Overall, there is a great need for more information on adolescent LBCs – particularly specific economic groups of adolescent LBCs – to better understand the impacts of parental migration on academic performance and mental health.

In addition to these patterns, we examined the literature for patterns regarding parental migration type and gender. Unfortunately, few studies have examined either of these factors. Only two studies have analyzed how the exact type of parental migration (that is, one parent migrating or both parents migrating) may impact LBC outcomes, and both of these studies focus on mental health outcomes, not educational outcomes. Sun, Zhou, Wang, and Fan (2010) found that LBCs feel greater loneliness when both parents migrate compared to both non-LBCs and LBCs with one parent migrating. In contrast, Zhou, Sun, Liu, and Zhou (2005) found that there are no significant differences in the anxiety levels of LBCs with both parents migrating, LBCs with one parent migrating, and children who live with both parents. There is little information to account for these differences, as these studies focus on different age groups (Sun et al. examine primary school students while Zhou et al. look at a mixed-age sample), and neither examines other factors such as wealth. To our knowledge, no study has examined the effects of parental migration type on adolescent LBCs specifically. Moreover, no study examines the role that the gender of the migrating parent may play in LBC outcomes.

Similarly, the gender of LBCs as a factor has not been closely examined in the literature. Research on adolescent psychology suggests that adolescent boys and girls react differently to family disruptions such as parental migration (Cross & Madson, 1997), indicating that there could possibly be gendered differences in LBC outcomes. In the context of rural China, where families have traditionally devoted more resources to boys (Hannum, Kong, & Zhang, 2009; Lu, 2012; Ma & Huebner, 2008), it also possible that the dynamics of increased income and decreased have gendered impacts. However, few studies have examined the different outcomes of LBC girls and boys. While two studies of LBCs of mixed ages (ranging from early primary school to late secondary school) have found that the academic performance of LBC girls is both more negatively impacted by parental absence and more positively impacted by increased income (Hu, 2013; Lu, 2012), no study has examined the gendered impacts of parental migration among adolescent LBCs. Similarly, studies of LBC mental health have rarely examined the role of gender. Although one study suggests that adolescent LBC girls may exhibit more unhealthy behaviors than LBC boys, there is a need for further study into this finding and the

role that other factors such as wealth may play in these outcomes.

In addition to the heterogeneity of LBCs, another possible reason for the mixed findings in the literature on LBC outcomes may be that the majority of studies are correlational and do not address causation. A number of studies on LBC outcomes rely on cross-sectional data (Gao et al., 2010; Lee, 2011; Wang, 2014; Wen & Lin, 2012; Zhao et al., 2014; Zhou et al., 2014), which makes it difficult to determine causality. Among causal studies, several have relied on samples of < 2000 students (Hu, 2013; Lu, 2012), which may not provide the statistical power necessary to accurately identify the impacts of parental migration. Additionally, other papers have relied on study samples consisting of a few towns or one county (e.g. Zhang, Behrman, Fan, Wei, & Zhang, 2014) or areas with a high proportion of ethnic minorities (Zhao, Yu, Wang, & Glauben, 2013) which are not representative of LBCs overall.

The purpose of this study is to improve our understanding of the relationship between short-term parental migration and LBC development outcomes in low-income areas. To achieve this goal, we have three specific objectives. First, we will examine the both the correlations and the causal impacts of parental migration on the educational and mental health outcomes of LBCs. Secondly, we will identify how different types of parental migration, including “both parents migrating,” “one parent migrating,” “only mother migrating,” and “only father migrating,” affect the educational and mental health outcomes for LBCs. Finally, we will examine whether parental migration impacts differ according to the gender of LBCs.

2. Data collection and statistical approach

The data presented in this study comes from seventh and eighth grade students in eight nationally-designated poverty counties in one prefecture of northern Shaanxi between September 2012 and February 2014. The province and counties used this study are representative of poor rural areas in other parts of China in term of several key economic and social indicators. Shaanxi Province is ranked 16 out of 31 provinces in China in terms of GDP per capita, and this province has the second largest number of nationally-designated poverty counties among all provinces in China (NBS, 2013). Within this prefecture, the average per capita income of rural areas was approximately $1296 (RMB 8687) in 2013 (Shaanxi Province Bureau of Statistics, 2014), below the average national rural per capita income of $1640 (RMB 10,990) reported for the previous year (NBS, 2013). Hence, the sample counties are areas that are significantly below average in terms of income. Additionally, 99.5% ofmost of the population in the province is Han, the ethnicity in China that accounts for 92% of China's overall population (National Bureau of Statistics, 2010). Therefore, we believe that our sample can be considered fairly representative of poor, Han-majority rural areas in a typical Chinese province.[1]

Our sample selection procedure consisted of two steps. In the first step, we selected the sample counties within the designated prefecture. The sample prefecture is in the north of Shaanxi province and includes 12 counties, four of which have vast of coal and natural gas resources and eight of which do not. As a consequence, there is a considerable income gap between areas with natural resources and those without. The per capita income of these four resource-rich counties are above the national average (Shaanxi Province Bureau of Statistics, 2011). In contrast, the other eight counties in the prefecture have below-average income levels and are designated as poor counties by the Central Government of China (The State Council Leading Group Office of Poverty Alleviation and Development, 2012). In order to focus the effect of migration on students (including LBCs) in relatively poor areas, we therefore selected the eight poor counties in the prefecture as our sample counties.

In the second step, we selected the sample schools within the eight sample counties. Using official records, we created a sampling frame of all junior high schools in the sample counties, totaling 170 schools. We then applied two exclusion criteria to these 170 schools. First, because our interest is in rural schools, we excluded junior high schools that were located in county seats or prefecture seats (which primarily enroll urban students). Second, because China's government is currently consolidating existing rural schools into new centralized schools, we excluded schools with fewer than 90 students to safeguard against excessive attrition. After applying these exclusion criteria, our sample included 70 schools. We selected all seventh and eighth grade students in these schools for inclusion in our study. In total, our sample consisted of 7495 students from 70 schools within eight counties.

