

**Vulnerability and Resilience in the Times of COVID-19: Family Resources and
Children's Well-being in China**

Ruo Chen Zhang^a, Yao Lu^b and Haifeng Du^a

^aXi'an Jiaotong University, Xi'an, China; ^bColumbia University, New York, New York, USA

Corresponding author: Yao Lu Email: yao.lu@columbia.edu Address: Department of Sociology, Columbia University, New York, NY 10027, USA.

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Vulnerability and Resilience in the Wake of COVID-19: Family Resources and Children's Well-being in China

The present study uses data from a 2020 survey conducted in Shaanxi Province during the COVID-19 outbreak to examine the family resources and psychological well-being of four major groups of Chinese children (urban, migrant, rural nonmigrant, and rural left-behind children). The results highlight the complex ways in which family resources intersect with the pandemic to affect these different groups of children. Family economic resources have generally declined across all groups, but left-behind children have suffered the most severe economic shock. However, parent-child relationships for all children have improved across the board during the pandemic. Diminished economic resources act as a risk factor, while improved family relationships play a protective role in children's psychological well-being. Parent-child relationships have had a more pronounced positive impact on psychological outcomes for migrant and left-behind children, who are the most deprived of parental input under normal circumstances, than for other groups of children. Because of these processes, migrant children and left-behind children fare similarly to urban children in terms of their resilience to the COVID-19 crisis. Among children enjoying especially favorable parent-child relationships, migrant children and left-behind children even appear to have higher psychological well-being than urban children during the pandemic. In comparison to this social impact, the impact of family economic resources is more moderate in magnitude and does not vary systematically across different groups of children. As a result, the positive impact of improved parent-child relationships largely outweighs the adverse effect of reduced family economic resources. Overall, the findings provide new insight into the relationship among disasters, family resources, and child well-being in the context of the COVID-19 crisis in China.

Keywords: COVID-19; Resilience; Chinese children; Disaster; Family resources; Well-being

Introduction

COVID-19, which first emerged in Wuhan in December 2019, has led to local and national lockdowns since January 23, 2020. The outbreak is now largely contained in China, with sporadic confirmed cases, but it has swept across the world, causing global damage. Since its outbreak, especially during the height of the outbreak in China from February-April 2020, COVID-19 has significantly altered family dynamics and disrupted the lives of hundreds of millions of Chinese children. Under nationwide mandatory quarantine orders, almost all Chinese children stayed at home and resorted to home-based learning. This major life change has presented tremendous challenges for children's adaptation to this stressful situation and for their overall well-being.

A large strand of research has demonstrated that children are particularly vulnerable to life challenges during disasters (Galea, Nandi, and Vlahov 2005; La Greca and Prinstein 2002; Boer et al. 2009). However, children's responses to these challenges are not uniform: some children are adversely affected, while others, facing similar stress, develop and exhibit remarkable resilience. Pre-existing or newly emergent risk factors can amplify the disruptive effects of disasters such as pandemics, whereas protective factors can nurture children's resilience and mitigate these negative effects (Wright and Masten 2005; Bellis et al. 2017; Hu, Zhang, and Wang 2015; Liu, Wang, and Li 2012). Hence, identifying risk and protective factors is important for safeguarding children's well-being during a crisis (Grant et al. 2004; Ingram and Luxton 2005). In addition, key to the understanding of children's vulnerability and resilience is how a crisis *reinforces* or *reallocates* the pre-existing disparities in resources and well-being across different groups of children, especially between traditionally disadvantaged and traditionally advantaged groups.

In understanding children's resilience to crises, previous research has demonstrated the importance of family resources, which provide children with both physical protection and emotional security (Bronfenbrenner 1979; Dubow et al. 2012; Waddoups, Yoshikawa, and Strouf 2019). Family resources are often classified into family economic and social resources. Family economic resources refer to material resources that provide physical security and instrumental support and allow children to develop resilience (Thomson, Hanson, and McLanahan 1994; Morooka and Liang 2009; Asis 2006). Family social resources include parent-child relationships and parental support; they offer emotional support and supervision that facilitate children's adjustment to new challenges (Pierce et al. 1996; Wu, Tsang, and Ming 2014; Dawson and Pooley 2013). Close, warm parent-child relationships, for instance, help alleviate stress and allow children to develop appropriate coping strategies (Lau and Li 2011; See 2016; O'Brien and Mosco 2012).

In China, the marked heterogeneity among different groups of children provides a unique opportunity to investigate how disasters such as pandemics *transform* and *interact with* family resources to affect children's well-being. Noting this variation among Chinese children also reveals how these processes may have different implications for distinct groups of children. The rural-urban divide is a major driving force behind inequalities in child development across China. Compared with rural-origin children, urban children enjoy greater family economic resources and parental support, which result in better physical and psychological well-being (Xu and Xie 2015; Xu et al. 2018). Some rural-origin children live in families with two parents, but many experience rural-urban migration. Some rural children are left behind by migrant parents and endure an extended period of parent-child separation, while others migrate with their parents to cities and retain some level of family unity. The latter two groups

of rural children, despite improved family economic conditions, are found to be especially vulnerable compared to their rural and urban nonmigrant counterparts (Hu, Lu, and Huang 2014; Lu 2012; Lu et al. 2019).

Against this backdrop, the present study uses data from a 2020 survey conducted in Shaanxi Province during the COVID-19 outbreak to study family resources and resilience across four major groups of Chinese children (urban children, migrant children, rural nonmigrant children, and rural left-behind children). We examine differences in children's resilience during the pandemic, operationalized by their psychological well-being. We specifically investigate how the pandemic has transformed family economic and social resources, how these resources in turn serve as risk or protective factors, and how they moderate the differences in child outcomes among different groups.

Because of the nationwide lockdown orders, the outbreak of COVID-19 has heightened the importance of the family environment for children while minimizing the impact of other social milieu. This context thus offers a useful lens for understanding the effects of family resources on children's resilience and well-being and how these effects depend on the dimensions of the resources under investigation. The results shed light on the extent to which the pandemic has disproportionately affected traditionally disadvantaged children who are already strained for resources or has created new resources for the groups of children who are most in need.

Background

Resources and resilience during disasters

When facing life adversities such as disasters, resilience is a critical factor that helps buffer the adverse effects of crises and facilitate positive adaptation to new routines (Kaplan 1999; Luthar, Cicchetti, and Becker 2000). Resilience is especially important

for the positive and healthy development of children (Wright and Masten 2005; Hu, Zhang, and Wang 2015). Resilience is not simply an inherent personal trait; rather, it is developed and expressed through repeated interactions between children and their social environment (Gilligan 2001). As such, resilience is influenced by the resources embedded within an individual's social milieu (Luthar 2003).

During a disaster, the family is often an individual's primary social environment. Loss of family resources is commonplace in the face of disasters. Such losses can include both economic resources (e.g., property, employment) and social resources (e.g., social networks, family members) (Ironson et al. 1997; Bonanno et al. 2007; Silverman and La Greca 2002; Peek 2008). Previous research has documented the enormous detrimental consequences of natural disasters for family resources and individual well-being. For example, the 2008 Sichuan earthquake caused 69,227 deaths and 374,643 injuries; its resultant economic losses totalled more than ¥845 billion yuan (Yang et al. 2014). Many survivors lost their family members and homes. The earthquake had severe traumatic effects on the physical and mental well-being of individuals, including children, and the impact was aggravated by the loss of family resources (Fan et al. 2011). Similar effects can be found in cases of disasters worldwide, including the 2005 Pakistan earthquake (Hewitt 2007), the drought in southern Africa (Babugura 2008), and the civil war in Sri Lanka (Amirthalingam and Lakshman 2009). The exposure to and experience of disasters often cause a chain of losses that accumulate to bring about chronic stress, thus crippling an individual's long-term well-being (Abramson et al. 2015).

