



Internal Capabilities and External Resources of Academically Resilient Students in Rural China

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Abstract

Resilience can play an important role in enabling disadvantaged students to succeed academically. However, few studies in low-resource contexts have evaluated resilience as a process (including a child's internal capabilities and external resources, like the internal capabilities of a child's caregiver) and as an outcome (e.g., academic achievement). In the current study, we examined the associations among students' self-reported internal capabilities, their external resources (e.g., caregivers' internal capabilities), and their academic resilience (operationalized as performance on a math test). The study was conducted among 1609 primary and secondary school students in rural China using the Connor–Davidson Resilience Scale (CD-RISC) to measure internal capabilities. Student CD-RISC scores were positively associated with external resources including caregiver CD-RISC scores, maternal education level, high levels of perceived social support, recreational reading, and involvement in group-based activities at school. A one-point increase in students' CD-RISC scores was associated with a 0.01 SD increase in math score ($p < 0.001$), and the math scores of students whose CD-RISC scores were in the bottom quartile were 0.18 SD lower than those of their peers ($p < 0.01$). High levels of perceived social support and recreational reading were also associated with academic resilience in the adjusted equation. Directions for future research and policy implications are discussed.

Keywords Academic Resilience · Adolescence · Protective Processes · Social Environment · Developing Countries · Rural China

Introduction

Social disparities may negatively impact the academic performance of disadvantaged school-aged children, leading to poorer life outcomes in the long term (Ferguson et al., 2007). Socioeconomic disadvantage and poor educational outcomes are closely related, as disadvantaged students are

exposed to a range of risk factors in their immediate social contexts, including in their households and in their communities (Tomul & Savasci, 2012). Poor performance in school, in turn, can prevent students from escaping the cycle of poverty (Awan et al., 2011).

Resilience, however, can enable students to thrive academically despite adverse social circumstances or

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stressors. There are many theories and definitions of resilience, which historically was interpreted as a fixed or stable trait (Ong et al., 2006). In recent years, it has been increasingly understood as either a dynamic process of adaptation to stress (Lyons & Schatzberg, 2020) or an outcome in itself (Chmitorz et al., 2018). When understood as a process, resilience encompasses protective factors that allow an individual to cope with, adapt to, and overcome adversity (Patterson, 2002; Plunkett et al., 2008). Protective factors may include internal capabilities or assets such as optimism, coping skills, and self-efficacy; as well as external resources such as social support and access to activities that promote healthy development (K. M. Brownlee et al., 2013; Connor & Davidson, 2003; Zimmerman, 2013). When resilience is understood as an outcome, it refers to maintaining or achieving positive functioning under adverse circumstances (Henry et al., 2015; Masten, 2018; Nath & Pradhan, 2012).

The term “academic resilience” is particularly salient while considering academic performance under adversity, and it refers to success in educational outcomes such as standardized tests despite the presence of adverse events or circumstances such as poverty (Cassidy, 2016; Jowkar et al., 2014; Martin & Marsh, 2006). Studies on academic resilience have focused on identifying the internal capabilities and external resources that are key for at-risk students to achieve academically. These studies report that academically resilient children possess internal cognitive, behavioral, and psychological capabilities such as persistence in working toward goals, emotional regulation or composure, and a sense of control over one’s ability to attain success or avoid failure (K. M. Connor & Davidson, 2003; Martin & Marsh, 2006), as well as external resources such as social support from adults and peers and access to developmentally appropriate, group-based recreational activities (National Scientific Council on the Developing Child, 2015). Other aspects of the social environment have been linked to the resilience of students as either risk factors that inhibit academic resilience (e.g., high amounts of screen time) (García-Hermoso et al., 2020; Przybylski & Weinstein, 2019) or protective factors that promote it (e.g., time spent engaging in recreational reading and involvement in extracurricular activities) (Lacina et al., 2016; Peck et al., 2008). In accordance with the socio-ecological theory of resilience, however, which internal capabilities and external resources are most essential for achieving academic resilience depends on a constellation of cultural and contextual factors, such as the nature and level of the vulnerabilities that children face, as well as the resources available to mitigate them (Ungar, 2013). Accordingly, academic resilience as an outcome can be moderated by several factors that can inform how to structure and target interventions designed to improve student academic resilience.

Although the body of international studies on academic resilience has expanded significantly over the past 2 decades, some gaps remain. Most notable is the limited empirical research examining academic resilience in low- and middle-income countries (LMICs), where the prevalence and impact of social adversities are considerable. Second, among the few large-scale studies conducted in LMICs (N. Mwangi et al., 2017; Vera et al., 2015; Wills & Hofmeyr, 2019), internal capabilities, and external resources have not been comprehensively examined. For example, Wills and Hofmeyr (2019) only used a standardized scale of grit in rural areas of South Africa to represent internal capabilities (which they refer to as “social-emotional skills”) and did not consider other capabilities commonly associated with resilience, such as optimism or self-efficacy (K. M. Connor & Davidson, 2003). Mwangi et al. (2017) examined a wider range of internal capabilities in Kenya using the California Healthy Kids Survey; however, their study was also limited to examining high expectations from teachers and caring relationships. Indeed, academic resilience may depend on the internal capabilities of a child’s caregiver (Miller-Graff et al., 2020), which may be closely related to those of the child. This dyadic interplay of adapting to stressors may form and sustain the child-caregiver relationship through shared adversities (Brahm et al., 2016; Pratt et al., 2015). Consequently, research has moved beyond individual resilience toward family resilience (Henry et al., 2015; Masten, 2018), evaluating how the dyadic interplay between a child and their caregiver contributes to the child’s academic resilience. Together, caregiving external resources in the social environment are conceptualized as being related to the internal capabilities of the child, which then lead to academically resilient outcomes.

Rural China is an ideal setting to examine academic resilience, as rural Chinese students are socially disadvantaged in several ways that cause them to fall behind academically. In China, approximately 70% of students grow up in rural areas (NBSC, 2008, 2018), and the determinants of poor schooling outcomes of rural students go beyond the poor quality of education received compared to urban areas (Hallinger & Liu, 2016). Rural households have 2.5 times lower income than urban households (NBSC, 2019). Rural students also have lower levels of social support, as many are “left behind” when their parents migrate away to cities for work, leaving students at home under the care of their grandparents or other relatives (Wu et al., 2017). With less parental supervision at home, rural students have less guidance with their homework and engage more in activities linked to worse academic outcomes and which might socially isolate them from their caregivers, such as higher amounts of screen time (Lin et al., 2021; Peiró-Velert et al., 2014). Furthermore, they engage even less in activities linked to more

favorable academic outcomes, such as recreational reading or group-based, prosocial extracurricular activities (Lin et al., 2021; H. Wang et al., 2020). Many rural students also board at school. Boarding has been shown to have a negative effect on mental health outcomes (Q. Chen et al., 2020) and may negatively impact academic achievement (Guo et al., 2021). Peer-to-peer bullying is also common in rural schools in China, which has independently been linked to worse academic performance (H. Wang, Tang, et al., 2021). Amidst this confluence of adverse circumstances, rural students must also compete with urban peers for seats at high schools and universities in China's high-stakes education system (Y. Liu, 2013a, b). Thus, the odds for social advancement are stacked against rural students in China.

