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Parental training, anemia and the impact on the nutrition of female students in China's poor rural elementary schools

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Abstract

Purpose – The purpose of this paper is to report the results of a randomized controlled trial designed to measure the impact of a parental training program on the nutritional status of primary school students in rural Shaanxi Province, in northwest China.

Design/methodology/approach – Using hemoglobin (Hb) levels as the outcome variable, the authors first measure the overall impact of a nutritional training program, then measure the impact separately by gender. Both descriptive and multivariate analyses are used.

Findings – The results for the descriptive and econometric results were robust and consistent with the literature. Overall, we find no impact on students' Hb levels when we trained their parents about undernutrition and anemia. In both the descriptive and multivariate results, there was no difference in the change of Hb levels between control and treatment students. Parents in the treatment group did learn more about anemia than parents in the control group, but this increased knowledge did not lead to sharp changes in behavior, in general. The authors did find, however, that there was a measurable impact of parental training on the Hb levels of female students. In both the descriptive and econometric results the authors found that the Hb levels of female students rose more than those of male students, and that this difference was statistically significant.

Originality/value – The paper reports the results of a randomized controlled trial that examined the effect of parental training on students in poor, rural schools in ten counties of Shaanxi province. Taken by itself, one of the policy implications of this study is that malnutrition is still a serious problem in China and it is worse among female students than male students. When parental training is given, the health status of girls improves but the health status of boys is unchanged. Parental training may not be the best way to fight anemia, but it can help narrow the nutrition gap between girls and boys.

Keywords China, Primary schools, Children (age groups), Parents, Nutrition training, Anemia, Gender

Paper type Research paper

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Despite growing wealth and a strengthening commitment from the government to provide quality education, a significant share of students across rural China still have inadequate access to micronutrient-rich diets (Luo *et al.*, 2010, 2011a). Poor diets can lead to nutritional problems, such as iron-deficiency anemia, that can adversely affect attention and learning in school (Grantham-McGregor and Ani, 2001; Iannotti *et al.*, 2006; Walter *et al.*, 1989). Luo *et al.* (2012) report on research in one of China's poorest rural areas, and find that hemoglobin (Hb) levels and standardized test scores rose significantly relative to a control group when students were given a daily multivitamin with mineral supplements.

Given that such a simple, relatively inexpensive intervention (vitamins cost about 0.2 yuan per day; and children in poor schools are already given a subsidy of between 2 and 3 yuan per day (China Radio International Online, 2011)) had such a large impact, it would seem that this "low hanging fruit" would be quickly adopted by governments throughout China. Unfortunately, it did not spread rapidly. Somewhat surprisingly, local and regional education and finance officials in several Northwest provinces have been reluctant to invest government funds into nutrition as a way of raising educational performance. Instead, they wash their hands of responsibility by pointing out that the government's position is that child nutrition is ultimately the duty of the parents.

However, officials do admit that parents in poor rural areas may not be aware of symptomless diseases like anemia. They lent their full support to this research: a joint study to examine the effect of providing health training to the parents of children in rural elementary schools as a way to combat anemia and raise educational performance.

In fact, the literature offers some evidence to support the positions of China's local officials, but, the nature of the literature is such that caution needs to be exercised before it can be concluded the health education campaigns will work. The logic begins with the observed fact that more educated and better trained parents raise healthier and better-nourished children (Cochrane *et al.*, 1982; Luo *et al.*, 2011b; Desai and Alva, 1998). But many of the studies that claim to offer evidence of the importance of health education either fail to include a control group (Onyango-Ouma *et al.*, 2005; Badruddin *et al.*, 2008) or lump health education together with free or subsidized health services (Huttly *et al.*, 1990; Quick *et al.*, 2002). Because of this weakness in the literature, it has been impossible to measure the actual improvements in health behavior and health outcomes directly attributable to health education.

The purpose of this paper is to examine the effect of a parental training program on the nutritional status of fourth-grade students in Shaanxi Province, in China's Northwest region. To meet this overall goal we have three specific objectives. First, we seek to use in-the-field blood tests to measure anemia prevalence in a school-aged population of more than 1,200 students in 45 schools in a set of ten randomly selected counties (a set that includes both poor and middle-income counties). Next, we seek to measure the impact of an intervention that provided training to parents of more than 400 students in 15 of the schools by comparing the changes in the Hb levels of students in the 15 treated schools against the Hb levels of students in 30 control schools (which received no intervention). Finally, we examine the impact separately on boys and girls, since in previous studies (Luo *et al.*, 2010) it was noted that the anemia rate of female students was higher than that of male students.