The impact of disasters tends to differ by their type and characteristics (Andermann 2002; Norris 2005). Disasters can be classified into natural disasters (such as earthquakes, hurricanes, and floods) and human-caused or technological disasters

(such as explosions and armed conflict). The detrimental impacts of disasters transpire when person-environment interactions are disrupted (Brun 2009; Perry 2007). A pandemic such as COVID-19 encompasses some of the characteristics of both natural disasters (e.g., earthquakes, tornadoes) and man-made disasters (e.g., chemical explosions) and thus is distinct from other types of disasters. On the one hand, as disruptive as a pandemic is to daily routines, its economic and social impacts tend to be less pronounced than those of other types of disasters. Pandemic mitigation measures typically do not require individuals to evacuate or uproot to new locations. Additionally, the mortality rate of COVID-19 is relatively low considering the large number of people stricken with the virus. The loss of one or more family members due to the virus is thus a rare event, and family separation due to COVID-19-related hospitalization tends to be temporary. On the other hand, however, the adverse impact of a pandemic may be strong compared to that of other types of disasters because of its long duration. While many other types of disasters constitute a transient shock that lasts for hours or days, a pandemic can endure for months or years. This can create chronic stress and adaptive responses that accumulate over time to affect an individual's well-being. Compared to research on other types of disasters, there is less systematic research on the impact of pandemics on individual adjustment and well-being. In the present study, we address this question through the lens of children.

Family resources and resilience of children in crises

The family is pivotal for a child's development, especially during a crisis, as it provides the child resources and support to develop resilience and overcome adversity (Bronfenbrenner 1979; Li, Zhang, and Li 2018). Based on the risk-protection framework, risk factors such as traumatic events can significantly exacerbate mental

health disorders among children, whereas protective factors play a buffering role in the effect of risk factors (Benight and Bandura 2004). Hobfoll and Lilly (1993) identified material resources (e.g., money and stable income) and interpersonal resources¹ (e.g., social support and parent-child relationships) as dimensions of family resources that are important for coping with disasters. Greater resources enhance children's resilience in the aftermath of a disaster, whereas limited resources hinder children's ability to recover, even if they are generally resilient under normal circumstances (Fothergill 2017).

Greater economic resources provide physical security for children to adapt to change and rise above challenges. In contrast, children in families with a lower economic status are less prepared for disasters and less capable of adapting to them because these children lack the resources to evacuate from, withstand, and recover from disasters (Becker-Blease, Turner, and Finkelhor 2010). The resource constraints families face severely limit their ability to buy goods and services that can cushion the effect of disasters (Dodgen et al. 2016). Moreover, disasters lead to economic loss or unemployment, which disproportionately affects low-SES families (Grattan et al. 2011; Arata et al. 2000; Nandi et al. 2009). Children who perceive or experience greater threats to their survival and greater loss are at greater risk of post-disaster psychosocial malfunctioning (Norris et al. 2002; Masozera, Bailey, and Kerchner 2007).

With respect to social resources, parental support can serve an important protective function to buffer the traumatic effects of stressful events and difficult situations such as disasters. A warm and supportive parent-child relationship fosters

¹ We use the terms material and interpersonal resources here to be consistent with the terminologies used by Hobfoll and Lilly (1993). Material resources refer to economic resources and interpersonal resources refer to social resources in our paper.

children's successful adaptation and resilience (Gunnar and Quevedo 2007; Luthar, Cicchetti, and Becker 2000). It contributes to greater positive affect and gives children the confidence and security to tackle environmental challenges (Dornbusch 1989; Gil-Rivas, Holman, and Silver 2004). Specifically, parents may facilitate their children's post-disaster adjustment "by listening to their children's fears and concerns, sharing their perspective, helping them appraise and understand what has happened, and providing them with guidance about how to cope" (Hafstad et al. 2010, 250). A strong parent-child relationship may also help alleviate the negative effect of family economic resource constraints on children (Burchinal et al. 2008; Doan, Fuller-Powell, and Evans 2012; Kiernan and Huerta 2008).

By contrast, poor parent-child relationships and family functioning increase the likelihood of malfunctioning (Call and Mortimer 2001), thereby presenting a risk factor in post-disaster adjustment. Studies found that in the case of the 2004 Thailand Tsunami (Tuicomepee and Romano 2008) and the Turkey Bolu earthquake (Kilic, Özgüven, and Sayil 2003), poor family relationships heightened children's psychological and behavioral problems after the disasters. In extreme situations where children lose loved ones, a prolonged period of grief and pain ensues, resulting in intensified mental disorders (Koplewicz and Cloitre 2006).

It is worth noting that parent-child relationships are not static and may change with the disaster. Parents in post-disaster environments experience added stressors because of a potential chain of losses and substantial uncertainty. These added stressors can result in the deterioration of family relationships and the functioning of the family unit (Bokszczanin 2008). In this context, parents often find themselves less capable of providing their children with adequate support, supervision, and care (Cohen, Berliner,

and Mannarino 2000). The reduced parenting efficacy can further contribute to post-traumatic stress disorder in children (Scaramella et al. 2008).

A typical disaster reduces *both* family economic and social resources, as children experience economic instability and inadequate family support. In such a context, a disaster interacts with existing socioeconomic disparities to disproportionately impair already marginalized groups of children (Browne 2015; Cannon 1994), such as ethnic minority children (Lai et al. 2018; Pfefferbaum et al. 2015). Nevertheless, in the case of COVID-19 in China, as we discuss below, the impact of the pandemic on family resources is not always negative and does not necessarily reproduce existing disparities. In this respect, studying family resources and children's well-being during a pandemic expands the conventional paradigm for understanding the social impact of disasters.

Conceptualizing Family Resources and Children's Resilience During COVID-19 in China

There are large disparities in family economic and social resources across groups of Chinese children (Lu 2012; Lu et al. 2019; Zhou and Cheung 2018; Liu and Xie 2015). Two key differentiating factors are rural-urban status and migration status. Rural children generally lag behind their urban peers in terms of economic resources. Among different groups of rural children, those with migrant parents (migrant children and left-behind children) enjoy greater economic resources than their nonmigrant counterparts (Xu and Xie 2015).

With respect to family social resources, parental migration is commonly found to disrupt and subsequently weaken parent-child relationships. In migrant families, parents are often overwhelmed with high-intensity work and spend limited time with their children (Hu, Lu, and Huang 2014). The situation is even worse for left-behind

families, in which parents are separated from their children for an extended period of time (Jia and Tian 2010). This separation and resultant parenting deficiency have a large adverse impact on the psychosocial development of left-behind children (Wen and Lin 2012; Lu et al. 2019). The substantial heterogeneity among Chinese children raises the important question of how different groups of children have coped with the COVID-19 crisis and what roles family resources have played in the process.

Findings from previous research suggest that left-behind children and migrant children in China have fewer family social resources to cope with disasters such as a pandemic. However, it is important to understand how the COVID-19 pandemic is transforming family resources. In summary, because of the pandemic mitigation measures enforced by the Chinese government, the COVID-19 crisis has to some extent had the unintended consequence of restoring parent-child relationships, especially for children who had the weakest parent-child relationships to begin with.

In the initial stages of the pandemic, essentially all Chinese were ordered to stay home, leading parents to spend significantly more time at home with their children. Coupled with widespread factory shutdowns and the timing of the COVID-19 outbreak (coinciding with the annual Spring Festival), many migrant workers returned home to ride out the pandemic. These family reunions may have helped partially repair parent-child relationships, especially for families with left-behind children. The pandemic may also benefit migrant children, whose parents are usually busy making ends meet in cities and disengaged in their children's daily lives. In these scenarios, traditionally disadvantaged groups of children may experience improved family social resources, which can help foster their resilience during the pandemic. This possibility presents a stark contrast with other disaster situations, which end up separating many children from their families (e.g., Hurricane Katrina; Broughton et al. 2006).