Few studies have examined the internal capabilities and external resources that are associated with academic resilience in rural China. Most past studies in rural China measure resilience as a score on a standardized measure of "psychological resilience" (thereby limiting the measurement to internal capabilities) and do not examine resilience as an outcome of academic achievement or consider external resources as resilience processes (Fu et al., 2014; Shi et al., 2016). Although one recent study ($n = 1729$) examined both internal capabilities and external resources associated with academic resilience in rural China, it limited the measurement of internal capabilities to optimism, symptoms of depression, and positive view about the self (Li & Yeung, 2019). Furthermore, many studies have measured internal capabilities with a psychological assessment that is only valid in China (e.g., the Resilience Scales for Chinese Adolescents), making international comparisons difficult (Tam et al., 2020; Xiao et al., 2019). Finally, evaluations of internal capabilities prior to adolescence are nonexistent, missing an opportunity to characterize targets for early intervention.

To address these gaps, the overall aim of this study was to examine the association between student internal capabilities, external resources, and academic resilience in a poor area of rural China using internationally validated and multidimensional assessments. Our specific objectives were to (a) measure the prevalence of internal capabilities (using the standardized and internationally validated self-report measure, the CD-RISC) and external resources in a large sample of grade 4 to 7 preadolescent to adolescent students in rural China; (b) identify the external resources (including caregivers' own self-reported internal capabilities) associated with students' self-reported internal capabilities; and (c) examine the association between both categories of protective factors (i.e., student internal capabilities and external resources) and students' academic resilience, taking into account risk factors such as peer bullying victimization and screen time that may moderate the relation between student internal capabilities and academic resilience.

Methods

This study used cross-sectional data collected in October 2020 from 30 rural schools in the northwestern province of Gansu, which was the poorest province in China (NBSC, 2019). Per capita yearly income of households in the sample region was approximately 1354 USD, which was significantly lower than the national average income of rural Chinese residents (2249 USD) and lay in the second-lowest income quintile among the rural population (NBSC, 2019). Approximately, 58% of the population in the sample area were rural residents, which was higher than the share of China's overall population that was rural (40%) (Statistical Report of Economic and Social Development of Pingliang Prefecture, 2019).

Ethical approval for this study was granted by the Institutional Review Board (IRB) of Stanford University. Written consent forms were sent to parents or guardians of eligible students prior to conducting the survey. We adhered to the Declaration of Helsinki throughout the study to maintain data privacy and confidentiality, prohibiting any discussion of student responses during or after the survey and deleting student names from all electronic files during data encryption.

Sampling

We followed a two-step protocol to select our study sample. In the first step, we obtained a list of all schools from the local education bureau and randomly chose 30 schools (including 20 primary schools and 10 junior high schools) for inclusion in our sample. We chose to conduct our study among fourth and fifth grades in each of the sample primary schools as well as in the seventh and eighth grades in each of the sample junior high schools. We selected students in these grades for two reasons. First, assessing levels and determinants of psychological resilience in childhood can inform early interventions, which can curb academic achievement gaps before they begin to widen (McClelland et al., 2017). Second, in China, it is easier to conduct such surveys in earlier grade levels (primary and middle school), as students in later grades generally face busier schedules due to preparation for high-stakes exams. For this reason, sixth-grade students were not included as in some parts of China they must prepare for middle-school entrance examinations. Due to financial constraints, we randomly selected at most two classes in each grade of each school. Specifically, if there were only one or two classes in a grade, all classes in this grade were selected. If there were more than two classes in a grade, we randomly selected two classes.

In the second step, we selected sample students. Half of the students in each sample class who were present on the day of the survey were randomly selected to participate in the survey. In total, we surveyed 1609 students in 95 sample classes across 30 sample schools. Students who participated in the survey filled out a demographic survey form that asked about their social environment, scales that measured their internal capabilities and perceived family support, as well as a standardized math test. Students also brought home a survey form to their primary caregivers to collect data on caregivers' self-reported internal capabilities (described below).

Measures

Internal Capabilities

The internal capabilities of students were measured by the 25-item Connor-Davidson Resilience Scale (CD-RISC). The CD-RISC is a well-recognized self-rating scale of resilience capabilities that can be used by different age groups and has been validated in many contexts around the world (Davidson, 2020), including among adolescents in China (Cronbach's alpha coefficient = 0.89) (Yu et al., 2011). For each of the 25 items, respondents indicate how well a statement applies to them over the past month on a scale of 0 to 4: 0 ("not true at all"), 1 ("rarely true"), 2 ("sometimes true"), 3 ("often true"), and 4 ("true nearly all the time."). A total score can range from 0 to 100 and is obtained by adding up all 25 items, with higher scores indicating higher levels of resilience (Davidson, 2020).

External Resources

Both past international literature on academic resilience and the context of rural China were considered when selecting which data to collect regarding external resources. Variables related to the students' households included caregiver internal capabilities, parental education level, and the time that the student spent involved in developmentally healthy activities including recreational reading and group-based activities organized at school. Below, we describe how each of these external resources was operationalized and measured.

Like internal capabilities of the child, caregiver internal capabilities were measured by self-report (i.e., by the caregivers themselves about themselves) using the 25-item version of the CD-RISC and scored according to the same procedure as described above. The other external resources were based on student responses to items in the demographic questionnaire. Students were asked to indicate the highest level of education attained by each parent, and then high school attainment or above was used as a cutoff to create a dummy variable (> 9 years education, yes or no). Students

were also asked to state how much time they spent each day engaging in recreational reading, using 30 min as a cutoff to create a dummy variable. We also asked students how often they typically participate in group-based activities that are organized by their school, and we coded responses into a dummy variable indicating whether they often chose to participate when activities were organized.

Academic Resilience

Student academic resilience was operationalized as performance on a 30-min standardized math test. We utilize a math test as opposed to a test in other subject areas (such as reading or language achievement) because achievement in math is more explicitly tied to learning experiences at school as opposed to learning experiences at home (Cooper H, Nye B, Charlton K, Lindsay J, Greathouse S., 1996). The test items for each sample grade were carefully designed with assistance from educators working at the local education bureau to ensure compliance with the national curriculum. The math testing scales have been used by the research team in several previous surveys to examine student academic performance in other parts of rural China (Y. Ma et al., 2020a, b; Mo et al., 2020; H. Wang, Abbey, Xinshu She, et al., 2021). We also pretested the exam multiple times to ensure its relevance in the sample schools and that time limits were appropriate. When we administered the exam in the sample schools, it was timed carefully and closely proctored by trained enumerators. All test scores were then normalized according to the distribution of scores in each grade.