The data collection process consisted of three rounds of surveys: a baseline survey at the end of a semester in December 2012, a midline survey at the end of one subsequent semester in August 2013, and an endline survey at the end of two subsequent semesters in February 2014. The baseline survey collected student information in three blocks. In the first block, survey questions asked for information on the individual and family characteristics of students, including student age and gender, parental ages, parental education status (whether each parent had graduated from junior high school), parental migration status (whether each parent migrated to the cities for certain periods of time), number of siblings, and the value of household assets (Wang et al., 2015).[2] Information collected through these questions provided the control variables for our analysis.

In the second block of the baseline survey, students were asked to take a 30-min, proctored standardized math test based on items

[1] There are many designated poverty counties in provinces that have similar income levels and ethnic compositions to Shaanxi. For example, Hebei Province has 39 designated poverty counties, Shanxi has 32, Henan has 29, Hunan has 20 and Anhui has 19 (The State Council Leading Group Office of Poverty Alleviation and Development, 2012). Based on these consistencies, Shaanxi can be considered a typical Chinese province, and the sample counties in this study can be seen as at least somewhat representative of other designated poverty counties across China.

[2] To measure economic levels of the households in our sample, we asked a series of questions related to the student's household assets: whether the household owned certain common household items, livestock, small businesses, the material used to construct their home, and the size of their home. Most responses to household asset ownership variables in our data set were dichotomous, so we used polychoric principal components analysis (PCA—Kolenikov & Angeles, 2009) to construct a standard index for household wealth among our sample students, which we refer to as the family asset index. We did so because recent studies suggest using household asset indicators and PCA to construct continuous measures for household wealth is more reliable than self-reported income (for a review, see Kolenikov & Angeles, 2009).

that collaborators collected from the Chinese national curriculum framework (Ministry of Education of the People's Republic of China, 2008). The math test scores were scaled into z-scores by subtracting the mean and dividing by the SD of the math score distribution of all students tested at baseline. These standardized scores were used as our key measures of baseline educational outcomes.

In the third block of the baseline survey, students were asked to answer 100 yes/no questions from a mental health test (MHT). Of the 100 test questions, 10 were used to detect whether the student answered honestly, and the other 90 were used to calculate mental health scores. Since each MHT question is meant to detect certain anxiety tendencies, a student with a higher MHT score is more at risk for anxiety. The standardized MHT scores were used as our key measure of baseline mental health outcomes.

In the midline and endline surveys conducted, students were also asked to take the MHT. The standardized total scores of these two tests were then used as our key measures of midline and endline mental health outcomes. Due to time limitations, the collaborators were not able to ask the students to fill out the math test during the midline survey. Students were given the thirty-minute math test at endline, and the standardized scores from that test were used as our key measure of endline educational outcomes.

Finally, during each of the three survey rounds, participating students were asked how long their mother and father had lived outside the home over a defined period of time. Previous research has used a variety of measures to define parental migration and LBC status. Some studies have defined LBCs as children whose parents have out-migrated for six or more months (Huang et al., 2015), while other studies have considered children whose parents have out migrated for two or more months as LBCs (Bai et al., 2017). Still other studies have defined LBCs as children whose parents have out-migrated for an undefined period of time (Li et al., 2017; Shi, Bai, Shen, Kenny, & Rozelle, 2016; Zhou et al., 2015). In this paper, we seek to understand the impacts of short-term migration on mental health and academic performance of LBCs. Specifically, we examine the impacts of one or both parents out-migrating within a recent time period for a period of two or more months. In other words, based on student survey responses, we define migrant parents as those who have out-migrated for two or more months within the eight-month period before the baseline survey and within the two five-month periods before midline and endline.[3] We used this information to define the treatment variables for this study.[4]

A total of 7495 seventh and eighth grade students from the sample schools participated in the baseline survey. At the time of the midline survey (8 months after the baseline), 1085 of the original 7495 students (14.5%) had attrited. At the time of the endline survey (15 months after the baseline), 1537 of the original 7495 students (20.5%) were no longer able to participate. This rate of attrition is quite common in samples of rural junior high school students in China (Chen et al., 2013; Grenard et al., 2006), as many of rural junior high school students do not finish school (Wang, Xu, & Wang, 2006; Yuan, Hong, Li, & Qin, 2004). Unfortunately, because we do not have data on the parental migration status of students who drop out, we cannot determine if changes in parental migration (going from parents to home to parents away) is leading to students to drop out. However, when we compare dropout rates between students who were LBCs at baseline to students who were non-LBCs at baseline, we find no significant differences between the two groups. According to our data, the dropout rate of the whole sample was 5.6% at midline. At this time, the dropout rate of those that were LBCs at baseline was 6%, and the rate for non-LBCs was 5.7%. Hence, the difference in magnitude is small. At the endline survey, the total dropout rate was 9.4%, and the dropout rate of LBCs (10.2%) was, again, only slightly higher than that of non-LBCs (9%). Therefore, it is unlikely that dropout impacted the results of our analysis.

2.1. Data analysis

The data analysis of this study comprises three parts: descriptive and correlational analysis, causal analysis, and heterogeneous analysis. The descriptive and correlational analysis provides summary statistics of the data sample and explores the correlational relationship between parental migration and outcomes of LBCs compared to non-LBCs. The causal analysis is intended to rule out, as much as possible, undetectable interferences in the correlational analysis. Finally, the heterogeneous analysis examines whether and how the impacts of parental migration on LBCs differ by gender of both parents and children.