In the economic domain of a pandemic involving a workplace shutdown, many families experience an economic shock, which can potentially compromise children's well-being. This decline may be especially pronounced for rural families, who are already strained for resources. Because of the nationwide lockdown and transportation restrictions in the recent pandemic, farmers who experienced crop waste were hit hard economically. The economic shock may also disproportionately disrupt the lives and well-being of migrant families because of widespread factory shutdowns and unemployment.

Previous research has yet to systematically examine the impact of pandemics on family resources and the subsequent impact of these resources on children's resilience. Also missing in the literature is how these processes play out among different groups of children characterized by pre-existing differences in family resources, which, in China, are exemplified by migration status. As discussed above, understanding the resilience of different groups of Chinese children in the midst of COVID-19 is a complex issue. The answer depends not only on the family resources prior to the pandemic but also on the changes in these resources as a result of the pandemic. Moreover, the different dimensions of the resources (economic versus social) may exert distinct impacts, serving as either risk or protective factors for child well-being in the course of the pandemic.

The current study

In the present study, we first examine whether and how the outbreak of COVID-19 has affected the economic and social resources of families across different groups of Chinese children. We expect that the pandemic has had varying degrees of economic shocks to families, with most families experiencing a decline in family economic

resources. The decline may be especially pronounced for rural families and migrant families. However, the same policy restrictions may have the unintended effect of enhancing family social resources, as parents and their children spend more time together. The social boost resulting from this enhancement may be especially evident for children who are traditionally deprived of parental support because of migration. We therefore anticipate a mild negative impact or even a positive impact of COVID on parent-child relationships.

Second, we examine whether different groups of Chinese children have different degrees of resilience to COVID-19, as measured by their psychological well-being. We conceptualize psychological well-being as a form of resilience because it reflects a process by which children facing similar adversities employ different coping mechanisms and exhibit different outcomes. This analysis allows us to identify the groups of children who are most resilient to the crisis. In a typical context, migrant children and left-behind children tend to have worse psychological outcomes than their nonmigrant peers because of their reduced family social resources. However, in the context of COVID-19, the difference among these groups is not so clear-cut. The traditional gap between urban and rural children living with both parents, on the one hand, and migrant children and left-behind children, on the other hand, may be narrowed because of the opposing processes discussed above. This narrowed gap in well-being may be partially explained by the transformation of family resources (namely, the mediating role of family resources in group differences in child well-being).

Third, we examine whether the decreased economic resources serve as a risk factor and whether the increased social resources act as a protective factor for children's psychological well-being. Importantly, we further investigate the degree to which the

effect of the risk and protective factors, namely, family economic and social resources, differ across various groups of children. This analysis sheds light on the moderating roles of different family resources that manifest themselves in the differences in child well-being among the groups identified above. We expect the protective and risk factors to be especially pronounced for the groups of children most deprived of such resources before the pandemic.

Overall, the goal of this paper is to integrate resilience theory (people, adversity, resources, responses) in the context of the COVID-19 pandemic in China and to understand children's responses and adjustments to the pandemic. We regard children's psychological well-being as an important and empirically testable response to the pandemic and thus an indicator of resilience. The conceptual framework is summarized in Figure 1. In answering the three main questions, the present study combines the literature on disasters, resources, and resilience to understand the multifaceted impacts of COVID-19 on Chinese families and children. It adds a new perspective to child development studies in China, which have not systematically examined the impact of disasters. Furthermore, our study advances the broad literature on disasters and child development by investigating a less studied type of disaster (i.e., a pandemic) and evaluating differences among families characterized by different migration statuses. We aim to determine which of the four groups of Chinese children are particularly sensitive to family resources and vulnerable to the pandemic.

[Figure 1. Conceptual framework]

Data and methods

Data and sample

The data are from the Survey of Life Circumstances of Students in Shaanxi during COVID-19, an online survey conducted by the New Urbanization and Sustainable Development Research Group at the School of Public Policy and Administration, Xi'an Jiaotong University, in February 2020. The survey was designed to investigate child development during the height of the pandemic in China. It was carried out at two urban secondary schools in Xi'an (the capital city in Shaanxi Province) and one rural secondary school in Ningqiang (a rural county in Shaanxi Province). The three schools were randomly selected from a list of all local secondary schools provided by the local educational department for another survey carried out by the same research group in 2016. We choose these same three schools for our investigation because it would be infeasible to randomly select a new set of schools during the pandemic for a large-scale survey. The working relationship we had already established with the selected schools in the previous survey was instrumental for the successful completion of this new survey.

The survey included a rich set of questions about children's development, families' socioeconomic status, and the home environment before and during COVID-19. The survey team conducted a pilot survey before the main fieldwork and confirmed the finding of previous research that secondary-school students were able to provide relatively accurate reports on their psychological well-being and home environment. The survey was assigned as homework for the sampled students in each school. Specifically, in the two urban secondary schools, all students in grades 7-9 participated in the survey, and 10 classes were randomly selected among grades 10-12 because of the large class size. All students in the sampled grade 10-12 classes were recruited for

this study. In the rural secondary school, all students were recruited for this study. The school-based design, coupled with the online survey platform, yielded a response rate of more than 95%. The final sample consists of 10,678 middle school and high school students.

Variables

The outcome variable is psychological well-being, which consists of five items adapted from the Achenbach Youth Self-Report (YSR; Achenbach and Rescorla 2001). The YSR has been translated, validated, and used in the Chinese context (Wang, Zhang, and Patrick 2005; Wang et al. 2013). We used a short version of the YSR, which primarily captures emotions and affect related to depression and anxiety. The five items assess how often the respondent feels worthless; feels that everything is boring; feels nervous and irritable; feels anxious; and feels sad or depressed. Each item was asked in reference to two time periods: before and during the pandemic. For each item, a three-point Likert scale was used (0 = “never”, 1 = “sometimes”, 2 = “often”). We summed the scores of the five items to construct the psychological well-being measure (range: 0-10) before and during COVID-19, with higher values indicating lower psychological well-being. Cronbach’s alpha values for the two scales were 0.83 and 0.86, respectively.

The mediating and moderating variables were family resources. The survey asked four questions about parent-child relationships (PCR): ‘How close was your relationship with your father/mother before the pandemic?’ ‘How close is your relationship with your father/mother during the pandemic?’ ‘How often did you talk to your father/mother before the pandemic?’ and ‘How often do you talk to your father/mother during the pandemic?’ Each item used a five-point Likert scale ranging from “not close at all” to “very close” for the closeness questions and from “almost

never” to “very frequently” for the communication question. We averaged the scores on the two questions and then averaged the scores for mother and father to create the overall parent-child relationship variables: one for the period before COVID-19 and one for the period during COVID-19. Higher values indicated a better parent-child relationship (protective factor).

Family economic status (FES) was measured by two questions: “What was the overall economic status of your family before the pandemic?” and “How has the pandemic affected your family’s economic situation?” The responses to the first question ranged from “very low” to “very high” on a five-point Likert scale. The responses to the second question fell into three categories: “0 = ‘no impact’, +1 = ‘positive impact’, and -1 = ‘negative impact’”². We summed the scores on the two questions to compute the family economic status during the pandemic, which ranged from 0 to 6. Because the lowest and highest economic statuses remained the least and most advantaged groups after the procedure and the proportion of these two groups within the total sample was small, we recoded 0 to 1 and 6 to 5 to rescale the variable to 1-5, which was the same as the economic status measured before the pandemic. Higher values indicated higher family economic status (risk factor).