Risk Factors

The survey team also collected information on several other characteristics of the students' social environments identified to be potential risk factors for heightened vulnerability. These included whether the child's parents were both migrants (i.e., left-behind children), low levels of family assets, whether the student boarded at school, exposure to peer bullying, and high levels of screen time.

To measure the perceived social support of the students, the Multidimensional Scale of Perceived Social Support (MSPSS) was included in the student survey forms. The 12-item MSPSS is a self-report questionnaire that measures the perceived degree of emotional support received from three sources (which form its three subscales, each of which includes four items): family, friends, and significant other. The wording of each item specifically refers to which type of relation (i.e., family, friends, or significant others) the student should respond about, though not all items of the subscales are identical due to contextual variations. For example, an item on the family subscale is "I get the emotional help and support I need from my family," while

the closest item on the friend subscale is “I can count on my friends when things go wrong.” Notably, although the English word “significant other” may have multiple connotations, the intended meaning of the word in the MSPSS is to refer to an important person in one’s life (i.e., not a romantic partner); the translation of the word in the Chinese version of the MSPSS is only used to describe an important person in one’s life and does not have other connotations. The MSPSS has been found to be reliable and valid for use among school-aged children (Chou, 2000; Ramaswamy et al., 2009) and has previously been validated in mainland China (Cronbach’s alpha coefficient = 0.89) (Chou, 2000). Following the guidelines of the authors of the scale (Zimet et al., 1988), responses were scored on a 7-point Likert scale (1 = “very strongly disagree” to 7 = “very strongly agree”), and an overall mean score was derived by adding together the responses to each item across the three subscales and dividing by 12. Similarly, mean scores for each subscale were calculated by summing the scores of the respective items and then dividing by 4. We then used established cutoffs to create dummy variables (1 = high levels of support, 0 = normal or low levels of support) for the overall scale and each subscale (Zimet et al., 1988).

To measure family assets, the questionnaire asked students whether or not their household owned seven selected items included in the National Household Income and Expenditure Survey to create a family asset index, which we categorized into quartiles (NBSC, 2008). Low socioeconomic status was defined by students whose assets were in the bottom 25% of participants. As the students all lived and attended school in a rural, underdeveloped area and have low levels of household assets compared to most students in China overall, “low” in this context is interpreted as low relative to other students. Regarding parental migration, students were asked whether their father and mother migrated out for work for more than 6 months in the past year. Students whose parents had both migrated for at least this duration were classified as “left-behind children.”

Information on peer bullying victimization was collected using an international scale developed for the Progress in Reading and Literacy Study (PIRLS) known as the “Students Bullied at School” (SBS) scale. This scale has been used to describe the frequency of peer bullying victimization among children across 52 countries and regions representing a variety of development and income levels, and it has also been previously validated in China (Lam et al., 2016). Following prior studies (Mullis et al., 2012), responses were categorized into two groups based on whether or not students had experienced bullying victimization on at least a monthly basis.

Students were also asked to indicate whether they were boarding in the current semester (yes or no) and to provide information about their daily screen time (i.e.,

recreational activities performed using a digital device such as a smartphone, television, computer, or video game console). Responses for screen time were then categorized into dummy variables using 1 h as a cutoff.

Demographic Characteristics

The survey also collected data on demographic characteristics including student gender (male or female) and age (which we divided into a dummy variable based on the median age of 11 years old). Age of each student’s mother or father (in years) was also collected.

Statistical Analysis

The statistical analysis in the paper followed two approaches. First, in the descriptive analysis, we reported the summary statistics of the participants, as well as the means and standard deviations of CD-RISC score (internal capabilities) and math test score (academic resilience). We also conducted *t*-tests to identify which social-environmental (external resources, potential risk factors, and demographic characteristics) were associated with higher levels of internal capabilities and academic resilience. Second, we examined the association between external resources and internal capabilities, as well as the associations of both internal capabilities and external resources with the outcome variable academic resilience (math score). An ordinary least square (OLS) linear regression model was used to conduct these multivariate analyses. We included the following demographic and potential risk factor variables as potential confounders in the multivariate analysis: student age and gender, whether both parents have out-migrated for more than 6 months in the past year (i.e., left-behind child status), low household asset index, whether the student boarded at school, whether the student had been bullied monthly or more, and screen time exceeding 1 h. To account for the nested nature of the data, we clustered all standard errors at the school level. All analyses were performed in Stata 16.1 (StataCorp LP, College Station, TX, USA). *p*-values below 0.05 were considered statistically significant.

Results

Summary Statistics

Table 1 displays the summary statistics of the participants. Forty-five percent (45%) of participant students were female, while the mean age was 12 years old. On average, fathers were 41 years old, while mothers were 38 years old. One-fifth of the students (20%) were left-behind children whose parents were both migrants and did not live at home, and

Table 1 Summary statistics of samples

	Obs	Mean	Std. Dev	Min	Max
<i>Demographic characteristics</i>					
Female, 1 = yes	1609	0.45	0.50	0	1
Age, years	1609	11.55	1.62	7.83	15.58
Father's age, years	1609	41.12	6.16	23	71
Mother's age, years	1609	38.30	5.76	21	66
<i>Risk factors</i>					
Left-behind child, 1 = yes (both parents migrated)	1609	0.20	0.40	0	1
Family asset index	1607	-0.01	1.24	-2.24	2.91
Boards at school, 1 = yes	1609	0.15	0.36	0	1
PIRLS monthly bullying or more	1609	0.43	0.49	0	1
Screen time per day, mins	1609	25.87	44.33	0	950
Screen time exceeds 1 h/day, 1 = yes	1609	0.15	0.36	0	1
<i>Student internal capabilities</i>					
Total CD-RISC scores, 0–100	1609	59.87	14.22	0	100
<i>External resources</i>					
Caregiver CD-RISC scores, 0–100	1565	55.36	18.91	0	100
Father's education level, 1 = high	1609	0.24	0.43	0	1
Mother's education level, 1 = high	1609	0.15	0.35	0	1
MSPSS high social support (overall), 1 = yes	1609	0.44	0.50	0	1
MSPSS high family support, 1 = yes	1609	0.43	0.49	0	1
MSPSS high friend support, 1 = yes	1609	0.44	0.50	0	1
MSPSS high significant other support, 1 = Yes	1609	0.49	0.50	0	1
Recreational reading per day (mins.)	1608	27.02	19.69	0	160
Recreational reading > 30 min per day, 1 = yes	1609	0.54	0.50	0	1
Often attends group activities at school, 1 = yes	1606	0.70	0.46	0	1
<i>Academic resilience</i>					
Standardized math test score	1608	0.01	0.96	-4.02	1.9

15% of the students boarded in a dormitory at school. Forty-three percent (43%) of participants reported being bullied at least monthly. The average screen time of students was 26 min, and 15% reported an average daily screen time exceeding 1 h.