Methods

In this paper we report on the results of an analysis of data from a cluster randomized controlled trial that included 1,169 students (those students for which we have both baseline and endline data). We use Hb levels as our primary outcome variable.

The students in the study were selected from ten counties in Shaanxi Province, a province in China's poor northwest region. To choose the ten sample counties we first obtained a list of all counties in the province that were mostly rural (had a majority of the population in rural areas). From this list, we randomly selected ten to form our sample.

Based on estimates from pilot studies, we used Optimal Design software to calculate that we require 15 schools per experimental group to detect a standardized effect size for the outcome variables of 0.2 standard deviations with 80 percent power at the 5 percent significance level (two-tail test). We assumed an intra-cluster correlation of 0.15, a pre and post-intervention correlation of 0.6, and a 10 percent loss to follow-up.

To choose the sample schools, we conducted a canvass survey by visiting each sample county's bureau of education. In each bureau we obtained a list of all elementary schools that had at least 200 students. We also required that of the 200 or more students, at least 50 of them lived as boarders in the dormitory and ate most of their meals (five days out of seven) at school. We decided to use these criteria since in the coming years it will be these types of schools that are most common in rural China (Liu *et al.*, 2010). A total of 80 schools fit these criteria. From this list, we randomly chose 45 schools. At the time of the baseline, there were 1,629 grade four students in the sample schools. However, power calculations indicated that we did not need such a large sample. Therefore, we randomly chose 75 percent of the students to be in the study. This ultimately resulted in an overall sample size at baseline of 1,237 students. The sample is representative of students in larger elementary schools with boarding facilities in Shaanxi Province's counties, an area that contains about 40-50 million people (CNBS, 2010). These areas are not too different from the rest of China's northwest and southwest counties. Data on the sampling process and final sample size can be found in Table I.

A baseline survey was conducted to measure Hb levels and collect information on students' diets as well as basic demographic information (described below under "Data Collection"). Following the baseline survey, our research team randomly assigned schools to one of two experimental arms (described in more detail under "Experiment Arms/Interventions"): 15 schools to an intervention group that received parental training; and 30 schools to a control group that received no treatment[1]. Figure 1 shows the flow of participants through each state of the study, as well as the project timeline.

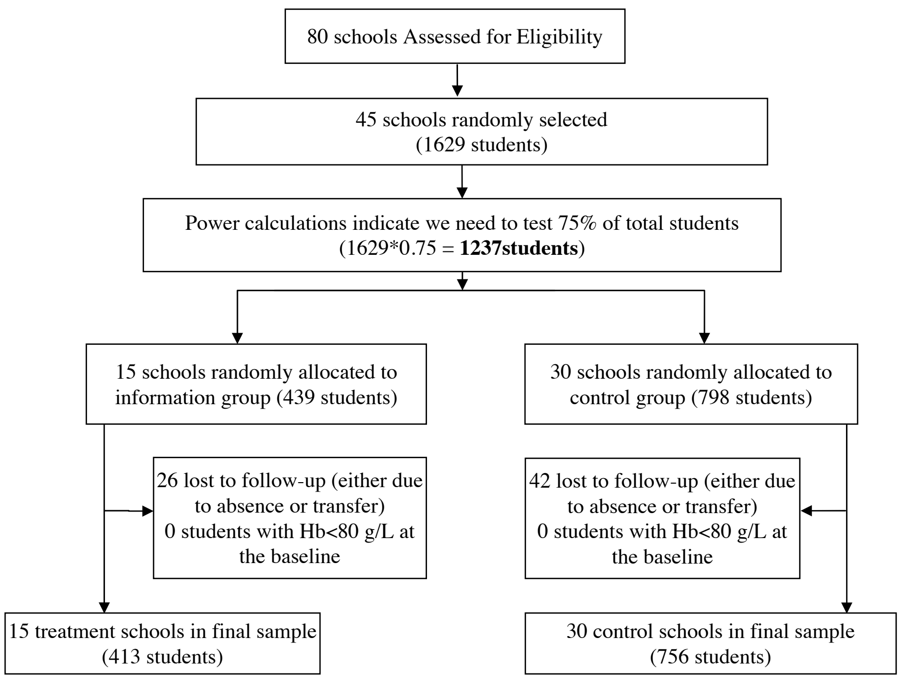
Although the main sample at baseline included a total of 45 schools and 1,237 students, there was some attrition by the end of the study. For various reasons (school transfers, extended absences, etc.), by the time of the endline survey we were only able to follow up with 1,169 students in the 45 sample schools: 756 in the control group and 413 in the treatment group. The attrition rate is not correlated with school dropouts and is balanced across experimental arms.

