Poverty, Health and Schooling in China

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Poverty, Health, and Schooling in Rural China

Shengchao Yu and Emily Hannum

As is widely recognized, China’s transition to a market economy since the early 1980s has brought remarkable growth in per capita income and reductions in poverty. Despite these favorable developments, many of China’s youth who live in poor rural areas continue to experience problems associated with poverty; basic health concerns and barriers to education persist. Regarding health, for example, whereas child malnutrition declined in rural areas in the late 1980s and early 1990s, physical stunting remains common in some poor rural areas. Regarding education, although overall levels of access are rising, significant shortcomings exist in poor rural areas. For example, among the 201 million illiterate people in 1997, 90 percent lived in rural areas and 50 percent lived in eight western provinces with a population of only 10 percent of the country’s total. Discontinuation and dropout rates of students in rural areas have been high, and although basic-level enrollments continued to rise through the 1990s, official statistics suggest that the discontinuation rate of middle school students in rural areas has increased slightly.

Further, some of the reforms that have emerged in the health and education sectors in recent years have heightened concerns about access for China’s poorest children. In the health sector, the dismantling of the rural cooperative medical system, together with fiscal decentralization and the privatization of costs, has diminished the role of the state in the provision of health care and increased the reliance on individuals’ out-of-pocket spending. As a result, many poor rural people are increasingly excluded from the pay-for-service medical system. Access to health insurance among children and youth remained extremely limited through the 1990s. At the same time, parallel changes in education—fiscal decentralization and privatization of costs—have mobilized new resources to support schooling, but have increased the financial burden on poor families and families in poor regions.
We focus on three aspects of health: child malnutrition, parental health, and psychosocial health. For each topic, we discuss available evidence regarding links to poverty and educational outcomes. We then discuss additional health issues that may be particularly significant for education but for which empirical data from China are not available, namely, nutritional deficits associated with micronutrient deficiencies and helminthic (parasitic) infections, myopia, and communicable diseases. We close with a discussion of the implications of findings about the relations between poverty, health, and children’s schooling.

**Child Malnutrition**

We begin with a discussion of malnutrition and consider two approaches to research on nutrition: anthropometrics and food security/food environment. For each approach, we discuss the link between poor nutrition and poverty in China. Then, considering evidence from China and, where relevant, from other settings, we discuss the linkage between nutrition and school outcomes.

**Anthropometrics**

Anthropometrics, or height and weight measures, are among the most commonly used measures of long-term malnutrition. In China, anthropometrics show an important association with poverty and levels of economic development. For example, Jamison found that about 35 percent of schoolchildren in rural Gansu, a poor western province, were stunted, whereas less than 1 percent of children in urban Beijing were stunted. Because poorly nourished children are more likely to drop out of school, Jamison also suggests that the differences in stunting that emerge in his sample of enrolled schoolchildren might well underestimate the real disparities in malnutrition among all children, including nonenrolled children.

Jamison’s work used data from 1979, but more recent analysis of the nutritional status of children using 1989 and 1993 data from the China Health and Nutrition Survey (CHNS) paints a consistent picture of nutritional disparities associated with geography and also with household socioeconomic status. For example, among children ages seven to twelve in 1993, children’s height-for-age and weight-for-age varied significantly by household per capita income and by residence location: children living in poorer families (bottom quintiles of per capita income) were generally lighter and shorter than those living in richer families (top quintiles of the per capita income), and children living in urban areas were better nourished than those living in rural areas (Table 3.1). Table 3.1 also suggests that weight-for-age varied...
Table 3.1  
Nutritional Status by Household Income and Residence