We first compiled summary statistics (Table 1), including the number of observations, mean, standard deviation, and minimum and maximum values for all the covariates at baseline and outcomes variables at baseline, midline, and endline. For each of the treatment dummy variables, namely “both parents migrating,” “only one parent migrating,” “only father migrating,” and “only mother migrating,” and the for the comparison dummy variable, “both parents staying at home,” we added the values through three time periods (the eight-month period before baseline, and the five-month periods before midline and endline) together to create new variables showing the number of time periods for which these treatment statuses held true (see Fig. 1). For instance, if, for one student, the value of the cross-period treatment variable, “only father migrating,” was two, it meant that for two time periods, the

[3] Because we collected data on parental migration from students, we only collected information on whether or not parents had out-migrated in the eight-month period before baseline and the two five-month periods before midline and endline. Therefore, in this paper, we seek to only understand the impacts of short-term migration on the mental health and academic performance of LBCs. For this reason, we classify migrant parents as those who have out-migrated for two or more months.

[4] We define students as LBCs or non-LBCs according to the migration status of their parents in a given survey wave, and classification of parents as migrating or not migrating in each of the three survey waves are not dependent on their status in the other survey waves. This means that the status of parent as a migrant or a non-migrant could change from baseline to midline or from baseline to endline. For instance, if a student's parent(s) had out-migrated for two or more months in the eight-month period before the baseline, that student would be classified as an LBC at baseline. However, if the parents had returned home by the midline/endline survey, the student would be classified as non-LBC for that specific survey wave. In our sample, about 20% of the students (50% of the students classified as LBCs at some point in the survey) saw their status change between baseline and endline, either from non-LBC to LBC or vice-versa.

Table 1
Summary Statistics of Control and Outcome Variables.

	N	Mean	SD	Min	Max
Demographic and family characteristics at baseline					
1. Female, 1 = yes	7442	0.467	0.499	0	1
2. Grade, 1 = 8th grade	7442	0.522	0.500	0	1
3. Student age, in months	7442	180.228	13.244	135	251
4. Number of siblings	7442	1.431	1.046	0	16
5. Plan to attend vocational high school, 1 = yes	7442	0.712	0.453	0	1
6. Plan to attend academic high school, 1 = yes	7442	0.808	0.394	0	1
7. Standardized family asset value	7442	0.002	1.000	−2.636	2.933
8. Has ever skipped class, 1 = yes	7442	0.246	0.431	0	1
9. Father graduated from junior high school, 1 = yes	7442	0.428	0.495	0	1
10. Mother graduated from junior high school, 1 = yes	7442	0.235	0.424	0	1
11. Father's age	7384	40.594	5.120	28	69
12. Mother's age	7302	38.140	4.730	24	65
13. Live home, 1 = yes	7441	0.211	0.408	0	1
14. Father ever migrated, 1 = yes	7442	0.320	0.467	0	1
15. Mother ever migrated, 1 = yes	7442	0.112	0.316	0	1
16. Single parent family, 1 = yes	7437	0.051	0.220	0	1
Baseline measures of outcome variables					
20. Standardized value of mental health general scores, baseline	7159	−0.028	0.989	−2.882	3.467
21. Standardized value of math test score, baseline	7442	0.001	1.000	−3.410	2.809
Midline and Endline measures of outcome variables					
22. Standardized value of mental health general scores, midline	6358	−0.020	0.992	−2.730	3.279
23. Standardized value of mental health general scores, endline	5911	−0.021	0.978	−2.468	3.347
24. Standardized value of math test score, endline	6126	0.003	1.000	−3.383	3.146

student's father migrated while the mother stayed at home. For the other time period, the student's household either experienced another migration type or had both parents staying at home. These cross-period treatment variables provide important information about the patterns of treatment frequency for our sample student families, allowing us to examine whether we had sufficient variation in each treatment.

In our correlational analysis, we use an ordinary least squares (OLS) multivariate regression to estimate the differences between parental migration and educational and mental health outcomes of LBCs compared to non-LBC. We also used OLS to examine the differences between various parental migration types and LBC outcomes. Two sets of regression models were created as the following:

$$Score_{ist} = \alpha + \beta_1 \cdot Mig_{ist} + \beta_2 \cdot Mig_{is,t-1} + \delta \cdot Score_{is,base} + X_{is} \cdot \gamma + \varepsilon_{is} \quad (1)$$

$$Score_{ist} = \alpha + \beta_1 \cdot BMig_{ist} + \beta_2 \cdot OMig_{ist} + \theta_1 \cdot BMig_{is,t-1} + \theta_2 \cdot OMig_{is,t-1} + \delta \cdot Score_{is,base} + X_{is} \cdot \gamma + \varepsilon_{is} \quad (2)$$

where i denotes student i in school s in period t (midline or endline survey), $Score_{ist}$ is the standardized math test score or the mental health score of student i in school s in period t. Mig_{ist} is a dummy for parental migration status, including “both parents migrating” and “only one parent migrating” as the only treatment variables. $BMig_{ist}$ represents “both parents migrating” and $OMig_{ist}$ represents “only one parent migrating.” $Mig_{is,t-1}$ mean represents all parental migration in the prior period (before the midline or endline survey). $BMig_{is,t-1}$ represents migration of both parents in the prior period. $OMig_{is,t-1}$ represents migration of only one parent in the prior period. $Score_{is,base}$ is the standardized math test score or mental health score of student i in school s in the baseline survey. The term X_{is} is a vector of covariates of students and their family characteristics. These covariates included gender (1 = female, 0 = male), grade (1 = 8th grade, 0 = any other grade), age (in months), number of siblings, standardized family asset value, father's age, and mother' age. The covariates also included dummy variables for whether the student planned to attend vocational high school (1 = yes, 0 = no), planned to go to academic high school (1 = yes, 0 = no), had skipped class in the current semester (1 = yes, 0 = no), was from a single parent family (1 = yes, 0 = no), whether the father migrated (1 = Yes, 0 = No) and whether the mother migrated (1 = Yes, 0 = No) in the baseline survey.