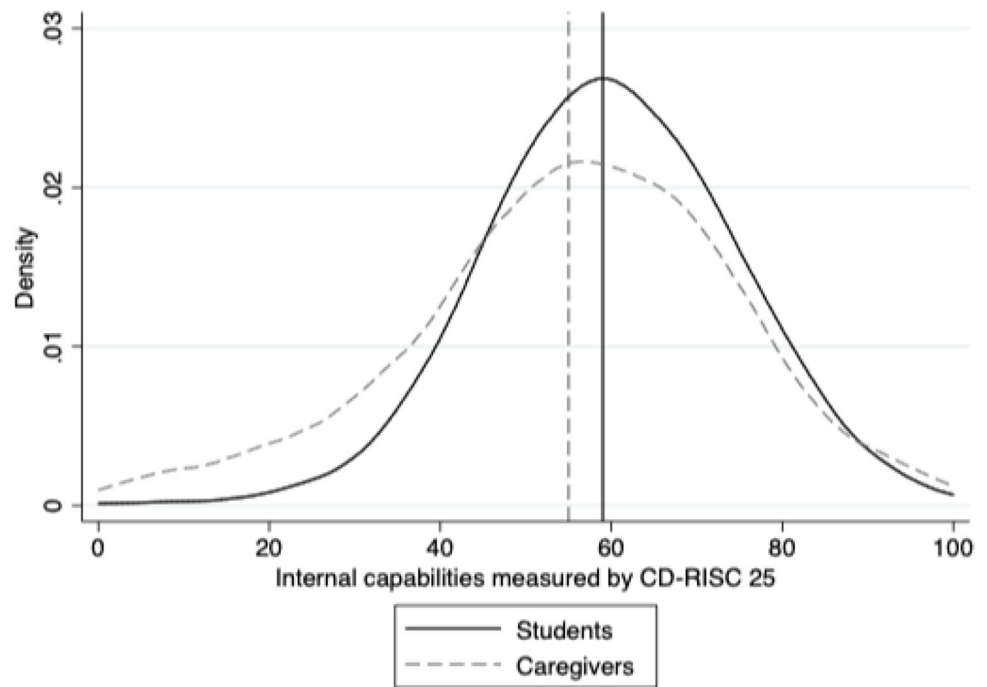
Table 1 also reports the mean (59.87) and standard deviation (14.22) of participant student CD-RISC scores. The mean score in this sample was lower than the mean scores reported in almost all other identified studies of similarly aged students. These include studies in other contexts such as Spain (mean CD-RISC score = 75.65, sample size (n) = 203) (Ramirez-Granizo et al., 2020), Singapore (mean = 71.13, n = 190) (Lim et al., 2011), South Korea (mean = 62.52, n = 519) (Nam et al., 2018), and South Africa (mean = 64.80, n = 701) (Jorgensen & Seedat, 2008); as well as several studies in urban areas of China (mean = 63.00, n = 6019; mean = 69.64, n = 914, respectively) (Gong et al., 2020; Yu et al., 2011). One study in urban China, however, reported a lower mean score (mean = 56.62, n = 942) (Kang et al., 2020).

For caregivers, the mean CD-RISC score was 55.36, and the standard deviation was 18.91. Like student CD-RISC

scores, caregiver CD-RISC scores were low when compared to those of general adult populations reported by studies in other contexts, including Hong Kong (mean = 66.0, n = 10,997) (Ni et al., 2016), Italy (mean = 66.70, n = 10,812) (Bonaccio et al., 2018), Sweden (mean = 68.80, n = 2599) (Velickovic et al., 2020), the Gaza strip (mean = 75.90, n = 768) (Kteily-Hawa et al., 2020), and the USA. (mean = 80.40, n = 577) (K. Connor & Davidson, 2003). The distribution of the student and caregiver CD-RISC scores followed a normal distribution (Fig. 1).

The analysis also produced point estimates for the other external resources of the students besides the caregiver CD-RISC score. Twenty-four percent (24%) of fathers had attended high school, compared to 15% of mothers. Forty-four percent (44%) of the students had high levels of overall perceived social support based on their total MSPSS score. In terms of support received from specific social relations, 43% of the students perceived high levels of support from family, 44% perceived high levels of support from friends, and 49% perceived high levels of support from a significant other. The average daily recreational reading time was 27 min, with 54% of the students exceeding 30 min per day.

Fig. 1 Distribution of CD-RISC scores of students (mean = 59.8) and caregivers (mean = 55.3)



For a recreational reading time, there was a large variation across the students, as measured by the standard deviation to the mean (20 min). Finally, 70% of the students indicated that they frequently participate in group activities organized by their school.

Internal Capabilities and Academic Resilience: Comparisons Between Different Subgroups of Students

Table 2 reports the differences in CD-RISC scores and standardized math scores between student subgroups. Compared to younger students (whose age was less than the sample median of 11 years), the CD-RISC scores of older students were on average 2.6 points higher ($p < 0.001$). The CD-RISC scores of students were also significantly higher for those whose caregivers' CD-RISC scores were in the top 25% of the sample compared to the bottom 25% (9.9-point difference, $p < 0.001$). The CD-RISC scores of students whose fathers had higher education levels were 1.8 points higher than their peers ($p = 0.033$), while students whose mothers had higher education levels were 3.6 points higher than those of their peers. Students who perceived high social support overall (11.0-point difference, $p < 0.001$) had higher CD-RISC scores relative to those students who perceived less social support. This was true regardless of which type of perceived social support was high, including high support from family (10.9-point difference), friends (10.9-point difference), or significant others (10.0-point difference)—all significant at the 0.1% level ($p < 0.001$). Those

students who were engaged in recreational reading for at least 30 min per day (2.7-point difference, $p < 0.001$) and the students who often attended group activities organized by their school (7.6-point difference, $p < 0.001$) had higher CD-RISC scores than their peers. Students whose family assets were in the top quartile of the participants also had higher CD-RISC scores than those in the bottom quartile (4.3-point difference, $p < 0.001$), while those who were bullied at least monthly had lower CD-RISC scores (3.1-point difference, $p < 0.001$) than their peers (who were not bullied at least monthly).