<table>
<thead>
<tr>
<th>Percentage of the median value of NCHS standards*</th>
<th>Height-for-age</th>
<th>Weight-for-age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First quintile (lowest)</td>
<td>92.31</td>
<td>82.42</td>
</tr>
<tr>
<td></td>
<td>(5.79)</td>
<td>(15.59)</td>
</tr>
<tr>
<td>Second quintile</td>
<td>92.20</td>
<td>82.70</td>
</tr>
<tr>
<td></td>
<td>(5.04)</td>
<td>(17.47)</td>
</tr>
<tr>
<td>Third quintile</td>
<td>93.91</td>
<td>86.82</td>
</tr>
<tr>
<td></td>
<td>(5.84)</td>
<td>(23.94)</td>
</tr>
<tr>
<td>Fourth quintile</td>
<td>95.46</td>
<td>87.70</td>
</tr>
<tr>
<td></td>
<td>(5.52)</td>
<td>(19.36)</td>
</tr>
<tr>
<td>Fifth quintile (highest)</td>
<td>94.82</td>
<td>90.22</td>
</tr>
<tr>
<td></td>
<td>(3.26)</td>
<td>(19.46)</td>
</tr>
<tr>
<td>F value</td>
<td>34.38</td>
<td>24.70</td>
</tr>
<tr>
<td>Prob &gt; F</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>92.93</td>
<td>83.35</td>
</tr>
<tr>
<td></td>
<td>(6.23)</td>
<td>(17.14)</td>
</tr>
<tr>
<td>Urban</td>
<td>96.24</td>
<td>93.31</td>
</tr>
<tr>
<td></td>
<td>(5.52)</td>
<td>(25.22)</td>
</tr>
<tr>
<td>F value</td>
<td>50.04</td>
<td>55.05</td>
</tr>
<tr>
<td>Prob &gt; F</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Note: Standard deviations shown in parentheses. NCHS = National Center for Health Statistics.
*These values are expressed as a percentage of the median value for a large sample of U.S. children surveyed, to establish standards, by the U.S. NCHS.

with household per capita income more consistently than height-for-age. The rural-urban divide was also particularly wide for weight-for-age, with urban students ages seven to twelve about 10 percent closer to the median value of the U.S. National Center for Health Statistics (NCHS) standard than their rural counterparts.

Other studies have similarly found evidence of dramatic regional variation in nutritional indicators, with physical stunting remaining a significant problem among some poor rural areas. By some estimates, the rate of severe malnutrition of children in poor rural areas is about three times that in urban areas.

In short, malnutrition is clearly linked to poverty in China, as it is in many other places in the world. The next question to consider is whether malnutrition can be linked to educational outcomes. Early, severe, and long-lasting protein-energy malnutrition can lead to substantial impairment of physical growth and possibly irreversible brain damage, and therefore may inhibit intellectual development and contribute to poor school outcomes. Many studies in developing countries have found associations between malnutrition and school outcomes.

In China, Jamison's study, described earlier, was the first to estimate the impact of children's malnutrition on schooling. Using data on 3,000 elementary school children ages seven to fifteen from five different locations, Jamison found that both height-for-age and weight-for-age affected children's grade attainment. In other words, better-nourished children were significantly less far behind in school than children with poorer nutrition (Table 3.2). Jamison's study did not incorporate information about children's home environment, and it should not be generalized without caution due to its limited sample. However, this study offered the first provocative suggestion that child malnutrition in China could be linked to school outcomes.

Jamison's analysis used data from 1979, prior to the dramatic improvements in quality of life seen in the 1980s and 1990s. To test whether his conclusions remained valid in more recent years, we replicated Jamison's
work using the same nutrition and school performance measurements, that is, height-for-age, weight-for-age, and grades behind, but we used more recent and comprehensive data from the 1989 and 1993 CHNS.78 Our models are not directly comparable to Jamison’s, as our sample drew from different provinces and we incorporated more home background factors, such as household per capita income, parental education, and number of siblings. However, inferences regarding the significant negative effects of malnutrition on age-adjusted grade attainment are consistent with those from Jamison’s earlier study: shorter and lighter children were significantly further behind the expected grade.19 Our results also suggest that height-for-age is a stronger predictor of school progress than weight-for-age. This result is consistent with Jamison’s finding and is unsurprising, as height-for-age is generally considered to be a better indicator of long-term nutritional status.20

**Food Security/Home Nutritional Environment**

As we discussed earlier, previous studies of health and schooling often use anthropometry as an indicator of nutritional status. Although useful, this approach is often criticized because of the fact that parents with a propensity to invest in children’s schooling are likely to also have a propensity to invest in children’s health, which causes methodological problems in statistical models of the impact of health on education.21 In addition, anthropometry measures do not capture information on shorter-term nutritional status, such as recent household food environment, which may be as influential as earlier nutritional status in affecting school outcomes. We are not aware of studies in China on this issue, but studies in the United States suggest that household food insecurity may adversely affect children’s attention, interest, and learning, even when it is not linked to physical size measures.22 Consistent with the importance of considering more short-term nutrition measures, studies in developing countries find that children receiving high-energy diets perform better in school through better attendance and concentration on stimuli in the learning environment.23

Using data on 2,000 children and households in rural Gansu, China, we examined the effects of household nutritional environment on children’s school experience.24 We measured family nutritional environment using a scale derived from food frequency questions that indicates a household’s access to a variety of nutritious foods in the previous year (see notes for Table 3.3).25 We first show that socioeconomic status is closely linked to nutritional environment in rural China (Table 3.3). Across the models in Table 3.3, annual household expenditures positively predict family nutritional environment, indicating that poorer children have significantly reduced access to nutritious foods, even net of school and community effects. Consistent with our discussion of anthropometry, these results indicate that poorer children tend to be more vulnerable to risks of poor nutrition.