Accurately estimating the causal impact of the migration on student achievement and mental health is a challenge because the assignment of the parental migration is non-random. This selection bias could lead researchers to under or overestimates the impact of the parental migration. In an attempt to estimate unbiased causal effects of parental on student achievement, we used student fixed effect analysis to explore the impacts of parental migration on the mental health and educational outcomes of LBCs. The use of student fixed effects removes confounders that may arise from factors that remain constant across semesters (e.g. gender, parental educational levels) as well as factors that change by a constant C across all students (e.g. age, grade level — see Angrist & Pischke, 2008). This allows us to reduce the impacts of endogenous factors that may impact the academic performance or mental health of all students. Other non-time varying unobservables, such as student ability, are also controlled for by including student fixed effects. In this way, we can look at the variance in academic performance and mental health of each student and directly connect these outcomes to parental migration status. The student fixed effects model is as follows:

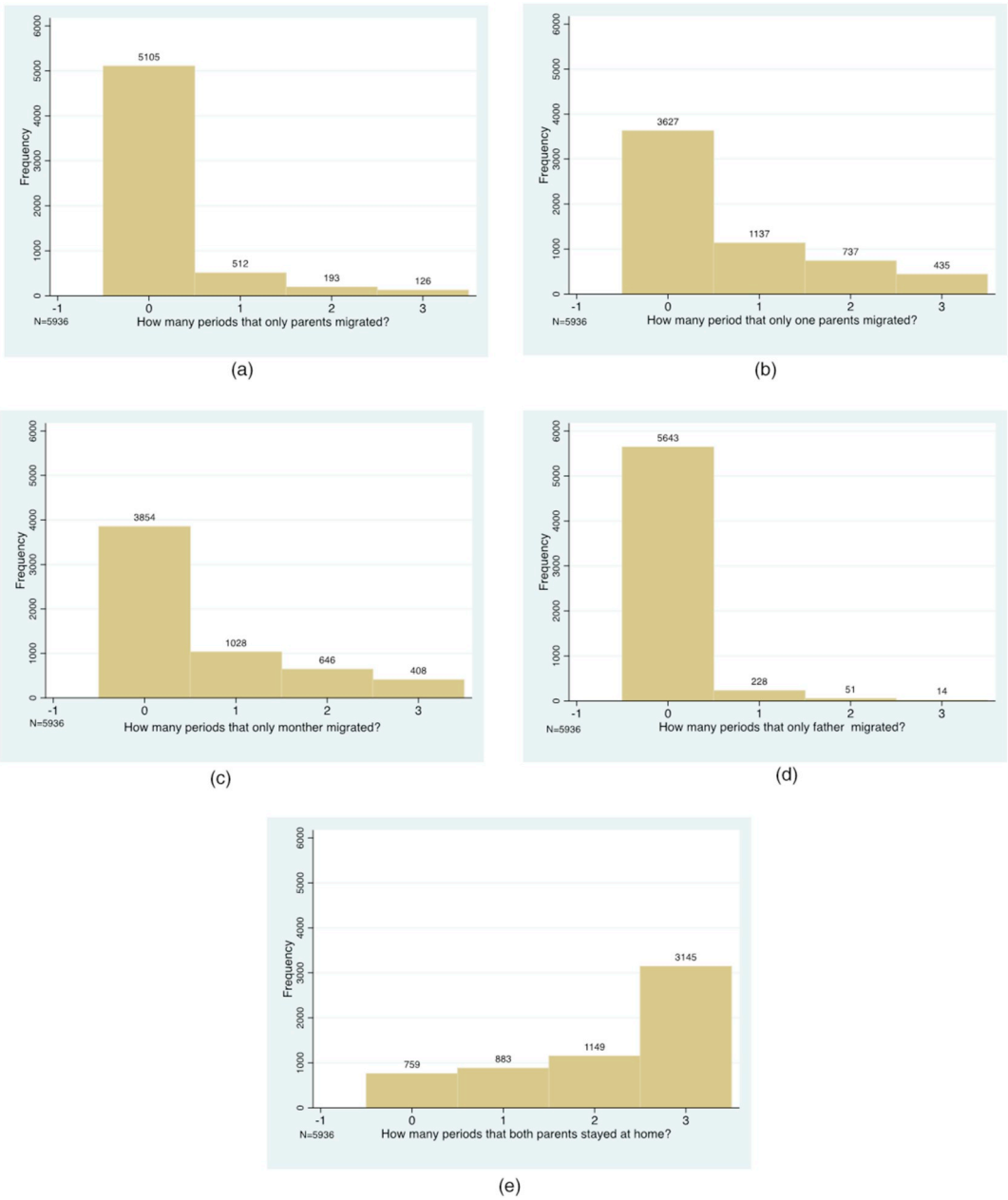

Fig. 1. Treatment Frequency Patterns through Three Time Periods. (a) Treatment: Both Parents Migrating (Number of periods during which both parents migrated). (b) Treatment: One Parent Migrating (Number of periods during which one parent migrated). (c) Treatment: Only Mother Migrating (Number of periods during which only the father migrated). (d) Treatment: Only Father Migrating (Number of periods during which only the mother migrated). (e) Comparison: Neither Parent Migrating (Number of periods during which both parents were at home).

