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To Board or Not to Board: Evidence from Nutrition, Health and Education Outcomes of Students in Rural China

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Abstract

The debate over whether boarding school is beneficial for students still exists in both developing and developed countries. In rural China, as a result of a national school merger program that began in 2001, the number of boarding students has increased dramatically. Little research has been done, however, to measure how boarding status may be correlated with nutrition, health and educational outcomes. In this paper, we compare the outcomes of boarding to those of non-boarding students using a large, aggregate dataset that includes 59 rural counties across five provinces in China. We find that for all outcomes boarding students perform worse than non-boarding students. Despite these differences, the absolute levels of all outcomes are low for both boarding and non-boarding students, indicating a need for new policies that will target all rural students regardless of their boarding status.

Key words: boarding students, education, health, nutrition, rural China
JEL codes: I10, I20, Q00

I. Introduction

Since the early 2000s, one of the most prominent endeavors of China's Ministry of

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Education (MOE) has been the implementation of the rural primary school Merger Program (Luo *et al.*, 2009). Over the past 10 years, enrollments in village-level rural primary schools have declined sharply (Wu and Shi, 2011). In response, the Merger Program began to close down smaller schools in more remote villages and merge them with larger "central" schools. The idea was that with fewer schools, the quality of facilities and teaching staff could be raised more effectively by concentrating investments. Nationwide, the number of primary schools in rural China fell by nearly 50 percent from 2001 to 2010 (Yuan and Li, 2012; NBS, 2013). Consequently, many rural students are no longer able to attend school in their home villages and, instead, have to room and board at schools far away from home. Since the implementation of the primary school Merger Program, the number of boarding students has increased rapidly. By 2008, more than 30 million primary and junior high school students were boarders (MOE, 2008).

Given this rapid growth in the number of rural boarding students, it is important to ask: What is the link between boarding and student wellbeing? On the one hand, boarders are exposed to a collective learning and living environment through boarding school, which may afford these students more time with and better access to school facilities such as libraries and gymnasiums relative to non-boarders (Adetunji and Oladeji, 2007; Behaghel *et al.*, 2015; Shu and Tong, 2015). Boarding students may also have more opportunities to communicate with and learn from their classmates and teachers (Fauziyah, 2012; Martin *et al.*, 2014). In addition, boarding schools have more opportunities to model positive social norms than non-boarding schools, which, in turn, may position them to better address emotional issues and correct student misbehavior. For example, teachers and roommates may be able to teach and/or model better lifestyle choices to disadvantaged and problem students, thereby helping them adapt to the rigors of academic life (Bronfenbrenner, 1970; Adams, 1995; Xu *et al.*, 2000; Papworth, 2014).

On the other hand, boarding schools may also have negative effects on students. Boarding students are removed from safe family environments, and may miss the care and support of their parents (Cookson, 2009). Combined with weak support networks, this may lead to social isolation (Ak and Sayil, 2006). Boarding students may also adopt negative behaviors, such as drinking, smoking or fighting, due to their constant close proximity to problem students or low achievers (Henderson *et al.*, 1998; Zhu *et al.*, 2008; Zhang *et al.*, 2014). Boarding schools in remote rural regions may also have poor living conditions, such as underequipped dormitories (Luo *et al.*, 2009; Pang and Han, 2005; Lu, 2009; Wang and Li, 2009), low nutritional composition of dining hall food (Luo *et al*., 2009) or fewer reading materials (Yang, 2009). Finally, boarding students may lack close adult supervision. For example, high student–teacher ratios may mean that

teachers have insufficient time to address students' problem behaviors (Moswela, 2006; Zai and Xuan, 2011; Yue *et al.*, 2014).

Quantitative evidence on the link between boarding and student performance is mixed. Some studies find better academic performance and reading outcomes at boarding schools compared with non-boarding schools (Adetunji and Oladeji, 2007; Adetunde and Asare, 2009; Fauziyah, 2012). Others find that the nutritional status of boarders is equally as good as that of non-boarders (Intiful *et al*., 2013; Bolajoko *et al.*, 2014).

However, a majority of existing studies find that boarding is associated with worse educational, behavioral and nutritional outcomes in developing countries. Data from Turkey and Africa show lower academic achievement among boarders in grades 5–9 than among non-boarders in the same grades (Ak and Sayil, 2006; Bozdogan *et al.*, 2014). Boarders have also appeared to have more behavioral problems (such as aggressiveness, coercion, use of physical force and alcohol dependency) than non-boarders (Henderson *et al.*, 1998; Ak and Sayil, 2006; Moswela, 2006; Agmon *et al*., 2015). Researchers have also found boarders to have more mental health problems than non-boarders (Murfin and Jamieson, 1977; Ak and Sayil, 2006; Agmon *et al.*, 2015).