Subgroups of students with better academic performance (academic resilience) had similar demographic and family characteristics as those who had higher CD-RISC scores. This included students whose caregiver themselves had CD-RISC scores in the top quartile versus the bottom quartile (0.322 SD difference, $p < 0.001$); whose fathers and mothers had higher education levels (0.253 SD, $p < 0.001$; 0.256 SD, $p < 0.001$, respectively); students with higher levels of perceived social support (0.428 SD, $p < 0.001$), including family support (0.360 SD, $p < 0.001$), friend support (0.379 SD, $p < 0.001$), and significant other support (0.385 SD, $p < 0.001$); students who engaged in recreational reading for at least 30 min per day (0.268 SD, $p < 0.001$), and students who frequently participated in group activities organized by their school (0.119 SD, $p = 0.023$). Likewise, students whose family asset index was in the top 25% of the sample had better academic performance than the bottom 25% (0.414 SD, $p < 0.001$), while those who were bullied monthly or more had lower academic performance than

Table 2 Descriptive analysis of internal capabilities and academic performance: comparisons between different types of students

Social-environmental factors and demographic characteristics			Internal capabilities (CD-RISC score)			Academic resilience (math score)		
			Mean	Difference	<i>p</i> -value	Mean	Difference	<i>p</i> -value
<i>Demographic characteristics</i>								
Gender	Female	717	59.300	−1.045	0.143	−0.015	−0.044	0.357
	Male	891	60.345			0.029		
Age, years	≥ 11	856	61.116	2.645***	0.000	−0.027	−0.079	0.102
	< 11	752	58.471			0.051		
<i>External resources</i>								
Caregiver CD-RISC score	Top 25%	389	64.748	9.866***	0.000	0.187	0.322***	0.000
	Bottom 25%	398	54.882			−0.135		
Father's education > 9 years	Yes	386	61.225	1.772*	0.033	0.201	0.253***	0.000
	No	1222	59.453			−0.051		
Mother's education level > 9 years	Yes	233	62.914	3.55***	0.000	0.228	0.256***	0.000
	No	1375	59.364			−0.028		
MSPSS high social support (overall)	Yes	707	65.999	10.992***	0.000	0.249	0.428***	0.000
	No	901	55.077			−0.179		
MSPSS high family support	Yes	685	66.117	10.868***	0.000	0.216	0.360***	0.000
	No	923	55.249			−0.144		
MSPSS high friend support	Yes	703	66.013	10.899***	0.000	0.223	0.379***	0.000
	No	905	55.114			−0.156		
MSPSS high significant other support	Yes	785	64.975	9.956***	0.000	0.207	0.385***	0.000
	No	823	62.811			−0.179		
Recreational reading after school > 30 min	Yes	871	61.101	2.667***	0.000	0.132	0.268***	0.000
	No	737	58.574			−0.136		
Often attends group activities at school	Yes	1119	62.204	7.639***	0.000	0.048	0.119*	0.023
	No	486	54.574			−0.071		
<i>Risk factors</i>								
Left-behind child (both parents migrated)	Yes	318	58.635	−1.550	0.082	0.027	−0.027	0.652
	No	1290	60.185			0.015		
Family asset index	Top 25%	397	62.811	4.272***	0.000	0.284	0.414***	0.000
	Bottom 25%	443	58.540			−0.130		
Boards at school	Yes	240	59.525	−0.416	0.676	−0.163	−0.203**	0.003
	No	1368	59.941			0.040		
Bullied monthly or more	Yes	686	58.102	−3.099***	0.000	−0.117	−0.220***	0.000
	No	922	61.201			0.103		
Screen time exceeds 1 h/day	Yes	249	58.586	−1.529	0.119	−0.057	−0.079	0.234
	No	1359	60.110			0.022		
<i>Student internal capabilities</i>								
Student CD-RISC score	Top 25%	396				0.263	0.584***	0.000
	Bottom 25%	440				−0.321		

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

their peers (−0.220 SD, $p < 0.001$). One exception was that students who were boarders did not have lower CD-RISC scores but did have lower math scores than their peers (−0.203 SD, $p = 0.003$). There were also no differences in the academic performance between students of different age groups.

Several subgroups of students did not significantly differ by either CD-RISC score or academic performance. These included female and male students, left-behind children and non-left-behind children, and those whose screen time exceeded 1 h per day (all $ps > 0.05$).

Finally, students whose CD-RISC scores were in the top quartile of the students had significantly better

academic performance than those whose scores were in the bottom quartile of the students (0.584 SD, $p < 0.001$, Table 2, last row). Compared to other subgroup differences between levels of academic performance, student CD-RISC score had the largest difference as measured by standard deviations.

OLS Regression of Factors Associated with Student Internal Capabilities

Table 3 displays the associations between social-environmental characteristics and student internal capabilities. We first examined caregiver internal capabilities as

Table 3 OLS regression of factors associated with student internal capabilities

Social-environmental factors and demographic characteristics	Student internal capabilities measured by CD-RISC score			
	(1)	(2)	(3)	(4)
<i>External resources</i>				
Caregiver CD-RISC score, 0–100	0.19*** (0.02)	0.13*** (0.02)	0.13*** (0.02)	0.14*** (0.02)
Father's education level, 1 = high school or above		–0.44 (0.81)	–0.46 (0.82)	–0.36 (0.83)
Mother's education level, 1 = high school or above		2.68** (0.98)	2.62** (0.99)	2.20* (1.01)
MSPSS high social support (overall), 1 = yes				9.07*** (0.67)
MSPSS high family support, 1 = yes		4.67*** (0.81)	4.55*** (0.82)	
MSPSS high friend support, 1 = yes		5.35*** (0.79)	5.24*** (0.79)	
MSPSS high significant other support, 1 = yes		2.63** (0.82)	2.89*** (0.83)	
Recreational reading time after school > 30 min, 1 = yes		1.22 (0.63)	1.28* (0.63)	1.56* (0.65)
Often attends group activities at school		4.91*** (0.70)	4.94*** (0.70)	5.57*** (0.71)
<i>Risk factors</i>				
Left-behind child, 1 = yes (both parents migrated)			0.33 (0.79)	0.31 (0.80)
Family asset index, 1 = bottom 25%			–0.41 (0.72)	–0.61 (0.74)
Boards at school, 1 = yes			–1.28 (1.11)	–1.15 (1.13)
PIRLS monthly bullying or more, 1 = yes			0.47 (0.65)	0.24 (0.67)
Screen time exceeds 1 h/day, 1 = yes			–0.82 (0.87)	–1.15 (0.89)
<i>Demographic characteristics</i>				
Female, 1 = yes			–1.39* (0.63)	–1.47* (0.64)
Age, years			–0.19 (0.41)	–0.20 (0.42)
Constant	47.55*** (1.85)	40.38*** (1.78)	42.84*** (4.72)	43.32*** (4.82)
Observations	1565	1562	1562	1562
R-squared	0.115	0.299	0.303	0.271

Standard errors in parentheses

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

a variable of interest, finding that caregiver CD-RISC score was positively associated with student CD-RISC score regardless of which factors we adjust for in the model (columns 2–4). Specifically, we found that a one-point increase in caregiver CD-RISC score was associated with a 0.13-point increase in student CD-RISC scores in the adjusted equation ($p < 0.001$ —column 3). Figure 2 provides a graphical illustration of the linear association between these two variables.

Other measures of external resources were also positively and significantly associated with higher student CD-RISC scores in the adjusted equations (Table 3, columns 3 and 4). These included maternal education level (2.62 points, $p < 0.01$ —column 3), though not paternal education level; higher levels of overall social support (9.07 points, $p < 0.001$) in column 4 as well as high family support (4.55 points, $p < 0.001$), high friend support (5.24 points, $p < 0.001$), and high significant other support (2.89 points, $p < 0.001$) in column 3; recreational reading time (1.28 points, $p < 0.05$ —column 3), and often participating in group activities at school (4.94 points, $p < 0.001$ —column 3). None of the risk factors were significantly associated with student CD-RISC score in the adjusted equation, though students who were female had marginally lower CD-RISC scores than male students (-1.39 points, $p < 0.05$). Supplementary Table 1 displays a pairwise correlation matrix between all included variables.