$$MScore_{is} = \alpha + \beta \cdot Mig_{is} + \delta_1 \cdot d_{end} + \varepsilon_{is} \tag{3}$$

$$MHScore_{is} = \alpha + \beta \cdot Mig_{is} + \delta_1 \cdot d_{mid} + \delta_2 \cdot d_{end} + \varepsilon_{is} \tag{4}$$

$$MScore_{is} = \alpha + \beta_1 \cdot BMig_{is} + \beta_2 \cdot OMig_{is} + \delta_1 \cdot d_{end} + \varepsilon_{is} \tag{5}$$

$$MHScore_{is} = \alpha + \beta_1 \cdot BMig_{is} + \beta_2 \cdot OMig_{is} + \delta_1 \cdot d_{mid} + \delta_2 \cdot d_{end} + \varepsilon_{is} \tag{6}$$

We used a panel dataset with three waves of observations for each student for models (3), (4), (5) and (6) including math test of baseline and endline surveys, as well as mental health of baseline and midline and endline surveys. $MScore_{is}$ represents the math score of the students, $MHScore_{is}$ represents the mental health score of the students, d_{mid} is a dummy variable (1 = midline survey, 0 = any

Table 2
Parental Migration Status, Children's Mental Health, and Math Achievement.

	Math Score (Endline)	Mental Health Score (Midline)	Mental Health Score (Endline)
Parental Migration	0.033	0.034	0.066**
	(0.039)	(0.031)	(0.032)
Constant term	2.014***	−0.302*	−0.509**
	(0.298)	(0.168)	(0.202)
No. of observations	5778	5964	5397
R-squared	0.179	0.381	0.332

Robust standard errors in parentheses adjusted for 70 clusters in schid Controlling for student gender, grade, age, number of siblings; whether the student lives at home, whether the student wants to go to high school/vocational school, whether the student has skipped class, whether the student comes from a single parent family, whether either parent has migrated at baseline, parental age, and parental education.
*** $p < .01$, ** $p < .05$, * $p < .1$.

Table 3
Parental Migration Types, Children's Mental Health, and Math Achievement.

	Math Score (Endline)	Mental Health Score (Midline)	Mental Health Score (Endline)
Both parents migrating	0.001	−0.060	0.019
	(0.068)	(0.045)	(0.063)
Only one parent migrating	0.051	0.059*	0.083**
	(0.045)	(0.033)	(0.034)
Constant term	2.018***	−0.296*	−0.509**
	(0.298)	(0.165)	(0.232)
No. of observations	5778	5964	5397
R-squared	0.180	0.382	0.333

Robust standard errors in parentheses adjusted for 70 clusters in schid Controlling for student gender, grade, age, and number of siblings; whether the student lives at home, whether the student wants to go to high school/vocational school, whether the student has skipped class, whether the student comes from a single parent family, whether either parent has migrated at baseline, parental age, and parental education.
*** $p < .01$, ** $p < .05$, * $p < .1$.

other survey), and d_{end} is also a dummy variable (1 = endline survey, 0 = any other survey). ε_{is} is the error term.

Finally, for our heterogeneous analysis, we examined how the causal effects of parental migration might differ between female and male students. To conduct the heterogenous analysis, we first divided the sample into male and female subgroups. We then ran the fixed effects models (described above) for each of these two subgroups and compared the results.

3. Results and discussion

3.1. Correlational analysis results

Tables 2 and 3 both present regression results for the correlational relationship between parental migration and educational as well mental health outcomes of LBCs. Table 2 shows that after controlling for the study's set of control variables, no significant difference between LBCs and non-LBCs was detected in math achievement at endline or in mental health status at midline. However, the mental health score of the LBCs is 0.066 standard deviations higher at the endline than that of non-LBCs ($p < .05$). Thus, LBCs reported significantly worse mental health outcomes at endline compared to non-LBCs.

In order to better reflect the complex migration practices and distinguish different LBC groups, Table 3 shows results for the divided treatment variable, where “parental migration” was split into “both parents migrating” and “only one parent migrating.” Compared with non-LBCs, the educational outcomes of children who had either both parents or only one parent migrating were not significantly different at either midline or endline after controlling for the same covariates described above. Furthermore, children who had both parents migrating did not have significantly different mental health outcomes than non-LBCs. However, the mental health score of LBCs with one parent migrating is 0.059 standard deviation higher at midline ($p < .1$) and 0.083 standard deviations higher at endline ($p < .05$) than non-LBCs. This means that although LBCs with both parents migrating do not appear to have worse mental health outcomes, the mental health of LBCs with only one parent migrating is significantly worse than non-LBCs.

3.2. Causal analysis results

In this section, we present regression results using the OLS model (including both cross-sectional data) and fixed effects models (including panel data).Table 4 shows both mental health and educational outcomes for LBCs and non-LBCs. The results of the OLS model show that the mental health core of LBCs is 0.066 standard deviations higher than that of non-LBCs ($p < .05$). Thus, LBCs

Table 4
Impacts of Parental Migration on Left-Behind Children's Mental Health and Math Achievement.

	OLS Regression Model (cross-section data)		Fixed Effect Model (panel data)	
	Math Test Score	Mental Health Score	Math Test Score	Mental Health Score
Parental Migration (both parents or only one parent migration)	0.026	0.066	−0.010	0.041
	(0.032)	(0.027)**	(0.048)	(0.037)
Constant term	1.861	−0.677	−0.012	−0.053**
	(0.210)***	(0.217)***	(0.055)	(0.020)
Observations	13,381	11,646	13,381	11,648
R-squared	0.067	0.050	0.694	0.882

Robust standard errors in parentheses adjusted for 70 clusters in schid.
For math achievement outcome, controlling for period number.
For mental health outcome, controlling for period number, mental health score in the previous period and parental migration status in the previous period.
*** $p < .01$, ** $p < .05$, * $p < .1$.

Table 5
Impacts of Two Parental Migration Types on Left-Behind Children's Math Achievement.