The key predictor was children’s migration status. Based on their household registration status, we distinguished between urban children (urban *hukou*) and rural children (rural *hukou*). Among rural children, we further distinguished among nonmigrant children, left-behind children, and migrant children. Rural nonmigrant children were defined as those who had rural *hukou* and lived with both parents before

² We also conducted analysis using another definition of family economic status (FES), such as “0 = ‘no impact’, +2 = ‘positive impact’, and -2 = ‘negative impact’, and obtained similar results.

the pandemic. Left-behind children were those who had rural *hukou* and lived with one or neither parent before the pandemic. Migrant children were defined as those who had rural *hukou* and lived in urban areas with at least one parent before the pandemic. We specifically asked whether parents did not live with their children because of “working outside”, “divorce”, “death” or “other reasons”. We dropped a small number of students (42) who lived in school dormitories during the pandemic, for whom the parent-child relationship during the pandemic was hard to explain. We also excluded 320 children from other types of nonintact families (i.e., divorced or deceased parents) and another 61 children with discrepancies in their residential and migration status (e.g., rural nonmigrant children lived in urban areas during the pandemic). There were no missing data for the completed questionnaire because the online survey had a built-in mechanism that prohibited question skipping. The final sample size was 10,255. Approximately 48.76% of these students were female, and the average age was 15.22 years, with a standard deviation of 1.60. The percentages of urban, rural nonmigrant, left-behind and migrant children were 74.78%, 8.37%, 8.75% and 8.10%, respectively. The urban schools included 9.8% rural migrant children (living in urban areas but having rural *hukou*; most of them lived in school dormitories before the pandemic).

We also controlled for a host of demographic attributes shown to be critical for children’s psychological well-being (Leadbeater et al. 1999). These variables were measured at the time of the survey and included children’s gender, their age (in years), whether they had siblings, children’s academic performance (based on their self-reports of whether their academic performance was poor, below average, average, above average, or excellent), whether they were healthy before and during the pandemic (on a five-point Likert scale, with higher values indicating better health), their parents’ educational attainment (illiteracy or primary school education, middle school education,

high school education, bachelor's degree or above), and a dichotomous variable of whether their parents still worked away from home and had not returned home during the pandemic.

Methods

We first performed random-effect (RE) models to assess the effect of COVID-19 on family economic resources, family social resources, and the psychological well-being of different groups of Chinese children. This was carried out by transforming the data to a person-time format (where time was dichotomous, indicating the periods before and during the pandemic). This transformation doubled the sample size. The key variables were measured at two time points, and other variables were time-invariant. A RE model accounts for the sample dependence in the variance-covariance structure (Raudenbush and Bryk 2002; Lu and Zhou 2013) and is able to fully exploit such person-time data. Without this approach, the standard assumption of sample independence may be violated. We also included interactions between time and children's migration status. This allowed us to investigate potential differences in the impact of COVID-19 across different groups of children. We further estimated corresponding fixed-effects (FE) models to adjust for potential unobserved confounding factors that are constant over time. The main effects of time-invariant variables cannot be directly estimated but are effectively adjusted for. The main variables of interest (time and its interaction with children's migration status) can be directly estimated. We also included the interaction items between the time variable and children's migration status to account for the pandemic shock and migration-level contextual effects.

We next performed lagged dependent variable (LDV) regressions (Godfrey 1978; Cohen 2010) to predict children's psychological well-being during COVID-19, the ultimate outcome of interest, while controlling for pre-COVID-19 psychological well-

being and other variables. LDV models help mitigate endogeneity bias to the extent that pre-existing differences not directly controlled for are captured in the lagged measure (Otero, Carranza, and Contreras 2017; Mani, Hoddinott, and Strauss 2012). We further included interactions between children's migration status and different types of family resources. We estimated a total of five models. Model 1 included children's migration status and pre-COVID psychological well-being. Model 2 additionally included other control variables. Model 3 further added the family resource variables. Model 4 and Model 5 included interactions of children's migration status with family social resources and economic resources.

Results

Descriptive statistics

Table 1 shows the descriptive statistics of the characteristics of urban children, rural nonmigrant children, left-behind children and migrant children before and during COVID-19. Urban children appeared to exhibit the best psychological well-being during and before the disaster, followed by migrant children. Rural left-behind and nonmigrant children had lower psychological well-being. Interestingly, the psychological outcome seemed to have improved during the pandemic for all groups of children.

[Table 1 about here]

There are also significant differences in family resources before and during COVID-19 with respect to children's migration status. Before the pandemic, urban children and migrant children had greater resources than left-behind and rural nonmigrant children. During the pandemic, children from all backgrounds experienced

lower economic resources, but the relative positions of different groups of children remained similar. An exception to this was that left-behind children became worse off economically than rural nonmigrant children. This is not surprising considering the job loss that many migrant workers experienced.

The pattern regarding parent-child relationships was the reverse. All groups of children experienced an improved relationship with their parents. The relative position of children remained similar before and during COVID-19, with urban children and migrant children enjoying better relationships with their parents than the two groups of rural children. Despite these interesting findings, these descriptive statistics should be interpreted with caution because they do not control for other factors that may differ across groups of children.

Regression Results

Table 2 presents the RE and FE regression results of the impact of COVID-19 on family resources and children's psychological problems. Model 1 and Model 2 display the RE results of parent-child relationships (PCR), and Model 3 presents the corresponding FE results. We see that rural nonmigrant and left-behind children are significantly worse off in terms of their parent-child relationships than urban children. However, COVID-19 had a significant positive impact on parent-child relationships, and its effect does not differ systematically across the different types of children. This suggests that the pandemic has improved parent-child relationships across all groups of children.

[Table 2 about here]

Model 4 and Model 5 present the RE results of family economic status (FES), and Model 6 displays the corresponding FE results. We find that rural nonmigrant, left-

behind and migrant children are significantly worse off in their economic status than urban children. More importantly, the pandemic has significantly reduced family economic resources. The interaction between children's migration status and COVID-19 is negative and significant, suggesting that the negative impact of COVID-19 is more pronounced for rural families and migrant families. This may be attributed to the lockdowns in cities and factory shutdowns, which sent many migrants home unemployed. At the same time, rural nonmigrant families have experienced an economic shock due to the lockdown policy, which has limited farmers' access to the market and reduced sales.

With respect to children's psychological problems (RE in Models 7-9 and FE in Model 10), we see that COVID-19 has had a positive impact on children's psychological well-being in general. This impact is found across groups of children with different migration statuses. Before controlling for family resources, we found little difference between the different groups of children. After controlling for these resources, we find that left-behind children appear to have higher psychological well-being. This result suggests that family resources are an important determinant of left-behind children's well-being. If they were to enjoy similar family social and economic resources, they would develop greater resilience in the face of disasters. The interaction between being left behind and COVID-19 is significant, indicating that the pandemic has had a less positive impact on left-behind children's psychological well-being. This result suggests the vulnerability of left-behind children in the face of disasters. We also conducted sensitivity analyses that distinguished urban nonmigrant children and urban left-behind children. The results, shown in Appendix A, do not change the main findings.

The regression results regarding children's psychological well-being are presented in Table 3. Table 3 provides additional insight to Table 2 (Models 7-10) because it tests how the stock (not change) of family economic/social resources during COVID-19 affects children's psychological well-being amid the pandemic and whether the role of the stock resources varies across different groups of children. Our ultimate outcome of interest is children's psychological well-being during the pandemic, which is captured in Table 3. Model 1 shows that different groups of migrant children experience different levels of psychological well-being. Rural nonmigrant and left-behind children fare significantly worse than migrant and urban children. Pre-COVID-19 psychological problems are highly associated with psychological well-being during the pandemic. After we controlled for various demographic and family socioeconomic characteristics, the significant group differences disappeared (Model 2). This suggests that during the pandemic, between-group differences are largely accounted for by group differences in these background characteristics. In other words, different groups of Chinese children would have fared similarly with respect to psychological well-being if they had shared similar family backgrounds. This result is different from existing research that points to a notable psychological disadvantage of rural nonmigrant children and left-behind children in general. This implies that other groups of children are potentially more adversely affected by the pandemic than rural nonmigrant and left-behind children. The roles of other variables are largely as expected. Older children are more depressed, and children with better health have better psychological outcomes.