These risks may have educational implications. In Table 3.4, we show that school performance, measured by mathematics and language (Chinese) scores on end-of-semester examinations, is predicted by household nutritional environment. We regressed end-of-semester test scores on children’s socioeconomic and demographic background characteristics and nutritional environment. First, we note that poor children are disadvantaged at school: Household economic status, measured by household expenditures in the past year, significantly predicts math and language scores, even net of all of the control variables (Table 3.4). Second, poor nutrition shows negative impacts on children’s school performance. In Table 3.4, Model 2 shows that our nutrition measure exerts a statistically significant impact in the most conservative specifications of the language and math models, which control for household expenditures, other factors, and school fixed effects. For example, each 1-point increase along the 8-point nutrition measure scale is associated with a 1.16 point (0.08 standard deviation) increase in math scores (Table 3.4).
Table 3.4

Regression of End-of-Semester Test Scores on Nutritional Environment:
Language and Math

<table>
<thead>
<tr>
<th></th>
<th>Chinese Model 1</th>
<th>Chinese Model 2</th>
<th>Mathematics Model 1</th>
<th>Mathematics Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutritional environment</td>
<td>0.972 (0.33)**</td>
<td>1.159 (0.37)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log expenditures</td>
<td>2.371 (0.61)**</td>
<td>1.781 (0.61)**</td>
<td>2.584 (0.68)**</td>
<td>1.878 (0.71)**</td>
</tr>
<tr>
<td>Mother’s education</td>
<td>0.450 (0.09)**</td>
<td>0.396 (0.09)**</td>
<td>0.444 (0.10)**</td>
<td>0.383 (0.10)**</td>
</tr>
<tr>
<td>Control variables</td>
<td>Child’s age, sex, number of siblings, books at home, parents’ help with homework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>53.182 (6.21)**</td>
<td>55.538 (6.21)**</td>
<td>54.493 (6.89)**</td>
<td>57.336 (6.94)**</td>
</tr>
<tr>
<td>Observations</td>
<td>1,915</td>
<td>1,915</td>
<td>1,921</td>
<td>1,921</td>
</tr>
</tbody>
</table>

Source: Adapted from Tables 4 and 5 in Yu and Hanan (2003). All models are school/village fixed-effects models.

Notes: Standard errors are in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001 (two-tailed test).

Finally, comparing the household expenditures effects in the models with and without the nutrition measure (Model 1 and Model 2) reveals that the addition of nutritional environment reduces the effects of household expenditures in both math and language models. In other words, Tables 3.3 and 3.4 show that poorer households are more likely to have poor nutritional environments, and poor nutritional environment appears to explain part, but of course not all, of the relation between family economic status and school achievement. The Gansu Survey of Children and Families also sheds light on a possible mechanism of impact: nutritional environment may influence children’s school performance through ability to concentrate and energy levels. For example, bivariate results suggest that children living in households with a better nutritional environment report better ability to concentrate and higher energy levels. In turn, children reporting better abilities to concentrate and higher energy levels perform better in school.26

Parental Health

Most studies of health effects on education have focused on children themselves. Another potentially important perspective, and one that to our knowl-

edge is unstudied in China, is the health of children’s parents. The effects of parental health on schooling could be direct or indirect. Parental illness may directly interfere with children’s school performance if a sick parent cannot help with children’s schooling or asks a child to spend additional time on household chores rather than schoolwork.

Indirectly, there are a number of paths by which children’s schooling could be affected. For example, parental illness can cause poverty if parents cannot work on the farm or participate in labor migration, or if their medical bills are high; poverty in turn affects both children’s opportunities to attend school and their performance in school. Poor parental health may also impose negative effects on children’s psychosocial well-being, affecting their ability to focus at school, or may have negative impacts on children’s health.