	Model 1	Model 2	Model 3
Both Parents Migrating	0.024		0.031
	(0.077)		(0.071)
Only One Parent Migrating	−0.020	−0.023	
	(0.047)	(0.043)	
Constant term	−0.013	−0.010	−0.016
	(0.055)	(0.052)	(0.054)
No. of observations	13,381	13,381	13,381
R-squared	0.694	0.694	0.694

Robust standard errors in parentheses adjusted for 70 clusters in schid.
Controlling for period number.
*** $p < .01$, ** $p < .05$, * $p < .1$.

reported significantly worse mental health outcomes compared to non-LBCs. However, the result of the fixed effects model reveals that parental migration has no significantly different impacts on either educational or mental health outcomes. These results for educational outcomes are consistent with previous studies such as Zhou et al. (2015), which find that LBCs perform about as well as non-LBCs in math; however, our results do not support previous the conclusions found in, for instance, Zhao et al. (2013), which suggests that LBCs were academically disadvantaged relative to their non-LBC peers. It is slightly more difficult to compare our mental health outcomes for LBCs with previous literature, because the scale we use focuses on anxiety risk rather than metrics like "life satisfaction." Nevertheless, our results do tend to agree with those found in studies such as Wen and Lin (2012) or Zhang, Tang, Hu, and Xu (2006), which do not find significant differences in mental health outcomes for LBCs and non-LBCs.

The fixed effects analysis of the impacts of parental migration type on math achievement outcomes on non-LBCs and on different subgroups of LBCs is shown in Table 5. For all three models, the coefficients for our predictors were not statistically significant. In other words, children with both parents staying at home, both parents migrating, and only one parent migrating did not, in comparison with any of these three groups, experience significantly different impacts on their math achievement. Again, these results support the existing literature that finds no major differences in the educational outcomes of LBCs versus non-LBCs (e.g. Lu, 2012) and contradicts the literature that suggests LBCs are suffering academically (e.g. Hu, 2013).

Table 6 presents the results of our fixed effects analysis of the impact of parental migration type on mental health outcomes for the three models. Our results indicate that different parental migration types also had no significant impacts on the mental health outcomes of corresponding groups of LBCs. This finding should increase our confidence in studies such as Zhang et al. (2006) and others that find no significant differences in mental health outcomes between LBCs and non-LBCs. Importantly, this finding contradicts our correlational results: whereas our correlational analysis finds that LBCs with only one parent migrating have significantly lower mental health outcomes, our fixed effects analysis finds no difference in mental health outcomes between non-LBCs and LBCs of any parental migration type. This indicates that although the lower mental health outcomes of LBCs with one parent migrating are correlated to parental migration, these outcomes may not be directly caused by parental migration.

One possible reason for this contraction is that exogenous factors are both causing parents to leave home and impacting the mental health of left behind children. In other words, parents are leaving home for the same reason that children are experiencing mental health challenges, but parental migration is not the direct cause of these mental health challenges. For example, poverty may simultaneously impact parental migration and the mental health of a child. If money is insufficient to feed a family properly, malnutrition may negatively affect the child's mental health, while need for greater income may also prompt one parent to migrate to find higher paying work. Another possible cause is family conflict, such as a strained or unhealthy spousal relationship. Family

Table 6
Impacts of Two Parental Migration Types on Left-Behind Children's Mental Health.

	Model 1	Model 2	Model 3
Both Parents Migrated	−0.030	−0.052	
	(0.064)	(0.066)	
Only One Parent Migrated	0.060		0.064
	(0.044)		(0.044)
Constant term	−0.052**	−0.034**	−0.056***
	(0.020)	(0.016)	(0.019)
o. of observations	11,648	11,648	11,648
R-squared	0.882	0.882	0.882

Robust standard errors in parentheses adjusted for 70 clusters in schid.
Controlling for period number, mental health score and parental migration status in the previous period.
*** $p < .01$, ** $p < .05$, * $p < .1$.

conflict may negatively influence a child's mental health, and it may also cause one parent to leave home.

On the whole, the parental migration types of different LBC households do not appear to have significant impacts on LBC academic performance or mental health when compared with non-LBC outcomes. On the one hand, this is good news, in that LBCs do not appear to be suffering negative academic or mental health problems because of their parents' migration behavior. On the other hand, parents likely make the decision to migrate because they hope it will improve their children's lives, and our findings do not indicate that LBCs are doing better than their non-LBC peers in terms of educational outcomes or mental health, at least within the time frame of our study. It is possible that the positive effects of parental migration are felt in the longer term; it is also possible that parental migration simply has a net neutral effect on LBC academic performance and mental health.

3.3. Heterogeneous analysis results

Based on the results of the causal analysis section, it seems that regardless of parental migration type (including both parents migrating, only one parent migrating, only mother migrating, and only father migrating), parental migration had no significant causal impact on either educational or mental health outcomes. However, this does not necessarily mean that both left-behind girls and left-behind boys experience the same impacts. This section therefore explores how different types of parental migration impact two LBC subgroups: left-behind girls and left-behind boys.

When looking at LBCs from households of any parental migration type (i.e., either one or both parents migrated), the heterogeneous fixed effects were different for educational and mental health outcomes (Table 7, row 1). In terms of educational outcomes, no parental migration type had a significantly different impact on male versus female LBCs. However, when the outcome variable was mental health test score, although male students did not experience significant impacts from having any parent migrate, for female students, the coefficient (0.010) of "any parent migrating" was significant ($p < .05$) with a standard error of 0.049 (Table 7, row 1 column 3). This means that the mental health score of all female LBCs is 0.010 standard deviation higher than non-LBCs, indicating that LBCs girls show significantly worse mental health outcomes than non-LBC girls.