OLS Regression of Student Internal Capabilities and Academic Resilience

Analyses demonstrated that there was a direct association between student internal capabilities and academic resilience (Table 4, Fig. 3). When measuring resilience as a continuous variable, a one-point increase in student CD-RISC score was associated with an increase of 0.01 SD in standardized math score ($p < 0.001$, Table 4 columns 2 and 3). Likewise, students whose CD-RISC score was in the top quartile had a math score that was 0.17 SD higher than that of their peers while controlling for other confounders ($p < 0.01$, Table 4 column 6).

Several external resources were also significantly associated with student academic resilience in the adjusted equations (Table 4 columns 3 and 6). These included high levels of perceived social support (0.26 SD, $p < 0.001$ —column 3; 0.32 SD, $p < 0.001$ —column 6) and more than 30 min of recreational reading time after school per day (0.19 SD, $p < 0.001$ —column 3; 0.20 SD, $p < 0.001$ —column 6). All other social-environmental variables—except for the risk factor “being bullied monthly or more” (-0.12 SD, $p < 0.05$ —column 3)—were not significantly associated with academic resilience in the adjusted equations. These included caregiver CD-RISC score, parental education levels, participation in group activities at school, student left-behind status, family asset index, boarding status, screen time, student gender, and student age.

Fig. 2 Association between student and caregiver CD-RISC scores

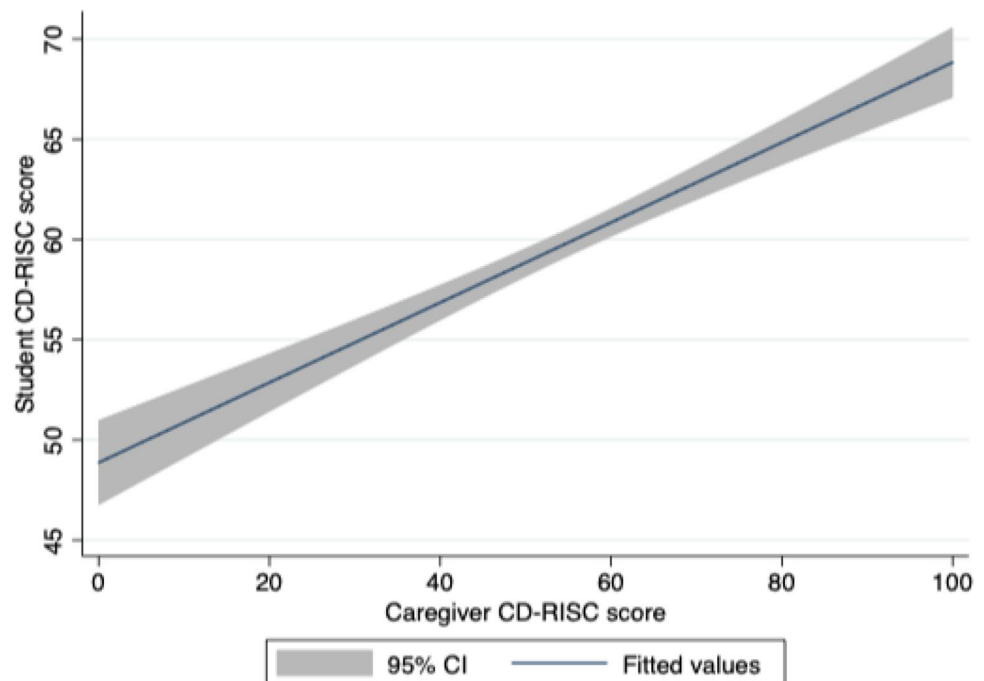


Table 4 OLS regression of student internal capabilities and academic resilience

Internal capabilities, social-environmental factors, and demographic characteristics	Academic resilience (standardized math test score)					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Student internal capabilities</i>						
Student CD-RISC score, 0–100	0.02*** (0.00)	0.01*** (0.00)	0.01*** (0.00)			
Student CD-RISC score, 1 = top 25%				0.34*** (0.05)	0.18** (0.06)	0.17** (0.06)
<i>External resources</i>						
Caregiver CD-RISC score, 1 = top 25%		0.05 (0.05)	0.05 (0.05)		0.07 (0.05)	0.07 (0.06)
Father's education level, 1 = high school or above		0.09 (0.06)	0.10 (0.06)		0.10 (0.06)	0.10 (0.06)
Mother's education level, 1 = high school or above		0.01 (0.07)	0.01 (0.07)		0.03 (0.07)	0.02 (0.07)
MSPSS high social support (overall), 1 = yes		0.29*** (0.05)	0.26*** (0.05)		0.35*** (0.05)	0.32*** (0.05)
Recreational reading time after school > 30 min, 1 = yes		0.19*** (0.05)	0.19*** (0.05)		0.20*** (0.05)	0.20*** (0.05)
Often attends group activities at school, 1 = yes		0.02 (0.05)	0.01 (0.05)		0.06 (0.05)	0.05 (0.05)
<i>Risk factors</i>						
Left-behind child, 1 = yes (both parents migrated)			0.05 (0.06)			0.05 (0.06)
Family asset index, 1 = bottom 25%			–0.06 (0.05)			–0.06 (0.05)
Boards at school, 1 = yes			–0.01 (0.08)			–0.03 (0.08)
PIRLS monthly bullying or more, 1 = yes			–0.12* (0.05)			–0.11* (0.05)
Screen time exceeds 1 h/day, 1 = yes			–0.08 (0.06)			–0.09 (0.06)
<i>Demographic characteristics</i>						
Female, 1 = yes			–0.06 (0.05)			–0.07 (0.05)
Age, years			–0.01 (0.03)			–0.01 (0.03)
Constant	–0.46*** (0.14)	–0.53*** (0.14)	–0.32 (0.35)	0.43*** (0.10)	–0.03 (0.11)	0.20 (0.34)
Observations	1608	1605	1605	1608	1605	1605
R-squared	0.124	0.154	0.159	0.093	0.141	0.147