Unfortunately, although anecdotes of parental ill health leading to children dropping out of school abound, there are no empirical studies of this issue. We provide one piece of illustrative evidence using data on 4,617 children in all sampled households from the 2000 Gansu Survey of Children and Families.27 Tables 3.5 and 3.6 depict the association of parental health, measured by disability, a long-term measure of parental health status, sickness in the past three months, and hospitalization in the past year with family wealth28 (Table 3.5) and children’s school outcomes (Table 3.6), measured by current enrollment status and whether the child is behind the expected grade.

Table 3.5

Percentage of Children with Parental Health Problems by Family Wealth Quintile

<table>
<thead>
<tr>
<th>Family wealth</th>
<th>Disability</th>
<th>Sickness</th>
<th>Hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>First quintile (lowest)</td>
<td>9.66</td>
<td>22.73</td>
<td>7.63</td>
</tr>
<tr>
<td>Second quintile</td>
<td>3.14</td>
<td>14.78</td>
<td>7.79</td>
</tr>
<tr>
<td>Third quintile</td>
<td>4.53</td>
<td>12.22</td>
<td>5.10</td>
</tr>
<tr>
<td>Fourth quintile</td>
<td>2.10</td>
<td>8.44</td>
<td>3.21</td>
</tr>
<tr>
<td>Fifth quintile (highest)</td>
<td>1.64</td>
<td>7.78</td>
<td>4.74</td>
</tr>
</tbody>
</table>


1 Either parent reported disability, including deafness and muteness, blindness, bodily disability, mental illness, or retardation.

2 Either parent reported sickness that prevented him or her from working in the past three months.

3 Either parent reported being hospitalized in the past year.
Grades behind may be caused by late enrollment or grade repetition or both. We include children ages seven to sixteen in this table.

There are several interesting findings in Table 3.6. First, different dimensions of parental health do not all seem to be associated with children’s school outcomes to the same degree. For instance, disability is significantly associated with children’s current enrollment status among all children, but the disparity appears concentrated among those ages thirteen to sixteen, where fees are higher and enrollment rates are lower. Among those ages thirteen to sixteen, the percentage of currently enrolled is only 56 when either parent is disabled, whereas the percentage is 72 among those whose parents are not disabled (the p value, however, is only marginally significant for this subgroup). Neither short-term sickness nor prior year’s hospitalization shows a significant association with current enrollment status. Given that short-term health problems may not bring dramatic stress, either on family finance or labor needs, as much as long-term disabilities might, we think this differential association across different measures of parental health reasonable.

When we consider grades behind, we find a more consistent, significant association with parental health, by all measures. In general, when parents do not report a health problem, about one-third of children are behind the expected grade. When parents do report a problem, about 44 to 48 percent of children are behind their expected grade.

These results must be interpreted with caution, because our sample consists of children in rural households with at least one nine- to twelve-year-old child and because the cross-sectional data preclude a convincing multivariate analysis due to temporal problems. However, Table 3.5 and Table 3.6 do provide suggestive evidence that poor children are more likely to experience parental illness and that parental illness may be an important conditioning factor in children’s school outcomes.

**Psychosocial Problems**

Another dimension of health that is not yet widely investigated in studies of education in China is mental health. A significant number of children and young people in school are experiencing a range of mental health problems, including symptoms of withdrawal, anxiety, depression, hyperactivity, aggression, and delinquency. Studies show that symptoms of psychosocial problems such as anxiety and depression are not uncommon in urban or suburban Chinese children, but studies of psychosocial well-being are few among children in poor rural areas of China.

We conducted a regression analysis of psychosocial welfare indicators on household socioeconomic status using data from rural Gansu. We employed...
scales created to tap into two kinds of psychological problems: internalizing and externalizing problems. Results in Table 3.7 indicate that psychosocial health, like other dimensions of health, is directly linked to economic status: children from wealthier families experience fewer psychosocial health problems. Associations are consistent and significant for both internalizing and externalizing problems, net of the effects of all other relevant factors and school fixed effects.

We then investigated the relation between psychosocial well-being and children's school achievement while controlling for a full range of resources that might affect children's educational achievement (Table 3.8). In this analysis, children's school achievement was measured by standardized mathematics and language (Chinese) tests. Of course, children's prior achievement probably conditions their psychosocial welfare, and these models partially address this problem by controlling for the feedback children have received in the form of end-of-semester test scores. The negative coefficients for psychosocial well-being in Table 3.8 demonstrate that children's psychosocial well-being significantly predicts their school achievement: children with fewer psychosocial problems achieve higher scores in both language and math tests than those with more psychosocial problems. These findings hold in models that consider household socioeconomic status, children's demographic characteristics, family sibling structure, and home learning environment, as well as end-of-semester scores and school fixed effects. In sum, our results suggest that in rural China children from wealthier families suffer from fewer psychosocial problems and that children with fewer psychosocial problems perform better in school.