In China, the evidence is also mixed. Some studies have found that boarding is linked with higher word recognition and numerical skills (Shu and Tong, 2015) and lower mental health problems (Ma and Jin, 2010). Other studies have found that boarders have a higher probability of being sick (Shu and Tong, 2015) and of exhibiting more aggressive and violent behaviors (Pang and Han, 2005; Zhao, 2011), and have more problems with substance abuse (alcohol and cigarettes) (Zhu *et al.*, 2008).

Unfortunately, nearly all of the papers cited above, both in China and in other developing countries, suffer from two main methodological weaknesses. First, their sample sizes are all quite small, containing generally fewer than 10 boarding schools. Second, most studies only consider a limited number of nutrition or education outcomes among boarding students. As a result, these papers can only provide limited understanding of the overall boarding experiences.

The goal of the present paper is to describe a wide range of health, nutrition, education and behavioral outcomes among both boarding and non-boarding students using a comprehensive and empirically rigorous methodology. In total, we will be measuring 11 outcomes among a population of 37 181 students in rural China. This study represents the biggest and most comprehensive study of boarders of which we are aware to date.

II. Data and Methods

1. Data

The data used for this study are aggregated from seven different school-level surveys that the authors and their collaborators conducted in the rural areas of five provinces in China from 2008 to 2013. Table 1 shows the provinces, years, sample sizes and primary outcomes of the surveys. The total sample includes 37 181 children aged 8 to 15 years. These sample provinces are located in China's western region, which is one of the nation's poorest areas (Gerard, 2006).[1]

Table 1. Description of Surveys and Datasets

(1) Project number	(2) Province	(3) Year	(4) Sample size	(5) Primary outcome variables
1	Shaanxi	2008	4058	BMI, math scores, mental health, hemoglobin
2	Ningxia, Qinghai	2009	7484	Math scores, mental health, hemoglobin
3	Gansu	2010	2650	Math scores, mental health, self-esteem, hemoglobin
4	Ningxia	2011	900	Math scores, mental health, self-esteem, hemoglobin
5	Shaanxi, Ningxia	2011	2976	Math scores, self-esteem, hemoglobin
6	Gansu, Qinghai, Shaanxi	2011	16 938	Math scores, Chinese language scores, hemoglobin
7	Guizhou	2013	2175	WAZ, HAZ, BMI, STH, working memory, processing speed, hemoglobin
Total			37 181	

Source: The authors and collaborators conducted seven different surveys in rural areas of five of China's provinces.

Notes: BMI, body mass index; HAZ, height-for-age Z-score; STH, soil-transmitted helminthes; WAZ, weight-for-age *Z*-scores.

2. Sample Selection

The data from the seven surveys are based on random sampling strategies that were identical across studies. First, we obtained a list of all the counties in each of the five provinces. Second, we randomly selected study counties from those meeting our study criteria. Third, using official records, we created a list of all primary (and/or secondary) schools in the sample counties. Fourth, we used official records and telephone calls to school principals to identify all schools with a set of fixed characteristics (e.g. all schools of a certain size). Fifth, we randomly selected schools and created our sampling frame.

[1]For the interested reader, more information is available through Stanford University's website (http://reap.stanford.edu./docs/628/).

Finally, within each of the randomly selected schools we randomly selected students (or classes of students) for inclusion in the studies. The exact sampling protocols are described in the papers from which the source data come; these papers have been published elsewhere and interested readers are encouraged to refer to those papers for more details (Luo *et al.*, 2010; Lai *et al.*, 2013; Chen *et al.*, 2014; Yue *et al.*, 2014).

3. Data Collection and Outcome Measures

The dataset established from these individual surveys can be considered a mega-dataset with successive waves of observations on students from rural schools. All of the surveys included in this study followed uniform data collection protocol and employed the same set of experienced enumeration team leaders and supervisors. The enumerators were undergraduate and graduate students from local universities who were recruited from academic departments relevant to the survey material. All enumerators underwent comprehensive multi-day training that lasted from 2 to 7 days, depending on the complexity of the survey and testing instruments. All of the survey enumerators were blind to children's boarding status when outcomes were measured.

In total, the dataset includes information on almost 500 schools in 59 counties from the five provinces. During the survey, we collected data on the basic demographic information of students, including whether the student is a boarder. As outcome variables, we collected information on the education, nutrition and health conditions of the students. We have data on weight-for-age Z-scores (WAZ), height-for-age Z-scores (HAZ), body mass index (BMI), anemia prevalence, rates of infection with soil-transmitted helminths (STH), mental health tests and self-esteem. We collected four measures of academic performance: test scores from standardized tests of math and Chinese language, working memory, and cognitive processing speed. The exact variable definitions are shown in Table 2.