Standard errors in parentheses

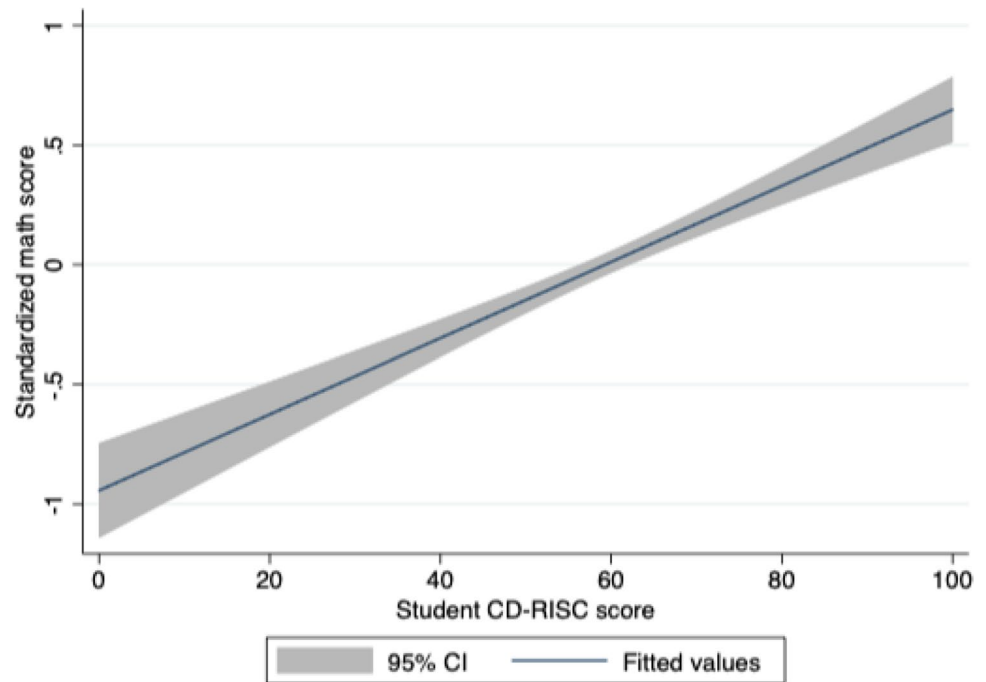
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Discussion

This paper examined the levels and associated social-environmental factors of internal capabilities (internal resilience processes) and academic resilience (a resilient outcome of academic achievement despite adversity) among vulnerable primary and secondary school students in rural China. First,

we measured internal capabilities with the internationally valid CD-RISC scale and found that the mean score of the student participants was 59.87, which was lower than the mean scores reported in almost all other identified studies of similarly aged students both inside and outside of China. The mean CD-RISC score of students' primary caregivers (55.36) was also low when compared to all other identified

Fig. 3 Association between student academic performance and CD-RISC scores, full sample



studies. Next, we identified the social-environmental factors that were associated with students' internal capabilities, including caregiver internal capabilities, mother's education level, high levels of perceived social support (from family, friends, and significant others), recreational reading, and frequent participation in group-based activities at school, all of which were positively associated with students' internal capabilities. Female gender was also negatively associated with internal capabilities, though there were no significant associations with potential risk factors such as left-behind status (i.e., both parents migrated out), family asset index, boarding status, bullying victimization, and screen time. Finally, there was a strong and positive association between internal capabilities and academic resilience, which persisted even when controlling for social-environmental and demographic factors. High levels of perceived social support and recreational reading time of over 30 min per day were positively associated while experiencing bullying at least monthly was negatively associated with academic resilience in the adjusted equation.

This study contributes to the extant literature both inside and outside of China by investigating academic resilience, conceptualized as a series of processes (internal capabilities and external resources) that lead to a resilient outcome (academic achievement), based on frameworks that use this twofold definition of resilience (Fergus & Zimmerman, 2005; Masten, 2018; Patterson, 2002; Southwick et al., 2014). By controlling for other social-environmental and demographic factors, our findings suggest that both internal capabilities and external resources are integral to student academic

resilience in rural China. The interplay of student internal capabilities (strengths measured by the CD-RISC) and external resources (high levels of perceived social support and recreational reading) account for a significant degree of the variation in academic performance across students (Table 4). External resources that were strongly and positively associated with student internal capabilities such as caregiver internal capabilities, maternal education level, and attending group activities at school (Table 3) were not significantly associated with academic resilience. As these factors (with the potential exception of caregiver internal capabilities) have been linked to academic performance in past studies (Abizada et al., 2020; Khan et al., 2015), this suggests their association with academic resilience may be at least partially mediated by student internal capabilities (i.e., they are part of the process of resilience by strengthening student internal capabilities).

Notably, a caregiver's own internal capabilities were strongly associated with their child's internal capabilities even when controlling for other characteristics, similar to the findings of a study in Peru in which caregivers reported both their own and their child's internal capabilities using the Resilience Research Centre-Adult Resilience Measure and the Strengths and Difficulties Questionnaire, respectively (Miller-Graff et al., 2020). The mediating factors of intergenerational "transmissions" of resilience may be multifactorial (Kazlauskas et al., 2017). One possibility is that the transmission may be indirect; that is, the child's coping strategies may be in part determined by environmental psychosocial factors such as the caregiver's own reactions to stressful

situations, which the child may observe and imitate through modeling. According to child–adult attachment theory, the coping strategies that a parent demonstrates during trauma may influence the way that their child deals with their own trauma (Colin & Low, 1991; Hesse & Main, 2000). Alternatively, the transmission may be directly delivered through intentional parenting practices, such as parent–child emotion talk (Aznar & Tenenbaum, 2015) and teaching deep breathing exercises (Chronis-Tuscano et al., 2016). Caregivers who can regulate their own emotions may be more likely and better equipped to help their child do so following adverse experiences (Calkins & Hill, 2007; Humphreys et al., 2021). As parenting practices are malleable aspects of the child’s social environment (Humphreys et al., 2021), this may be a target for intervention that increases resilience among at-risk children. Heritable genetic factors may be another mechanism for the intergenerational transmission of resilience (Bowes & Jaffee, 2013), as certain genes may be responsible for variations in the stress response system (Maul et al., 2020). Investigating environmental and genetic factors associated with intergenerational transmission of internal capabilities and the interactions between them requires further study.

Other external resources associated with internal capabilities included 30 min or more of daily recreational reading and frequent participation in extracurricular activities. Non-screen sedentary activities may be protective factors for internal capabilities that merit replication in rural China and in other contexts (H. Wang et al., 2021a, b). It is possible that recreational reading, especially when involving certain types of narrative fiction, may support positive coping strategies by increasing the student’s ability to reframe their experiences and by modeling the behaviors of resilient characters (Gold, 2001; Howard, 2011). It is also possible that levels of participation in non-screen activities in a household may be an indicator of nurturing parenting practices and emotional responsiveness that contribute to a similar outcome (Samaha & Hawi, 2017). In contrast to recreational reading, participation in prosocial group-based activities forms the basis of many interventions implemented globally to target resilience among school children (Zimmerman et al., 2013). Engaging in developmentally and culturally appropriate activities at school and in the community has been shown to promote resilience and reduce negative outcomes such as mental health problems, particularly among students who are from less-privileged environments (Ungar, 2013). Future intervention-based studies might investigate which intervention designs are most effective at promoting these internal capabilities of rural students in China, as well as which students (e.g., age or gender variations) benefit most from which types of interventions.