Additional Health Concerns

The particular health issues that we consider here are illustrative and of course do not represent the full range of potential health-related barriers to schooling for poor children in China. Additional issues, for which we were not able to present empirical evidence, are probably also worthy of consideration, and we outline a few of these here.

One important example is nutritional deficits associated with micronutrient deficiencies and helminthic infections. Although these problems may be correlated with anthropometric measures or food security type measures, it is unlikely that such measures serve as very precise proxies. In China, micronutrient deficiency disorders have been widespread in rural areas, and helminthic infections are a major public health problem. In other countries, micronutrient deficiencies and helminthic infections have been convincingly linked to either poor school performance or to symptoms that plausibly im-

Table 3.7

Regression of Psychosocial Well-Being (Internalizing and Externalizing Problems) on Household Expenditures

<table>
<thead>
<tr>
<th>1A Internalizing</th>
<th>2A Internalizing</th>
<th>1B Internalizing</th>
<th>2B Internalizing</th>
<th>3A Externalizing</th>
<th>2B Externalizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log household expenditures</td>
<td>-0.369***</td>
<td>-0.219***</td>
<td>-0.243***</td>
<td>-0.333***</td>
<td>-0.383***</td>
</tr>
<tr>
<td>Control variables</td>
<td>Mother's education, age, and sex of child, scores on standardized tests, and school achievement</td>
<td>1A + previous test scores on standardized tests</td>
<td>1B + previous test scores on standardized tests</td>
<td>2A + school achievement</td>
<td>3B + school achievement</td>
</tr>
<tr>
<td>Observations</td>
<td>1,954</td>
<td>1,914</td>
<td>1,854</td>
<td>1,834</td>
<td>1,834</td>
</tr>
</tbody>
</table>

Source: Adapted from Table 2 in Zhangtian Hu, Emily Flamm, and Xiaodong Liu. "Poverty, Psychosocial Well-Being and School Performance in Rural China" (work in progress). *p < 0.05, **p < 0.01, ***p < 0.001. **p < 0.001. (two-tailed tests).
work and opportunities to learn in the classroom, especially given the poor lighting conditions prevalent in many rural homes and schools, we believe that vision problems are a significant topic for further research on educational inequalities in China.

Finally, a third health issue worthy of scrutiny is communicable diseases. Analyses of recent Global Burden of Disease Project data show that communicable diseases are the world’s biggest killers of children and among the top causes of death of adults in the developing world. About half of all deaths in children under age five are due to five preventable and treatable communicable diseases such as pneumonia, diarrhea, measles, malaria, and HIV/AIDS. Although China has an impressive track record of fighting many communicable diseases, there are some old and emerging diseases that are important to consider, including tuberculosis (TB), HIV and hepatitis B (HBV).

Each of these illnesses is linked to poverty. The TB problem is most severe in rural populations in the most disadvantaged counties and among migrant workers in areas of high economic activity. In poor rural areas of China, the rate of TB is nearly three times higher than in economically developed urban areas. A major mechanism of HIV spread in China has been blood-selling by impoverished peasants; poverty and the dislocation of poor rural migrants have also contributed to the rising sex industry and to the spread of disease.

Regarding HBV, there is a high prevalence of the infection, despite its being vaccine-preventable: 10 to 14 percent of the total population are HBV carriers. An official survey in 1999 revealed an average coverage rate of three doses of HBV vaccination of 70.7 percent, and this rate was higher in urban areas than in rural areas. One study found that about 2,000 persons surveyed in 1992 in Guangxi Province, one of the poorest provinces in China, only 5.6 percent reported receiving HBV vaccination. Poverty and poor health services also contribute directly to HBV infections because of unsafe medical injections, which are primarily experienced by the poor.

It is reasonably evident that micronutrient deficiencies, helminthic infections, myopia, and communicable diseases pose particular problems for China’s rural poor. What is not empirically established is whether the presence of these problems detracts from school achievement. However, given the nature of these health problems, it is probably safe to speculate that they, like the health problems discussed earlier for which more direct evidence is available, exacerbate the educational barriers faced by poor rural children.

Discussion and Conclusions

In this chapter, we have considered evidence about linkages between health, poverty, and schooling in China, focusing on examples of malnutrition, pa-
rental health, and psychosocial health. While each of these dimensions of health is unique, the story that emerges is consistent: Across these dimensions of health, we find evidence, sometimes suggestive and sometimes strong, that the poor tend to face heightened risks of ill health and that ill health predicts school outcomes for children.