[Table 3 about here]

Model 3 adds family economic and social resources, which reverse the sign of the coefficient for left-behind children. This group of children appears to fare better

psychologically, but the difference is nonsignificant. This alludes to the mediating role of family resources: that is, if rural left-behind children were to have the same amount of family social and economic resources as urban children, they would have lower (though insignificantly lower) mental health problems than urban children. Turning to the coefficients of family resources, social resources serve as a protective factor because higher resources lead to lower psychological problems. Lower family economic resources serve as a risk factor that increases the risk of children's psychological problems. These results are consistent with those of previous research demonstrating the positive effect family resources have in fostering children's resilience (Gunnar and Quevedo 2007; Gil-Rivas, Holman, and Silver 2004).

Model 4 presents the interaction effect of parent-child relationships and migration status on children's psychological well-being. The interaction terms are significant, suggesting that while there is a general protective effect of family social resources, this effect is more pronounced for migrant children and left-behind children than for other groups of children in the face of adversities. Among children enjoying good parent-child relationships, rural children and migrant children display greater resilience than urban nonmigrant children.

This result may seem different from the findings of previous research that points to worse psychological outcomes of left-behind children. We believe that this is not the case. The common disadvantage of left-behind children stems largely from parental absence and parenting deficits, while strenuous work contributes to a deficit of care to the detriment of migrant children. The pandemic has reshuffled the cards among different groups of children: it has reunified many left-behind children with their parents, which has helped to restore family relationships in the short term, leading to more time spent and more communication between parents and children. Consequently,

improved family relationships strengthen the resilience of migrant and left-behind children and outweigh the negative consequence of the pandemic. The impact is greater for migrant and left-behind children considering the greater disadvantage in family social resources they encounter in a normal setting. Hence, they enjoy the largest marginal effect.

Model 5 includes the interaction between children's migration status and family economic status during COVID-19. The coefficient of family economic status is negative and significant, suggesting that reduced economic resources are a risk factor during the pandemic. The interaction items are insignificant. This means that the adverse effect of reduced family economic resources is similar across different types of children.

The additional analysis that distinguishes different groups of urban children is shown in Appendix B. Furthermore, we estimated corresponding models that include both pre-COVID levels of FES and PCR and change in FES and PCR (Appendix C). The results showed that a decrease in FES and PCR leads to worse psychological outcomes, and an increase in PCR improves children's psychological well-being. The role of FES and PCR change does not vary across different groups of children. Other findings are consistent with those in the main tables.

Taken together, the results suggest two opposing processes brought about by the pandemic. On the one hand, COVID-19 has improved parent-child relationships, which serve as a protective factor for psychological well-being. This protective effect is especially large for left-behind children and migrant children. On the other hand, the pandemic has brought economic shocks to many families and are disproportionately experienced by rural-origin children. A reduced economic status operates as a risk factor for children's well-being. Comparing the respective roles of family social and

economic resources, social resources appear to play a stronger role than economic resources; specifically, the standardized coefficient is -0.056 for PCR and -0.012 for FES. Therefore, despite the disruption caused by the pandemic, the overall change in psychological well-being brought about by the pandemic has been positive, especially for children typically deprived of parental support.

Discussion and conclusion

The present study examines the psychological well-being of multiple groups of Chinese children characterized by migration status during COVID-19. The focal point of the study is how the pandemic has shaped and transformed family resources in ways that foster or impair children's resilience to the pandemic.

Overall, the results highlight the complex ways in which family resources have intersected with the pandemic to affect different groups of children. With respect to family economic resources, there has been a general economic decline. Rural-origin children have suffered the most severe economic shock, presumably due to their migrant parents' unemployment and return amid the nationwide lockdown and factory shutdowns. However, the same processes seem to have brought migrant parents and their children closer, thereby enhancing family social resources. This phenomenon seems to have occurred all across the board for children. As a result, there has been a small boost in children's psychological well-being during COVID-19, which is similar across different groups of children.

Moreover, two opposing processes operate to shape children's resilience during COVID-19: the depleted economic resources act as a risk factor, while the improved family relationships play a protective role in promoting children's well-being during the disaster. The former undermines children's capacity to cope with the disaster, and the

latter allows children to display remarkable resilience. Further interaction analyses reveal important moderation effects, namely, that certain groups of children are especially sensitive to the impact of family resources. Parent-child relationships have a more pronounced positive impact on psychological well-being for migrant and left-behind children, who are the most deprived of parental input under normal circumstances, than for the other groups of children. Among children enjoying especially favorable parent-child relationships, migrant children and left-behind children appear to have even higher psychological well-being than urban children during the course of the pandemic. In comparison, the role of family economic resources is more moderate in magnitude and does not vary systematically across different groups of children. As a result, the impact of improved parent-child relationships largely outweighs the effect of reduced family economic resources. Because of these processes, migrant children and left-behind children have not fared significantly worse than urban children during the pandemic. This presents a different picture from previous research that has demonstrated greater psychological vulnerability for these two groups of children.

Taken together, the findings contribute to the literature on child development in the context of disasters, which has been largely drawn from studies outside of China and has focused on natural disasters. We provide new insight in the context of the COVID-19 pandemic in China, where there are marked pre-existing disparities among different groups of children. The results underscore the ways in which disasters intersect with familial resources to shape child well-being and resilience in the face of adversities. The impact of COVID-19 on children and their families seems to be less disruptive than the impacts of natural disasters, which often decrease both economic and social resources. Consequently, rather than reinforcing existing patterns of inequality across different

groups of children, the pandemic seems to have mitigated the developmental differences among children.

The present study also has some practical implications. Although COVID-19 is a disastrous event that has had large detrimental consequences in both the short term and the long term, it has had the unintended impact of changing the family landscape. With nationwide lockdown orders, parents get to spend more time with their children. Additionally, because the outbreak coincided with a national holiday (Spring Festival), migrant parents were able to return home and spend an extended amount of time with their children. The restored family relationships play an important role in fostering left-behind children's resilience and boosting their psychological functioning. To some degree, this finding reemphasizes the critical importance of parent-child relationships in understanding the psychosocial well-being of left-behind children and migrant children. Its importance manifests itself especially saliently during a national crisis. That said, the positive effect may be short-lived. The reunions and closer parent-child relationships may end with the pandemic when migrant parents have to return to work. The ultimate key to reducing left-behind children's vulnerability hinges on either closing the rural-urban gap so that migrant parents work in localities closer to home or easing structural barriers for migrant families so that they are more capable of raising children in cities.

It is worth pointing out that in other situations of natural disasters, traditionally vulnerable children, such as left-behind children in China, may not benefit from the protective effect of the parent-child relationship if they remain separated from their parents. This may further disadvantage these children, rendering them even more vulnerable to developmental problems in the face of adversities.

One limitation of the present study is that we could not distinguish children left behind by only their mothers from those left behind by only their fathers. The question

then remains whether children left behind by their mothers before the pandemic respond differently than those left behind by their fathers and whether the impact of father-child relationships is similar to that of mother-child relationships. In addition, our sample is from one province that has not been severely devastated by COVID-19. There are reasons to speculate that children in areas more severely affected by the pandemic may show greater vulnerability and less resilience. Meanwhile, due to pandemic restrictions, the surveyed schools we chose were randomly selected from a list of all local secondary schools provided by the local education department for another survey carried out by our research group in 2016, and the sample may be biased towards urban schools and students. To include multiple dimensions in this survey and improve the quality of responses, we purposely kept the questionnaire short and refrained from including multiple scales. Another limitation is that the survey was based on current and retrospective reports. Retrospective reports may be susceptible to recall bias. Longitudinal studies with a larger national sample and rich information on family resources as well as child development are needed to provide a more complete and robust picture.