When comparing left-behind girls to girls living with both their parents, our fixed effects models also produce different results for left-behind girls who lived in "both parents migrating" versus those who lived in "only one parent migrating" households (Table 7, rows 3 and 4). While there were no significantly different impacts on math outcomes for either group, there were significant impacts on mental health for girls living in "only one parent migrating" households. We find that the mental health score of female LBCs with only one parent migrating is 0.124 standard deviations higher than non-LBCs ($p < .01$), while the difference in mental health outcomes between LBCs with both parents migrating and non-LBCs was not statistically significant.

Why might girls living in "only one parent migrating" households exhibit worse mental health outcomes than boys in a similar situation? It is possible that boys are experiencing something like a "freedom offset" when one of their parents migrates outside the household. The majority of our participants were between the ages of 12 and 15 years old, which is usually when both boys and girls are undergoing puberty. During this period, adolescents typically seek independence from their parents and social acceptance among their peers (Stanford Children's Health, 2019). One parent not being at home may mean less supervision for a son, allowing him to spend less time at home and more time socializing with friends, which would offset some of the negative effects the son might feel when missing his absent parent. However, a daughter may be less likely to experience this freedom because she may be expected to pick up more of the burden of household duties that were previously the responsibility of the now-absent parent. Indeed, previous literature has noted that when at least one parent migrates, left-behind girls experience a dramatic rise in farm work and domestic work, while left-behind boys do not experience any increase in responsibilities (Chang et al., 2011). This increase in household responsibilities may also increase stress for female LBCs. Considering this previous research, and considering that adolescent LBCs may be more vulnerable to mental health consequences from stress (Andersen & Teicher, 2008; Kaltiala-Heino, Rimpelä, Rantanen, & Laippala, 2001), it is not surprising that left-behind girls with one parent migrating exhibit lower mental health outcomes.

Finally, we examine the impacts on mental health outcomes for left-behind girls of "only father migrating" and "only mother migrating" household types (Table 7, rows 6–8). We do this simply to provide preliminary results as benchmarks for future research,

Table 7
Impacts of Parental Migration on Math Achievement and Mental Health of Left-Behind Girls and Boys Respectively

	Female Students		Male Students	
	Math Score	MH Score	Math Score	MH Score
Model 1				
Parental Migration (both parents	−0.028	0.010**	0.007	−0.015
or only one parent migrating)	(0.060)	(0.049)	(0.069)	(0.514)
Constant term	−0.033	0.204***	0.007	−0.310***
	(0.049)	(0.028)	(0.066)	(0.026)
Model 2				
Both Parents Migrating	0.057	0.016	−0.006	−0.770
	(0.097)	(0.086)	(0.173)	(0.085)
Only One Parent Migrating	−0.054	0.124**	0.010	0.002
	(0.067)	(0.054)	(0.064)	(0.059)
Constant term	−0.035	0.205***	0.007	−0.309***
	(0.049)	(0.028)	(0.067)	(0.027)
Model 3				
Both Parents Migrating	0.058	0.015	−0.009	−0.007
	(0.097)	(0.086)	(0.138)	(0.084)
Only Mother Migrating	−0.008	0.125	−0.062	0.144
	(0.175)	(0.106)	(0.150)	(0.142)
Only Father Migrating	−0.059	0.126**	0.023	−0.026
	(0.069)	(0.059)	(0.071)	(0.066)
Constant Term	−0.035	0.205***	0.008	−0.309***
	(0.049)	(0.028)	(0.068)	(0.026)
No. of observations	6382	5719	6999	5929

Robust standard errors in parentheses adjusted for 70 clusters in schid.
For math score, controlling for semester number.
For MH score, controlling for mental health status and migration status in the previous semester and semester number.
*** $p < .01$, ** $p < .05$, * $p < .1$.

because we may not have enough "only mother migrating" households for robust results. We find that the mental health score of female LBCs with "only father migrating" is 0.126 standard deviations higher than female LBCs with both parents migrating ($p < .05$), meaning that the impact on mental health for girls living in "only father migrating" households was larger than for girls living with both parents ($p < .05$). There were no significantly different impacts on mental health for any other treatment variables. While this may be indicative of a larger trend, the small number of "only mother migrating" households in our sample means that the result may not be robust, and that we should treat this finding only as a starting point for future research.

In summary, the results of our heterogenous analysis indicate that while male LBCs experience no adverse mental health outcomes due to parental migration, female LBCs are more likely to show lower mental health outcomes. Differentiating by migration type helps us to discern that female LBCs may experience additional mental health challenges due to single parent migration, leading to lower mental health outcomes. This is likely because female LBCs are expected to take up more household duties than male LBCs in the event of one parent migrating. It is also possible that female LBCs may experience greater mental health burdens when only the father migrates, however there is a need for more research to confirm the accuracy of these results.

4. Summary and conclusions

This paper examines the correlational and causal relationships between short-term parental migration and the educational and mental health outcomes of left-behind children. Focusing specifically on impoverished areas in rural western China, we look at the effects of single parent migration and dual parent migration. Within single parent migration we also explore the differential effects of fathers and mothers migrating. In addition, we examine the differential impacts of parental migration on male and female LBCs.

Our results show that overall, there are no effects of parental migration on the educational outcomes of LBCs. Both our correlational and causal analyses find no differences between LBCs and non-LBCs in terms of academic performance. We do find a correlational relationship between LBCs with one parent migrating and lower mental health outcomes (using the OLS model); this is supported by the many previous correlational studies of LBC mental health (Chang et al., 2017; He et al., 2012; Jia et al., 2010; Su et al., 2012) However, our causal analysis (using student fixed effects) finds no differences in mental health of non-LBCs and LBCs of any parental migration type, suggesting that for LBCs with one parent migrating, exogenous factors (e.g., poverty) may be simultaneously impacting both child mental health and parental migration. The only significant causal impact that we found is that female LBCs with one parent migrating experience lower mental health outcomes. This may be because female LBCs experience more pressure than male LBCs to take up household duties when one parent migrates. It is possible that female LBCs with only fathers migrating may experience worse mental health outcomes compared to those with only mothers migrating; however, because of the small number of families in which only mothers migrated within our sample, there is a need for further research to confirm this finding.