The coincidence of ill health and poverty and the apparent consequences of ill health for education have significant implications. First, and most generally, health may be an important unobserved determinant of educational acquisition in China. Second, ill health may be a significant mechanism—largely ignored in empirical research—by which poverty operates on educational outcomes and subsequent life outcomes. Our findings suggest a vicious intergenerational cycle for poor families experiencing ill health. Children’s schooling is compromised as a result of poverty and ill health of the child or family, and the lack of schooling serves as a barrier to children’s own subsequent ability to avoid poverty and ill health.

More constructively, these findings point to the need for policies or interventions designed to promote children’s schooling among the poor to more fully consider how to address potential barriers associated with ill health. This conclusion, of course, pertains particularly to China, but it can be placed in a broader context. In recent years, health has increasingly been recognized as a key component of human capital. Improving public health is now a leading strategy undertaken by development agencies to lift populations out of poverty. Yet, a recent review of global research on public health and education comes to the conclusion that the correlation between education and health outcomes is widely observed, but an understanding of these relations does not appear to influence public policy in a meaningful way. In China, at least, this state of affairs is a significant problem. Health issues appear worthy of additional attention for members of the policy community interested in promoting education for underserved populations.

Notes


9. Jamison’s data were from 1979, which predicted the large-scale emergence of the floating population. Thus, we do not believe that these figures refer to the children of the floating population in 1986.

10. The data used in Tables 3.1 and 3.2 come from the China Health and Nutrition Survey (CHNS). This survey covers eight provinces, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong, which vary substantially in geography, economic development, public resources, and health indicators. The analysis included children who were aged seven to twelve in 1993 and who had ever enrolled in primary school, with a maximum sample size of 1,206 for analyses. We show grades behind measured in 1993 and nutritional status and other characteristics of children and their household measured in 1989. Measures included in the tables are described below:

School Performance. In the CHNS household survey, the years of formal education and age were collected for each member in the selected households. Like in Jamison’s 1986 study, grades behind is simply the grade a child should be in, given age, minus actual grade. The criterion used to measure grades behind in school is based on the national standard of seven years old for entering Grade 1.

Nutritional Status. Children received detailed physical examinations in the CHNS survey that included weight and height. Height is measured as centimeters in the survey and in this analysis we construct height-for-age using height, age, and sex for the purpose of standardization. Height-for-age is expressed as percentage of the median value for a large sample of U.S. children of the same age and sex surveyed by the U.S. National Center for Health Statistics (NCHS), referred to as the NCHS standard. Similarly, weight-for-age is constructed in the same way as another indicator of children’s nutritional status.
Other Variables. We use per capita income as an indicator of family wealth. Income was constructed by summing all sources, including wages, home gardening, farming, raising livestock, fishing, small business, and so on. As a measure of parental human capital, we use mother’s and father’s years of schooling. As demographic controls, we use measures of gender, age, and siblings in the age range of seven to twelve. Urban-rural and regional differences in living standards and public resources in China are significant and increasing with rapid economic development; we also include in our analyses measures of urban-rural residence and province of residence.

11. These measures are defined as percentage of the median value for a sample of U.S. children surveyed by NCHS standards. For example, height-for-age/weight-for-age 100 means that the nutritional status is equivalent to the NCHS standards. The smaller the value, the worse the nutritional status compared to the NCHS standards.

12. See Note 8.


16. See, for example, Ernesto Pollitt, Malnutrition and Infection in the Classroom (Paris: UNESCO, 1990). Other examples include the following: In the Philippines, Florescio concluded that the academic performance of pupils with good nutritional status was significantly better than that of pupils with poor nutritional status, although the relation varied by grade level and subject matter. See Cecelia Florescio, “Child, School, Home: Determinants of Academic Performance,” except from Education, vol. 1, no. 2 (1982), A Quarterly Monograph Series of the University of the Philippines Education Research Program (ERP). See also Harold Alderman, Jere R. Behrman, Victor Levy, and Rekha Menon, “Child Health and School Enrollment—A Longitudinal Analysis,” Journal of Human Resources, vol. 36, no. 1 (1997), pp. 185–205. Alderman and his colleagues suggested that child’s health and nutrition were three times more important for enrollment than suggested by the assumption that children’s health and nutrition are predetermined or exogenous. In rural northeast Brazil, a study showed that students’ nutritional status affected school performance; a recent study on a large sample of Filipino children also suggested a causal link between nutrition and academic success; see Olwewe, Jacoby, and King, “Early Childhood Nutrition and Academic Achievement.”