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Table 1. Percentages (and means and standard deviations for continuous variables) by status of the child

	Urban non-migrant children	Rural non-migrant Children	Left-behind children	Migrant children	Children Group Difference
Psychological problems (pre-COVID-19)	1.56 (2.06)	1.95 (2.20)	1.95 (2.18)	1.57 (2.04)	***
Psychological problems (during COVID-19)	1.38 (2.06)	1.86 (2.27)	1.88 (2.34)	1.45 (2.15)	***
Parent-child relationships (pre-COVID-19)	3.92 (0.67)	3.50 (0.69)	3.45 (0.65)	3.78 (0.67)	***
Parent-child relationships (during COVID-19)	3.97 (0.68)	3.54 (0.71)	3.50 (0.68)	3.84 (0.69)	***
Family economic status (pre-COVID-19)	3.07 (0.44)	2.53 (0.64)	2.60 (0.59)	2.90 (0.56)	***
Family economic status (during COVID-19)	2.77 (0.79)	2.05 (0.89)	2.04 (0.81)	2.54 (0.93)	***
Girl	48.73	48.72	54.29	43.08	***
Age	14.98 (1.41)	16.36 (1.96)	16.39 (1.89)	14.92 (1.44)	***
Without sibling	67.49	23.66	28.32	37.55	***
Healthy (pre-COVID-19)	4.25 (0.88)	4.19 (0.88)	4.07 (0.93)	4.31 (0.86)	***
Healthy (during COVID-19)	4.23 (0.90)	4.20 (0.91)	4.06 (0.94)	4.30 (0.88)	***
Academic ranking of the child	3.30 (1.13)	2.87 (1.15)	2.91 (1.11)	3.10 (1.13)	***
Father's education level					
Illiterate or primary school	0.86	47.90	48.72	4.21	***
Junior high school	7.00	41.96	44.04	33.33	
Senior high school	25.73	8.62	6.69	43.68	
Bachelor's or above	66.41	1.52	0.56	18.77	

Mother's education level					
Illiterate or primary school	1.23	64.57	72.80	7.10	***
Junior high school	7.98	28.67	24.75	36.10	
Senior high school	32.90	6.29	2.12	43.92	
Bachelor's or above	45.49	0.47	0.33	11.91	
Father working away and not returning home during COVID-19	2.35	-	4.68	1.93	***
Mother working away and not returning home during COVID-19	0.55	-	10.37	0.24	***
N	7669	858	897	831	

Notes: The "pre-COVID-19" measure was from retrospective report.

"-": Not Applicable. This item only applies to the parents who migrate for work before the COVID-19.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 2. Regression analysis of PCR, FES and children's psychological problems by children group and other control variables before and during COVID-19

	PCR			FES			Psychological problems			
	Model 1 (RE)	Model 2 (RE)	Model 3 (FE)	Model 4 (RE)	Model 5 (RE)	Model 6 (FE)	Model 7 (RE)	Model 8 (RE)	Model 9 (RE)	Model 10 (FE)
Children group (ref. urban non-migrant children)										
Rural non-migrant children	-0.111*** (0.033)	-0.105** (0.034)	-	-0.260*** (0.031)	-0.166*** (0.033)	-	-0.016 (0.103)	-0.064 (0.105)	-0.142 (0.102)	-
Left-behind children	-0.151*** (0.034)	-0.154*** (0.035)	-	-0.203*** (0.031)	-0.072* (0.033)	-	-0.063 (0.106)	-0.118 (0.108)	-0.215* (0.105)	-
Migrant children	-0.007 (0.025)	-0.009 (0.025)	-	-0.073** (0.023)	-0.038 (0.026)	-	-0.031 (0.077)	-0.059 (0.080)	-0.068 (0.078)	-
During COVID-19	0.059*** (0.003)	0.060*** (0.003)	0.055*** (0.003)	-0.342*** (0.006)	-0.298*** (0.007)	-0.294*** (0.007)	-0.162*** (0.012)	-0.184*** (0.014)	-0.184*** (0.015)	-0.183*** (0.015)
Rural non-migrant children × During COVID-19		-0.012 (0.010)	-0.012 (0.010)		-0.188*** (0.023)	-0.189*** (0.023)		0.097* (0.043)	0.074 (0.043)	0.084 (0.043)
Left-behind children × During COVID-19		0.006 (0.010)	0.004 (0.010)		-0.262*** (0.022)	-0.262*** (0.022)		0.108* (0.042)	0.090* (0.043)	0.099* (0.043)
Migrant children × During COVID-19		0.004 (0.010)	0.003 (0.010)		-0.070** (0.023)	-0.070** (0.023)		0.056 (0.044)	0.052 (0.044)	0.053 (0.044)
PCR (parent-child relationships)				0.063*** (0.008)	0.063*** (0.008)	0.008 (0.023)			-0.588*** (0.025)	-0.175*** (0.044)
FES (family economic status)	0.012** (0.004)	0.012** (0.004)	0.001 (0.004)						-0.078*** (0.016)	-0.035+ (0.019)
Girl	0.051*** (0.012)	0.051*** (0.012)	-	0.036** (0.011)	0.036** (0.011)	-	0.109** (0.039)	0.109** (0.039)	0.143*** (0.037)	-
Age	-0.036*** (0.004)	-0.036*** (0.004)	-	-0.010** (0.004)	-0.010** (0.004)	-	0.114*** (0.013)	0.113*** (0.013)	0.092*** (0.012)	-
Without sibling	0.077*** (0.014)	0.077*** (0.014)	-	-0.025* (0.013)	-0.025* (0.013)	-	-0.107* (0.042)	-0.107* (0.042)	-0.063 (0.041)	-
Healthy	0.109*** (0.005)	0.109*** (0.005)	0.031*** (0.007)	0.042*** (0.006)	0.043*** (0.006)	0.067*** (0.017)	-0.384*** (0.018)	-0.385*** (0.018)	-0.303*** (0.018)	-0.179*** (0.033)

Academic ranking of the child	0.067*** (0.006)	0.067*** (0.006)	-	0.011* (0.005)	0.011* (0.005)	-	-0.177*** (0.017)	-0.177*** (0.017)	-0.136*** (0.017)	-
Father's education level (ref. illiterate or primary school)										
Junior high school	0.093** (0.030)	0.093** (0.030)	-	0.127*** (0.027)	0.127*** (0.027)	-	0.052 (0.092)	0.052 (0.092)	0.116 (0.089)	-
Senior high school	0.144*** (0.037)	0.144*** (0.037)	-	0.161*** (0.034)	0.161*** (0.034)	-	-0.035 (0.113)	-0.035 (0.113)	0.063 (0.110)	-
Bachelor's and above	0.207*** (0.038)	0.207*** (0.038)	-	0.253*** (0.035)	0.253*** (0.035)	-	-0.033 (0.119)	-0.033 (0.119)	0.110 (0.115)	-
Mother's education level (ref. illiterate or primary school)										
Junior high school	-0.020 (0.030)	-0.020 (0.030)	-	0.106*** (0.028)	0.106*** (0.028)	-	-0.077 (0.094)	-0.077 (0.094)	-0.080 (0.091)	-
Senior high school	0.011 (0.037)	0.011 (0.037)	-	0.223*** (0.034)	0.223*** (0.034)	-	-0.164 (0.114)	-0.164 (0.114)	-0.140 (0.110)	-
Bachelor's and above	0.086* (0.039)	0.086* (0.039)	-	0.261*** (0.036)	0.261*** (0.036)	-	-0.138 (0.120)	-0.138 (0.120)	-0.065 (0.116)	-
Constant	3.416*** (0.082)	3.416*** (0.082)	3.692*** (0.034)	2.322*** (0.081)	2.299*** (0.081)	2.650*** (0.113)	2.248*** (0.254)	2.261*** (0.254)	2.261*** (0.263)	3.160*** (0.221)
R-squared within	0.033	0.034	0.041	0.223	0.237	0.238	0.018	0.019	0.019	0.023
N	20,510 (10,255×2)									