Children's height and weight were measured and recorded by trained nurses from local provincial hospitals. The children were measured in light clothing without shoes. Body weight was measured with a calibrated electronic scale and body height was measured using a standard tape measure. Weight-for-age Z-scores (WAZ) were calculated using a SAS program for the 2000 CDC growth chart for children aged 0–20 years (WHO, 2009).[2] Physical indicators of height and weight were used to construct height-for-age Z-scores (HAZ) and body mass index (BMI) using WHO AnthroPlus, a software application of the WHO Reference 2007 for children aged 5–19 years that

[2]See: US Center for Disease Control and Prevention, 2002, A SAS Program for 2000 CDC Growth Charts (0 to <20 years old). For more information, please see http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm.

is used to monitor the growth of school-aged children and adolescents. We followed internationally recognized cutoffs to consider children whose HAZ, BMI or WAZ fall more than two standard deviations below the international mean to be stunted, malnourished or underweight, respectively (WHO, 2006).

Table 2. Variable Definitions

(1) Variable	(2) Descriptions
WAZ	A person's weight in kilograms divided by the age or date of birth and date of interview
HAZ	A person's height in kilograms divided by the age or date of birth and date of interview
BMI	A person's weight in kilograms divided by the square of height in meters
Anemia rate	Hemoglobin concentration <115 g/L, if age >=9 and <=11 (1 = yes, 0 = no); Hemoglobin concentration <120 g/L, if age >=12 and <=14 (1 = yes, 0 = no)
STH infection	Child is infected with any of the three types of STH: Ascaris, hookworm or whipworm (1 = yes, 0 = no)
Standardized math test score	% of questions answered correctly on standardized math test
Standardized Chinese test score	% of questions answered correctly on standardized Chinese test
WMI	Standardized score on the working memory module of the WISC-IV
PSI	Standardized score on the processing speed module of the WISC-IV
MHT	Mental health test
Self-esteem score	Standardized score on Rosenberg Self-esteem Scales I & II (SES)

Source: The authors and collaborators conducted seven different surveys in rural areas of five of China's provinces.

Notes: BMI, body mass index; HAZ, height-for-age Z-score; MHT, mental health test; PSI, processing speed index; STH, soil-transmitted helminthes; WAZ, weight-for-age Z-scores; WISC-IV, Wechsler intelligence scale for children; WMI, working memory index.

Hemoglobin concentrations were measured onsite using a Hemocue Hb 201+ fingerprick system. The WHO recommends an anemia cutoff of 115 g/L for children aged 9 to 11 years and 120 g/L for those aged 12 to 14 years. STH infection was assessed using the Kato–Katz smear test for *Ascaris lumbricodes* (Ascaris), *Trichuris trichuria* (Whipworm), and *Ancylostoma duodenale* or *Necator americanus* (hookworm) (CCDCP, 2008). Stool samples were considered positive for infection if the test on the same day showed signs of infection with one or more types of STH.

Students were also given a standardized math test and a standardized Chinese language test. Our enumeration team carefully proctored the test to minimize cheating, and strictly enforced the time limits. Scores on both standardized tests were normalized (with mean zero and standard deviation equal to one) and used as two of our measures of student academic performance.

We used a psychological test of well-being, the mental health test (MHT), to measure children's mental health. The test is a variation of the children's Manifest Anxiety Scale (CMAS), a scale that has been widely used in the United States and other developed countries for more than a decade as a screening and clinical tool. Professor Zhou Bucheng of East China Normal University (1991) developed the MHT scale used in the present study. Researchers have used this test extensively across China to measure the mental health of grade school students in urban contexts. The purpose of the test is to measure students' anxiety levels. The test is scored out of 90 points, where a lower score corresponds to lower anxiety. The test results can be broken down into eight subcategories, each of which represents a specific aspect of anxiety: learning anxiety, personal anxiety, loneliness anxiety, self-blaming tendency, sensitivity tendency, body anxiety, phobia anxiety and impulsive tendency. A score of >8 on any subpart is considered clinically high and indicates a need for treatment. A total score of 65 or higher indicates high risk for mental health problems and an urgent need for professional intervention. Self-esteem was assessed using the Rosenberg Self-esteem Scales I & II (SES) created by Rosenberg (1965). The SES consists of 10 statements, each of which is scored as a Likert scale.