17. See note 10 for more information on the analysis using CHNS data.

18. Our approach links the 1989 and 1993 CHNS data, using 1989 data on predictors and 1993 data on outcomes. One rationale for linking the two years’ data is that household per capita income in 1993 may influence household decisions on both nutrition and schooling. However, this simultaneous decision is very unlikely to have been made in 1989, when most of the children in our analysis had not yet entered school. In addition, this strategy reduces the problems of interpretation associated with the fact that children who were behind in 1993, in many cases, started to fall behind earlier than 1993.

19. See, for example, Dean T. Jamison, “Child Malnutrition and School Performance in China,” Journal of Development Economics, vol. 20 (1986), pp. 299–309. To maintain a parallel analysis to Jamison, our outcome variables are calculated for children currently in school. Enrollment rates are 91 percent among the seven- to twelve-year-olds in the sample, so we believe that the selection problem is small. However, if those who were not in school were due to health problems, our results could underestimate the effects of malnutrition on schooling.

20. Height is generally preferred because weight is more subject to short-term fluctuations, while height is a relatively stable indicator. See, for example, Yu and Hannum, “Child Malnutrition and School Performance in Rural China.” Interestingly, Yu and Hannum find more consistent variations of weight-for-age with socioeconomic status than height-for-age using CHNS data (Table 3.1); weight-for-age does not show stronger impacts on school outcomes. This inconsistency may suggest that nutritional status is not simply a proxy for poverty’s influence on school performance, and nutritional status itself may exert impacts on school outcomes net of poverty level. It is important to acknowledge genetic differences in stature, independent of nutritional status. We are not able to incorporate controls for these differences.

21. The common problem is endogeneity, caused by households’ simultaneous decision making on nutrition and schooling.


23. Pollitt, Malnutrition and Infection in the Classroom. Levinger, Nutrition, Health and Education for All. In one study in the Philippines, Florescio concluded that attendance in school, ability to concentrate in class, and/or study habits at home were not independent of participation in supplementary feeding, breakfast skipping, feeling of hunger in school, and/or health and nutritional status. See Florescio, “Child, School, Home!”


25. In this sample in Gansu, 98 percent of respondents are Han Chinese, and thus these particular results are unlikely to be confounded by religious practices. Food questions are asked about the previous year, in hopes of avoiding issues of seasonal-
ity. In Gansu, it is possible that there may be regional differences in availability of particular types of foods, which could be substituted by other types. However, within the broad categories of our scale, we believe that regional disparities would represent real regional contributions to differential nutritional status of children.

26. Yu and Hamann, “Food for Thought.”

27. This sample includes all children in the 2000 households of nine- to twelve-year-old children that were sampled for the survey.

28. Family wealth is constructed from detailed measures of household assets, including the value of housing, fixed capital, and household durable goods. It is the sum of the current value of all household durable goods (furniture, appliances, machines, and tools, etc.) and the current value of housing.

29. Specifically, there is a lack of appropriate lag time between illness measures and current enrollment, and there is a temporal ordering problem with parental illness measures and the grades below data, because, in many cases, children became behind due to having started late or repeated early school grades.

30. See Shengchao Yu, Emily Hamann, and Xiaodong Liu, “Poverty, Psychosocial Well-Being, and School Performance in Rural China,” work in progress. In this study, the indicators for the internalizing and externalizing problems are summative scales from thirty-six items, eighteen items each for each, reported by children. Internalizing problems cover numerous questions that address symptoms of unhappiness, feelings of being unloved, mood swings, feelings of worthlessness, and feelings of being withdrawn (exact wording for questions is available at www.ssc.upenn.edu/china). Externalizing problems assess children’s acting out, truancy, fighting, and delinquency.


33. Xiaodong Liu, “Parenting Practices.”

34. The tests were designed by experts at the Gansu Educational Commission to cover the range of official primary school curriculum.