Notes: Standard errors in parentheses. "-": Horizontal hyphen for the cells with no coefficient.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Table 3. Regression analysis of children's psychological problems during COVID-19 by PCR and FES and other control variables

	Model 1	Model 2	Model 3	Model 4	Model 5
Children group (ref. urban non-migrant children)					
Rural non-migrant children	0.148*** (0.042)	0.038 (0.061)	0.005 (0.061)	0.006 (0.064)	0.007 (0.065)
Left-behind children	0.166*** (0.041)	0.028 (0.064)	-0.005 (0.064)	-0.042 (0.067)	-0.042 (0.069)
Migrant children	0.057 (0.042)	0.041 (0.046)	0.034 (0.045)	0.030 (0.046)	0.038 (0.046)
PCR (parent-child relationships) during COVID-19			-0.169*** (0.018)	-0.146*** (0.021)	-0.170*** (0.018)
Rural children × PCR				-0.021 (0.059)	
Left-behind children × PCR				-0.126* (0.060)	
Migrant children × PCR				-0.125* (0.061)	
FES (family economic status) during COVID-19			-0.030* (0.014)	-0.031* (0.014)	-0.034* (0.017)
Rural children × FES					-0.016 (0.048)
Left-behind children × FES					0.051 (0.051)
Migrant children × FES					-0.067 (0.046)
Psychological problems (pre-COVID-19)	0.848*** (0.006)	0.836*** (0.006)	0.823*** (0.006)	0.823*** (0.006)	0.823*** (0.006)
Girl		-0.029 (0.023)	-0.018 (0.023)	-0.019 (0.023)	-0.018 (0.023)
Age		0.017* (0.008)	0.012 (0.008)	0.012 (0.008)	0.011 (0.008)
Sibling		-0.040 (0.025)	-0.029 (0.025)	-0.030 (0.025)	-0.028 (0.025)

Healthy (during COVID)		-0.106***	-0.080***	-0.080***	-0.080***
		(0.013)	(0.013)	(0.013)	(0.013)
Academic ranking of the child		-0.012	-0.003	-0.004	-0.003
		(0.010)	(0.010)	(0.010)	(0.010)
Father's education level (ref. illiterate or primary school)					
Junior high school		0.057	0.076	0.080	0.077
		(0.054)	(0.054)	(0.054)	(0.054)
High school		0.045	0.073	0.076	0.070
		(0.067)	(0.067)	(0.067)	(0.067)
Bachelor's or above		0.029	0.071	0.072	0.068
		(0.071)	(0.070)	(0.070)	(0.070)
Mother education level (ref. illiterate or primary school)					
Junior high school		-0.116*	-0.117*	-0.119*	-0.117*
		(0.056)	(0.056)	(0.056)	(0.056)
High school		-0.140*	-0.132	-0.132	-0.135*
		(0.068)	(0.068)	(0.068)	(0.068)
Bachelor or above		-0.107	-0.084	-0.086	-0.087
		(0.071)	(0.071)	(0.071)	(0.071)
Father working away and not returning home during COVID-19		0.074	0.044	0.048	0.044
		(0.077)	(0.076)	(0.076)	(0.076)
Mother working away and not returning home during COVID-19		0.022	0.000	-0.013	0.001
		(0.104)	(0.103)	(0.103)	(0.103)
Constant	0.057***	0.435**	0.346*	0.348*	0.354*
	(0.016)	(0.155)	(0.155)	(0.155)	(0.155)
Adjusted R-squared	0.700	0.703	0.705	0.705	0.705
N			10,255		

Notes: Standard errors in parentheses

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

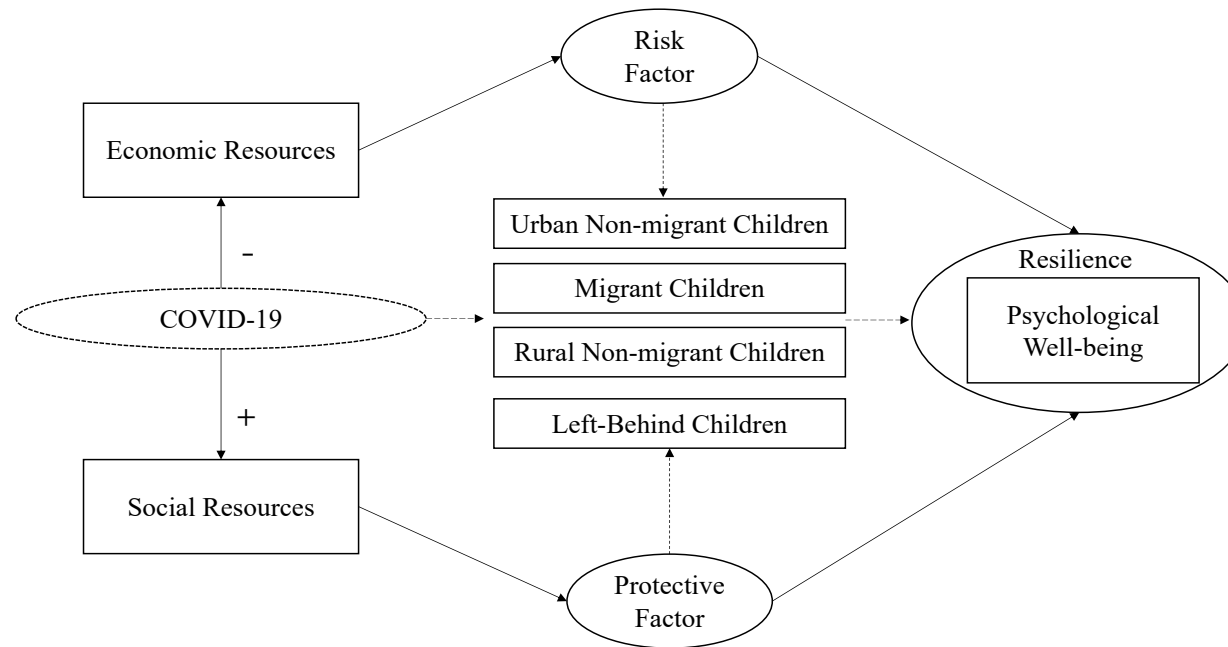


Fig 1. Conceptual framework

Appendices

Appendix A. Regression analysis of PCR, FES and children’s psychological problems by children group (include urban left-behind children) and other control variables before and during COVID-19