Two additional cognitive measures were generated using the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV): Working Memory and Processing Speed (Wechsler, 2003). The working memory index (WMI) was assessed through two core subtests: the Digit Span subtest and the Letter Number Sequencing subtest. The processing speed index (PSI) was also assessed through two core subtests: the coding subtest and the symbol search subtest. Raw scores obtained from these subtests were converted to age-scaled index scores using tables of norms from the official WISC-IV administration and scoring manual for China.

4. Statistical Approach

Calculations of WAZ, HAZ, BMI and standardized test scores for working memory, processing speed, self-esteem, mental health, mathematics and Chinese are described as means of the standardized score of each sample. Anemia rates and STH infection rates are presented as percentages. A χ^2-test was used to compare differences in percentage rates between boarders and non-boarders (Table 4).

5. Ethical Approval

All of these individual studies were approved by the relevant Chinese authorities and the Stanford University Institutional Review Board (IRB). The caregivers of all participants provided informed oral consent, and the children themselves provided oral assent prior

to the start of any study activities.

III. Results

Overall, a total of 17 percent of students were boarders; the remaining 83 percent of students were non-boarders. With the exception of Ningxia (where the proportion of boarders is relatively low, at 7 percent), the proportion of boarders is fairly consistent across provinces, at around 25 percent.

Health and nutrition indicators for the full sample are poor (Table 3). The WAZ and HAZ of the sample children are both −1.39, indicating lower than ideal heights and weights for all children. The average BMI is 16.16. Approximately one-fifth of all children are anemic (19.27 percent), and nearly half (41.87 percent) are infected with STH.

Table 3. Description of Sample Children in Rural China[a]

(1) Variable	(2) Sample size	(3) Unit	(4) Mean value
WAZ	2174	Z-score	–1.39
HAZ	2174	Z-score	–1.39
BMI	5800	Kg/cm2	16.16
Anemia rate	25 954	%	19.27
STH infection rate	2175	%	41.84
Working memory	2175	45–150 points	78.59
Processing speed	2175	45–150 points	86.18
MHT	14 635	0–90 points	39.72
Self-esteem[b]	3550	10–40 points	25.17

Source: Authors' data.

Notes: [a]In this table, we do not include standardized test scores of math and Chinese language scales because these scores are only used to compare students' relative performance; [b]Higher scores indicate higher self-esteem. BMI, body mass index; HAZ, height-for-age Z-score; MHT, mental health test; STH, soil-transmitted helminthes; WAZ, weight-for-age Z-scores.

Measures of academic and non-academic outcomes among the full population are also poor. Average scores of working memory and processing speed as measured by the WISC test are 78.59 and 86.18, respectively, well below the internationally scaled mean of 100. The average score on the MHT is 39.72, which is comparable to measures found in previous studies of rural children in China (Ye, 2000; Luo, 2012; Zhang *et al.*, 2013). In addition, the average score on the self-esteem test is 25.17, which is lower than both the global average (30.85 [Schmitt and Allik, 2005]) and the urban Chinese average (31.19 [Liu, 2014]) calculated in previous studies.

In terms of health and nutrition, boarders have poorer outcomes than non-boarders for most of the variables (Table 4, rows 1 to 5). HAZ among boarders is –1.53, compared with –1.34 among non-boarders ($p < 0.01$). WAZ of boarders is also significantly lower among boarders versus non-boarders ($p < 0.02$). Boarders also have significantly higher anemia rates ($p < 0.01$) and significantly higher rates of STH infection ($p < 0.01$) compared with non-boarders. The one exception to this trend is for BMI, where boarders significantly outperform non-boarders (16.22 *vs* 16.13, $p < 0.1$).

Table 4. Comparison of Health, Nutrition and Educational Status of Boarders and Non-boarders in Rural China

(1) Variable	(2) Sample size	(3) Units	(4) Boarders	(5) Non-boarders	(6) *p*-value
Health and nutrition					
WAZ	2174	*Z*-score	–1.48	–1.35	0.02
HAZ	2174	*Z*-score	–1.53	–1.34	0.00
BMI	5800	kg/cm2	16.22	16.13	0.06
Anemia prevalence	25 954	%	24.06	18.34	0.00
STH infection rate	2175	%	47.36	39.89	0.00
Education					
Standardized math test	24 644	SD	0.01	0.02	0.31
Standardized Chinese test	7075	SD	–0.06	0.06	0.02
Working memory	2175	45–150 points	77.31	79.05	0.00
Processing speed	2175	45–150 points	85.25	86.51	0.05
Mental health					
MHT	14 635	0–90 points	40.52	39.42	0.00
Self-esteem	3550	10–40 points	24.99	25.18	0.43

Source: Authors' analyses of seven different surveys that the authors and collaborators conducted in rural areas of five of China's provinces.