36. Iron-deficiency anemia, iodine, and vitamin A deficiency are among the most concerning micronutrient deficiency disorders in the developing world. Iron deficiency can lead to anemia, and anemia reduces energy necessary for playing and learning in children and leads to poor motor skills and delayed speech and reading. School-age children who are iron deficient exhibit reduced levels of alertness, attention, and concentration in class and display less aptitude. These traits hinder the development of children’s ability to learn and cause poor school performance. See, for example, Levinger, Nutrition, Health and Education for All, also see J. Larry Brown and Ernesto Pollitt, “Malnutrition, Poverty and Intellectual Development,” Scientific American (February 1996), pp. 38–43. Although the mechanisms that iron-deficiency anemia affects behavioral dysfunction are not understood, previous studies demonstrate that iron-deficiency anemia directly impede educational efficiency. See, for example, Pollitt, Malnutrition and Infection in the Classroom.

Similarly, iodine deficiency can cause mental and physical handicaps, such as reduced intelligence, psychomotor retardation, mental and neurological damage, and cretinism. The consequences of iodine-deficiency disorder were found to be significant in terms of school outcomes. In 1990, Pollitt reviewed studies dealing with the consequences of iodine deficiency and noted that children who suffer from iodine deficiency disorder may have impaired visual-perception organization, visual-motor coordination, speed of information-processing, and hearing. Poor perception, motor skills, hearing, and so on constitute major obstacles to satisfactory school achievement. Vitamin A deficiency causes blindness and also leads to night blindness and limited peripheral vision. Because of its close association with an impaired immune system and therefore reduced resistance to acute respiratory infection, diarrhea, and measles, direct examinations on vitamin A deficiency alone and school outcomes are few, although poor vision itself is obviously a barrier for students who cannot see well in the classroom. Helminthic infection, or parasitic worm infection, is another type of childhood health issue that has significant impact on school outcomes. Some studies found evidence of this relation. For instance, see Edward Miguel and Michael Kremer, “Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities,” Econometrica, vol. 72, no. 1 (2004), pp. 159–217. In this recent study in Kenya, Miguel and Kremer found that deworming drugs increased school attendance and was by far the most cost-effective method of improving school attendance among a series of educational interventions implemented in the larger study. Another study in the American South showed increased school enrollment and school attendance with hookworm infection treatment. However, whether helminthic infections directly cause cognitive deficits is a matter of debate. See Hoyt Bleckley, “Disease and Development: Evidence from Hookworm Eradication in the American South” (Population Research Center, NORC, and the University of Chicago, 2002).


38. Shi et al., “People’s Republic of China.”


43. Such a low rate of HBV vaccination results from the fact that there is no universal HBV vaccination program and the fact that parents have to use personal resources to pay for their children’s vaccination. See Zhou Jiating, Guoyu Tao, Shaohui 11. Elbricht, Shusheng Wang, Zhongbin Luo, and Haiqiao Wang, “The Relationship of Hepatitis B Virus Infection Between Adults and Their Children in Guangxi Province, China,” Journal of Hepatology, vol. 33 (2000), pp. 628–631. High costs of service are still among the challenges facing poor rural children today, although the Ministry of
Public Health of China planned to incorporate HBV vaccination into the nationwide Expanded Program of Immunization starting January 1, 2002. See Z. Sun, L. Ming, X. Zhu, and J. Lu, “Prevention and Control of Hepatitis B in China,” *Journal of Medical Virology*, vol. 67, no. 3 (2002), pp. 447–450. Even when the immunization program claims to be free, parents often have to pay all kinds of added costs such as administration fees and payment for needles and syringes, which poor people cannot afford.


45. Sun et al., “Prevention and Control of Hepatitis B in China.”


47. In China, the common means of HBV transmission is dirty needles, because a large percentage of health facilities reuse needles and syringes without sterilization only to cut costs. See Hitoshi Murakami, Makoto Kobayashi, Xu Zhu, Yixing Li, Susumu Wakai, and Yasuo Chiba, “Risk of Transmission of Hepatitis B Virus Through Childhood Immunization in Northwestern China,” *Social Science and Medicine*, vol. 57 (2003), pp. 1821–1832. In their model-based estimate, they suggest that at least 135–3,120 among 100,000 fully immunized children are infected with HBV due to unsafe immunization injections. This study reveals that immunization injections pose a significant public health risk for the transmission of HBV in northwestern China. Even when the health facilities are willing to switch to use auto-disable syringes, they may face the challenges of insufficient supply of equipment and training, as well as the resistance to behavior change of vaccinators.


49. Ruth Levine, “Better Health Through More Education: Getting to Win-Win Policy,” American Academy of Arts and Sciences Working Paper, April 4, 2004. One exception to this statement is a nutritional intervention project in Gansu sponsored by the British Department for International Development. We thank the editor of this volume for alerting us to this project.