This paper makes several contributions to the literature on LBCs regarding both mental health and education. Whereas previous studies have often focused on one dimension of LBC outcomes, this study explores multiple outcome variables to examine the various impacts of parental migration on the same population of LBCs. This study also addresses variation in parental migration types and the gendered impacts of parental migration on adolescent LBCs, which previous literature has often neglected.

Additionally, this study may help address some of the conflicting literature on LBC educational outcomes. Many of the previous studies on LBC educational outcomes have been correlational studies, rather than causal studies. The few studies that have performed causal analyses have relied on data sets with relatively small sample sizes, which may not provide the statistical power necessary to provide robust results on the impacts of parental migration. This study uses a fixed effects approach to produce causal estimates of the impacts of migration on LBCs using a large sample of LBC students to more accurately address the impacts of parental migration on LBC education. Moreover, this study focuses on designated poverty areas, allowing us to examine the interactions between increased income and decreased care (as discussed in Démurger, 2015; McKenzie, 2005; Lu, 2012) in poor communities. Our results support previous findings (e.g. Lu, 2012) that suggest that in high-poverty areas, increased income from parental migration may offset the impacts of decreased care, though it does not give LBCs any advantage over non-LBCs.

This study also makes a key contribution to scholarship on LBC mental health. As mentioned above, while many studies have examined correlations between parental migration and LBC mental health outcomes, to our knowledge, no study on LBC mental health has examined the causal relationship between parental migration type and LBC outcomes. This study performs both a correlational analysis and a causal analysis to better understand the mental health circumstances of LBCs and determine the specific impacts of parental migration type on LBC mental health outcomes. As our results show, there are correlations between parental migration type and LBC outcomes that may not be indicative of a causal relationship. There are causal relationships between parental migration type and LBC mental health that differ by gender. By examining correlation and causation, different types of parental migration, and the gendered effects of parental migration, we are better able to identify the specific mental health impacts of parental migration on different sub-groups of LBCs.

Despite the robust results of this paper, there are some limitations. Although our study uses fixed effects to control for time-invariant factors that may affect our outcome variables, it is difficult to determine that our causal estimates are fully free of endogeneity. A classic fixed effects approach will not produce any estimates of the effects of variables that do not change over time. Moreover, fixed effect estimates use only within-individual differences, essentially discarding any information about differences between individuals. If predictor variables vary greatly across individuals but have little variation over time for each individual, then fixed effects estimates will be rather imprecise (Allison, 2009). The fixed effects model also may not account for the ways that academic achievement, and particularly mental health, may impact a parent's decision to migrate. For example, if parents believe that their child is resilient, or that grandparents are especially capable, then they may be more willing to leave their child behind. Conversely, if parents feel that their child is not doing well academically or emotionally and have greater worry about that child, they may choose to stay home rather than to migrate. Both cases may lead us to underestimate the true impact of parental migration on LBC outcomes (since these are traits of the family/parent/students that are inherently unobservable). In addition,

In addition, this study looks only at the impacts of short-term migration on LBC outcomes. It is possible that impacts of parental migration may be different in the long-term. Also, because we do not have the full migration histories for each family in the study sample, we cannot identify the impacts of earlier parental migration on the current academic and mental health outcomes of LBCs in our sample. This study also focuses specifically on junior high school students within designated poverty counties in one province of China. As LBCs are a heterogenous group made of children of difference ages and socioeconomic backgrounds, studies of younger or older LBCs, or studies in a different region or wealthier area of China, may see different outcomes in education and mental health.

To the extent that our results are valid, we have three policy recommendations. First, because we find no correlational or causal impact of parental migration on academic performance of LBCs, we recommend that existing policies aimed to improve the educational outcomes of LBCs be expanded to include all rural students. Based on our results, LBCs do not appear to be a group that is particularly vulnerable to poor educational outcomes. However, given the well-documented education gap between rural and urban areas (Khor et al., 2016; Wang, Li, Abbey, & Rozelle, 2018), it is likely that all rural students could benefit from increased educational support.

Second, our finding that LBCs with one parent migrating may be experiencing mental health challenges correlated to parental migration leads us to recommend that future policies address factors that may be contributing to both poorer LBC mental health outcomes and parental migration. Previous studies can help us to identify potential factors. One key factor is poverty: poverty is a major cause of parental migration, and poverty can lead to a host of other challenges, from malnutrition to untreated visual impairments. Any of these poverty-related factors may be contributing to a child's poor mental health (Guo & Zhou, 2015; Han, 2014; Klieman-Weiner et al., 2013). To improve the mental health outcomes of this group, we recommend that future policies address the effects of poverty on the quality of life of rural children, particularly nutritional deficiencies.

Finally, based on our findings that female LBCs with one parent migrating experience lower mental health outcomes than other groups, we recommend that policymakers recognize female LBCs living with only one parent as a potentially vulnerable group. Policymakers interested in improving mental health outcomes should recognize that this group in particular may benefit from increased mental health resources, such as access to counselors. However, we do not suggest that mental health resources be limited to this group. The results of our correlational analysis show that it is not only female LBCs with one parent migrating that experience mental health challenges; rather, all LBCs with one parent migrated may face mental health challenges, even if such challenges are not directly caused by parental migration. Increased access to mental health resources may also benefit other potentially vulnerable groups not identified in this study, as well as the broader array of students who may experience mental health challenges. Therefore, we recommend that mental health resources be made more available to all students in rural schools. In this way, mental health

outcomes could improve for all children, including LBCs.

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