Notes: BMI, body mass index; HAZ, height-for-age *Z*-score; MHT, mental health test; SD, standard deviation; STH, soil-transmitted helminthes; WAZ, weight-for-age *Z*-scores.

In regards to educational performance and cognition, boarders underperform relative to non-boarders in terms of all of the outcome variables (Table 4, rows 6 to 9). Non-boarders scored significantly higher than boarders on the standardized Chinese language test ($p < 0.05$). Non-boarders also scored higher than boarders on both the working memory ($p < 0.01$) and processing speed scales ($p < 0.1$). Boarders and non-boarders performed similarly on the standardized math test ($p = 0.31$).

Boarders had slightly poorer mental health outcomes than non-boarders (Table 4, rows 10 and 11). Boarders performed significantly worse than non-boarders on the MHT, both overall and for all MHT subscales (except for impulsive tendency and personal anxiety: Table 5). There was no difference in self-esteem between boarders and non-boarders ($p = 0.43$).

Table 5. Comparison of Categorical Breakdown of the Mental Health Test Score between Boarders and Non-boarders

(1) Subscales of MHT	(2) Mean	(3) Units	(4) Boarders	(5) Non-boarders	(6) *p*-value
Learning anxiety	8.50	0–15 points	8.60	8.47	0.01
Personal anxiety	4.38	0–10 points	4.43	4.37	0.13
Loneliness anxiety	3.13	0–10 points	3.20	3.10	0.01
Self-blaming tendency	5.57	0–10 points	5.74	5.50	0.00
Sensitivity tendency	5.10	0–10 points	5.23	5.05	0.00
Body anxiety	5.56	0–15 points	5.66	5.52	0.01
Phobia anxiety	4.69	0–10 points	4.88	4.62	0.00
Impulsive tendency	2.79	0–10 points	2.79	2.79	0.91
Total	39.72	0–90 points	40.52	39.42	0.00

Source: Authors' analyses of seven different surveys that the authors and collaborators conducted in rural areas of five of China's provinces.

Note: MHT, mental health test.

IV. Discussion

The main aim of this study has been to show the link between boarding status and student education, health and nutrition outcomes in rural China. We find that across all of our outcomes, boarding students perform worse than non-boarding students. Given the large increase in boarding students in rural China over the past several years, these findings raise serious concerns.

This study has a number of strengths. First, our aggregated sample, comprised of seven different datasets, is much larger (>35 000) than that used in any similar study. This gives the research a high degree of statistical power and considerable external validity, at least in relatively poor regions of rural China. Second, all of the observations were collected using a common sampling strategy by a single research team. The data collection instrument was standardized, as was the enumeration process. Because of this, we can compare outcome variables across boarders and non-boarders.

We identify two main limitations to our study. First, given the nature of the sample,

we are unable to extrapolate our findings to boarding schools in non-poor or urban areas. Second, although this paper measures differences in education, health and nutrition between boarders and non-boarders, we are unable to identify an exact causal relationship between boarding status and these outcomes.

Despite these limitations, the present study makes a significant contribution to the domestic and international literature on the status of boarding students. In China, most existing studies were conducted in a single province or sub-provincial region and only focus on a limited number of outcomes. To our knowledge, ours is the first study of Chinese boarding students that examines multiple outcome variables, including health, nutrition and education, for a large sample (covering five provinces).

Our results should not be construed to mean that students ought not attend boarding school. Indeed, the absolute levels of education, health and nutrition among all students are still low. In comparison with international standards, children in rural China (both boarders and non-boarders) are shorter and lighter. Approximately 20 percent of students suffer from anemia and over 40 percent are infected with intestinal worms. Other work has documented the poor levels of educational performance among rural children relative to urban children (Wang *et al.*, 2011). Perhaps a more accurate interpretation of the results of this paper is that all children in rural China are vulnerable. They all require extra care, attention and resources.

From a policy perspective, our results point to serious weaknesses in the existing rural school system. Both boarders and non-boarders perform poorly in terms of all of the indicators considered in this study. A handful of non-government organizations, government departments and research centers have already begun developing initiatives such as training student guidance counselors, building school libraries and training library staff, introducing more nutritional meals, and launching extracurricular computer assisted learning programs (Luo *et al.*, 2009; Mo *et al.*, 2012; Lai *et al.*, 2013; Yue *et al.*, 2014). These programs have completely or partly succeeded in improving education, health and nutrition outcomes among boarders. Based on our findings, we suggest that these special programs be expanded to cover all students in rural China.

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