Surprisingly, we did not observe an association between being a left-behind child and student internal capabilities. This contradicts the results of one recent meta-analysis of

12 cross-sectional studies ($n=9777$) (Dong et al., 2019), which indicated that left-behind children had lower scores on the Resilience Scale for Chinese Adolescents than non-left-behind children, as also reported by another study (Zhou et al., 2021) in rural Anhui. However, not all studies have reported worse outcomes for left-behind children. Dong et al. also identified several studies which—like ours—found null results (Feng et al., 2016; Liu, W. F., 2013). Demographic (e.g. age) differences across samples aside, one potential explanation is that, in certain samples, the lower parental support received by left-behind children may be offset by the increased economic resources received in households where parents earn higher wages by migrating to cities to find work. This explanation has also been raised by past studies that have found null differences between left-behind children and non-left-behind children across other domains such as anxiety, nutrition, and academic performance (L. Wang et al., 2019; Zhou et al., 2015). In the present study, students in families with higher asset index scores were found to have higher levels of resilience, though this difference disappeared when controlling for other factors. A second possible reason is that, in certain contexts, there may be a selection effect by which parents consider factors such as certain traits of the child like their self-regulation and coping skills and/or the faculties of the student’s alternate primary caregiver (such as a grandmother’s ability to care for the child) before deciding whether to migrate (Zhou et al., 2015). A third possible explanation relates to the timeframe during which the studies were conducted. In recent years, due to the widespread ownership of mobile phones in rural China (W. Ma et al., 2020a, b), it is possible that communication between left-behind children and their parents has become more frequent than in the past, thereby mitigating the negative impacts of parental migration on child development (P. L. Liu & Leung, 2017). This may also be a possible explanation for the null difference between the resilience of boarding and non-boarding students in this study, as boarding students—like left-behind children—also generally live far away from their parents (M. Liu & Villa, 2020). Future research should examine how the ownership and use of mobile technology for parent–child communication moderates the effects of parental migration and boarding at school on student resilience and other developmental outcomes. This would especially inform analyses evaluating the level of support received from surrogate caregivers and the degree of neighborhood cohesion (Wen et al., 2015). Qualitative methods such as focus groups might facilitate understanding of real-world dynamic factors that facilitate resilience when encountering adverse conditions such as poverty, lack of access to health and educational resources, and parental migration.

Finally, given the importance of both a child’s own internal capabilities as well as those of their caregiver in

promoting healthy child development, our findings that the CD-RISC scores of both the students and caregiver participants were low when compared to almost all other identified studies bring attention to the urgent need for future interventions to improve the resilience of families in rural China. The income level of the study region was lower than in most of the comparison studies (which were mostly conducted in high-income countries), which may partially explain the lower CD-RISC scores in our study. Family therapy programs enhance family resilience among vulnerable populations in other contexts (Saltzman et al., 2011; Walsh, 2016), and future research should explore the applications of culturally adapted interventions to improve family resilience in poor rural areas of China. Conceptualizing resilience as a dynamic process involving the student's whole social ecosystem (including members of their households, schools, and communities) is integral for designing interventions that promote the multisystemic protective factors that work together to allow children to achieve positive outcomes despite adversity.

We note several limitations of our study. First, because we use cross-sectional data, we are unable to draw any causal connections between student internal capabilities, external resources, and academic resilience as an outcome. It is possible, for instance, that the relation between resilience and academic performance is bidirectional and that a student's success in school may allow them to cultivate internal capabilities. For this reason, future studies should utilize longitudinal and interventional designs with randomization to better understand the causal links between these factors. Second, there are certain mental health outcomes (i.e., risk for depression and anxiety) and social-environmental variables (e.g., teacher-student interactions, community-level variables, etc.) that may be salient in the context of rural China which we do not explore in the current study; in addition, a complex interplay of additional factors may simultaneously influence resilience, including genetic and epigenetic factors as well as adverse childhood experiences. Future studies may include a broader assessment of potential determinants and protective factors of resilience, such as mental health outcomes, a wider range of social environmental factors that are most proximal to the well-being and development of at-risk students in rural China, life events, and biological traits. Third, we acknowledge the difficulty of conducting a cross-cultural comparison of internal capabilities, partially due to the context-dependent nature of resilience and variations across populations regarding how resilience is understood and the processes that are most salient. These are nuances that a standardized scale like the CD-RISC may not accurately reflect or capture. Nevertheless, the CD-RISC is used almost universally and may permit future cross-cultural comparisons with settings where academic resilience is also shaped by universal social determinants

such as poverty. Fourth, although there are benefits to using a single standardized measure of academic achievement to compare academic resilience across schools, our study only measured performance on one exam in one school subject (math), which may not have accurately reflected their overall performance in multiple subjects over an extended period. Finally, although we used a multidimensional measure of internal capabilities, exploring which specific capabilities (e.g., optimism, self-regulation, etc.) were associated with academic resilience was beyond the scope of this study and an important direction for future research. The authors and their collaborators have published several of the relatively small numbers of mental health studies conducted among this school-aged population in rural China and will continue to dedicate efforts focused on direct mental health outcomes.

Conclusion

Using a sample of 1609 students selected from 30 primary and lower secondary schools in a poor, rural region in China, we examined the association between protective factors of resilience (internal capabilities and external resources), as well as the link between these factors and academic performance as an outcome (academic resilience). Our findings indicate that students and their caregivers had relatively low internal capabilities (mean CD-RISC scores = 59.87, 55.36, respectively) when compared to most past studies, including both those conducted inside and outside of China. External resources associated with student internal capabilities included caregiver internal capabilities, mother's education level, high levels of perceived social support, recreational reading time, and frequent participation in group-based activities at school. There was also a strong positive association between student internal capabilities and academic resilience when controlling for other factors: a one-point increase in resilience was associated with a 0.01 SD increase in math score ($p < 0.001$), and students whose resilience scores were in the bottom quartile scored 0.17 SD lower in math ($p < 0.01$). Our study adds to the growing body of empirical evidence related to the links between a student's social environment, internal capabilities, and academic resilience; and it highlights the need to identify interventions that take context-specific, multisystemic approaches to improve the access of at-risk students to protective resources such as social support and pro-social activities, with the aim of increasing their resilience and ultimately improving their chances at success in school and in life.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s42844-022-00073-x>.

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Declarations

Competing Interests Dr. Singh has received research support from Stanford's Maternal Child Health Research Institute and Stanford's Department of Psychiatry and Behavioral Sciences, National Institute of Mental Health, National Institute of Aging, Patient-Centered Outcomes Research Institute, Johnson and Johnson, and the Brain and Behavior Research Foundation. She is on the advisory board for Sunovion and Skyland Trail and is a consultant for Johnson and Johnson, Alkermes, and Neumora. She has previously consulted for X, moonshot factory, Alphabet Inc., and Limbix Health. She receives honoraria from the American Academy of Child and Adolescent Psychiatry and royalties from American Psychiatric Association Publishing and Thrive Global. No other authors report any conflicts of interest.

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