	PCR			FES			Psychological problems			
	Model 1 (RE)	Model 2 (RE)	Model 3 (FE)	Model 4 (RE)	Model 5 (RE)	Model 6 (FE)	Model 7 (RE)	Model 8 (RE)	Model 9 (RE)	Model 10 (FE)
Children group (ref. urban non-migrant children)										
Rural non-migrant children	-0.121*** (0.034)	-0.115*** (0.034)	-	-0.263*** (0.031)	-0.166*** (0.033)	-	-0.005 (0.104)	-0.053 (0.106)	-0.137 (0.103)	-
Rural left-behind children	-0.161*** (0.035)	-0.164*** (0.035)	-	-0.206*** (0.032)	-0.073* (0.034)	-	-0.052 (0.107)	-0.106 (0.109)	-0.209* (0.106)	-
Migrant children	-0.014 (0.025)	-0.016 (0.025)	-	-0.076*** (0.023)	-0.038 (0.026)	-	-0.024 (0.077)	-0.051 (0.080)	-0.065 (0.078)	-
Urban left-behind children	-0.085** (0.032)	-0.097** (0.032)	-	-0.029 (0.029)	0.019 (0.033)	-	0.097 (0.098)	0.112 (0.103)	0.056 (0.100)	-
During COVID-19	0.059*** (0.003)	0.058*** (0.003)	0.054*** (0.003)	-0.342*** (0.006)	-0.293*** (0.007)	-0.289*** (0.007)	-0.162*** (0.012)	-0.183*** (0.014)	-0.173*** (0.015)	-0.181*** (0.015)
Rural non-migrant children × During COVID-19		-0.011 (0.010)	-0.011 (0.010)		-0.193*** (0.023)	-0.194*** (0.023)		0.095* (0.043)	0.072 (0.044)	0.082 (0.044)
Rural left-behind children × During COVID-19		0.008 (0.010)	0.005 (0.010)		-0.267*** (0.022)	-0.267*** (0.022)		0.107* (0.043)	0.088* (0.043)	0.097* (0.043)
Migrant children × During COVID-19		0.005 (0.010)	0.004 (0.010)		-0.075** (0.023)	-0.075** (0.023)		0.054 (0.044)	0.051 (0.044)	0.052 (0.044)
Urban left-behind children × During COVID-19		0.024 (0.014)	0.023 (0.014)		-0.096** (0.032)	-0.095** (0.032)		-0.030 (0.060)	-0.024 (0.061)	-0.029 (0.060)
PCR (parent-child relationships)				0.063*** (0.008)	0.063*** (0.008)	0.009 (0.023)			-0.588*** (0.025)	-0.175*** (0.044)
FES (family economic status)	0.012** (0.004)	0.013** (0.004)	0.002 (0.004)						-0.078*** (0.016)	-0.035+ (0.019)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Constant	3.428***	3.428***	3.692***	2.327***	2.301***	2.647***	2.235***	2.247***	4.416***	3.160***
	(0.082)	(0.082)	(0.034)	(0.081)	(0.081)	(0.113)	(0.254)	(0.255)	(0.263)	(0.221)
R-squared within	0.033	0.034	0.041	0.223	0.238	0.239	0.018	0.019	0.019	0.023
N	20,510 (10,255×2)									

Notes: Standard errors in parentheses. “-”: Horizontal hyphen for the cells with no coefficient.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

Appendix B. Regression analysis of children’s (include urban left-behind children) psychological problems during COVID-19 by PCR and FES and other control variables

	Model 1	Model 2	Model 3	Model 4	Model 5
Children group (ref. urban non-migrant children)					
Rural non-migrant children	0.148*** (0.030)	0.048 (0.043)	0.010 (0.043)	0.009 (0.045)	0.010 (0.046)
Rural left-behind children	0.166*** (0.029)	0.037 (0.045)	-0.001 (0.045)	-0.041 (0.047)	-0.040 (0.049)
Migrant children	0.057 (0.030)	0.036 (0.032)	0.030 (0.032)	0.025 (0.032)	0.033 (0.032)
Urban left-behind children	-0.005 (0.041)	-0.039 (0.043)	-0.044 (0.043)	-0.041 (0.043)	-0.046 (0.043)
PCR (parent-child relationships) during COVID-19			-0.171*** (0.013)	-0.157*** (0.015)	-0.171*** (0.013)
Rural children × PCR				-0.012 (0.042)	
Rural left-behind children × PCR				-0.116** (0.043)	
Migrant children × PCR				-0.116** (0.044)	
Urban left-behind children × PCR				0.135* (0.056)	
FES (family economic status) during COVID-19			-0.031** (0.010)	-0.031** (0.010)	-0.036** (0.012)
Rural children × FES					0.014

Rural left-behind children × FES						(0.034)
						-0.051
Migrant children × FES						(0.036)
						0.070*
Urban left-behind children × PCR						(0.033)
						0.026
						(0.050)
Psychological problems (pre-COVID-19)	0.848***	0.837***	0.823***	0.823***	0.823***	0.823***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Control variables	No	Yes	Yes	Yes	Yes	Yes
Constant	0.057***	0.710***	0.538***	0.541***	0.545***	0.545***
	(0.011)	(0.065)	(0.066)	(0.066)	(0.066)	(0.066)
Adjusted R-squared	0.700	0.703	0.705	0.706	0.706	0.706
N			10,255			

Notes: Standard errors in parentheses

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Appendix C Regression analysis of children's psychological problems during COVID-19 by PCR (or PCR Change) and FES change

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1
Children group (ref. urban non-migrant children)						
Rural non-migrant children	0.019	0.019	0.092	0.022	-0.020	0.095
	(0.061)	(0.064)	(0.087)	(0.061)	(0.065)	(0.087)
Left-behind children	0.003	-0.034	-0.061	0.003	0.015	-0.060
	(0.064)	(0.067)	(0.086)	(0.064)	(0.068)	(0.086)
Migrant children	0.032	0.028	0.061	0.031	0.044	0.059
	(0.046)	(0.046)	(0.075)	(0.046)	(0.054)	(0.075)
PCR (parent-child relationships) during COVID-19	-0.171***	-0.148***	-0.171***			
	(0.018)	(0.021)	(0.018)			
Rural children × PCR		-0.023				
		(0.059)				
Left-behind children × PCR		-0.123*				
		(0.060)				
Migrant children × PCR		-0.125*				

				(0.061)			
PCR change (ref. not change)							
PCR decrease					0.190***	0.167***	0.190***
					(0.042)	(0.048)	(0.042)
PCR increase					-0.096**	-0.094**	-0.096**
					(0.029)	(0.033)	(0.029)
Rural children × PCR decrease						0.190	
						(0.182)	
Rural children × PCR increase						0.201	
						(0.117)	
Left-behind children × PCR decrease						0.023	
						(0.157)	
Left-behind children × PCR increase						-0.084	
						(0.106)	
Migrant children × PCR decrease						0.087	
						(0.144)	
Migrant children × PCR increase						-0.100	
						(0.103)	
FES change (ref. not change)							
FES decrease	0.114***	0.114***	0.125***		0.114***	0.114***	0.126***
	(0.025)	(0.025)	(0.028)		(0.025)	(0.025)	(0.028)
FES increase	0.023	0.024	-0.003		0.023	0.025	-0.004
	(0.042)	(0.042)	(0.048)		(0.042)	(0.042)	(0.048)
Rural children × FES decrease			-0.130				-0.131
			(0.091)				(0.091)
Rural children × FES increase			0.012				0.012
			(0.163)				(0.163)
Left-behind children × FES decrease			0.074				0.072
			(0.088)				(0.088)
Left-behind children × FES increase			0.214				0.216
			(0.193)				(0.193)
Migrant children × FES decrease			-0.078				-0.080
			(0.094)				(0.094)
Migrant children × FES increase			0.079				0.087

			(0.135)			(0.135)
PCR Pre-COVID-19				-0.155***	-0.155***	-0.155***
				(0.019)	(0.019)	(0.019)
FES pre-COVID-19	0.047	0.045	0.047	0.046	0.045	0.046
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Psychological problems (pre-COVID-19)	0.822***	0.822***	0.822***	0.822***	0.822***	0.822***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Control variables				Yes		
Constant	0.177	0.181	0.167	0.768***	0.774***	0.756***
	(0.168)	(0.168)	(0.168)	(0.179)	(0.179)	(0.179)
Adjusted R-squared	0.706	0.706	0.706	0.706	0.706	0.706
N				10,255		

Notes: Standard errors in parentheses

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$