Table II shows that study schools were balanced across the key dependent variable (hemoglobin or Hb levels – row 1) and anemia prevalence (row 2). Rows 3-6 show that there were no statistically significant differences between the levels of any of the control variables: boarding status, age, gender, mother's education, and mother's presence (whether the mother lives at home or outside of the village as a migrant).

Table I.
Distribution of sample schools and students

	Number of schools (1)	Number of students in sample schools (2)	Number of students with Hb tests (3)	Percentage of students (4)
Full sample	45	1,629	1,169	100
By county				
County 1	4	120	118	7.36
County 2	4	141	120	8.65
County 3	7	290	187	17.80
County 4	6	179	154	10.99
County 5	5	184	137	11.30
County 6	5	271	119	16.63
County 7	3	99	77	6.08
County 8	4	146	111	8.97
County 9	3	80	57	4.91
County 10	4	119	89	7.31
By treatment				
Information	15	528	413	35.33
Control	30	1,101	756	64.67
By gender				
Female	NA	788	572	48.93
Male	NA	841	597	51.07

Source: Authors' survey



Source: Authors' survey

Figure 1.
Flow of participants through each state of the study

	All students	Information group	Control group	Difference between information and control groups
1. Hb level (g/L)	127.24	127.20	127.26	−0.06 (−0.05)
2. Percentage of students that were anemic (%)	25.75	26.49	25.33	1.16 (0.29)
3. Percentage of boarding students (%)	45.25	49.64	42.80	6.84 (0.99)
4. Student's age (in months)	121.67	122.07	121.44	0.63 (0.50)
5. Percentage of female students (%)	48.93	47.26	49.87	−2.61 (−1.02)
6. Education of mother (years)	6.34	6.19	6.42	−0.23 (−0.71)
7. Percentage of students with mother stay at home (%)	79.98	81.86	78.93	2.93 (0.89)

Note: *, ** and *** indicate significantly different from 0 at the 10, 5 and 1 percent levels, respectively, *t*-values in parentheses
Source: Authors' survey

Table II.
Distribution of sample students across treatments at time of baseline survey in November 2009

In other words, at the time of the baseline survey, students in the treatment group were statistically identical to students in the control group in terms of the dependent variable and a set of control variables.

All study participants and enumerators were blind to which schools belonged to which arms of the study. Ethical approval for the study was granted by Stanford University's Institutional Review Board (IRB Protocol #15962).

Experiment arms/interventions

Our study design included two groups: a parental training treatment group, and a control group with no intervention. Students in both groups were given a daily hard-boiled egg as part of a province-wide school nutrition program.

In the parental training schools, the principal sent home an announcement with the students, stating that at least one individual from each family was required to attend a special parents' meeting at school. The message made clear that the meeting was important and that it was mandatory to come.

During the meeting, which typically lasted 1 h, carefully trained trainers from Xi'an Jiaotong School of Medicine's nutrition department presented the material to the parents. The parents sat in a classroom, small auditorium, or central courtyard. After the presentation, parents were allowed to ask questions. The trainers only answered questions about material that was explicitly covered in the training session. If a question was asked that was not covered in the training material, the trainer said that he/she would take it back to his/her advisor and try to get an answer back to the parents. All of these types of questions were collected, and a master sheet of additional questions and simple answers was generated and sent home with the children about three weeks after the meeting.

During the training session a simple, straightforward message was communicated to the parents using a carefully created protocol that was written and edited by nutritionists at the Xi'an Jiantong University School of Nutrition. The training protocol included three parts: a power point presentation, a video, and a small colorful booklet for each parent to take home. In each of the three parts the same message was given to the parents:

- a basic description of anemia;
- a warning that areas like theirs typically have high anemia prevalence;
- a detailed discussion of how anemia can affect health, behavior, IQ and educational performance;
- a list of symptoms associated with anemia, or rather, lack of symptoms; and
- an explanation of how to treat anemia, focusing on the importance of feeding children a balanced diet that includes foods with high iron contents.

Many concrete examples were given.

In essence, each person that attended the parent training session heard the training message at least three times. This message was first given to the audience by the trainer in the form of a power point presentation. A video was then shown. The trainers then went over the material in the booklet. The booklets were passed out and questions were fielded.

During each visit to the treatment schools, the research teams also visited the control schools, checking in on the principal and observing classroom activities of fourth grade homeroom teachers. This was to ensure that any impact found in the treatment schools would be due to the parental training intervention and not to a Hawthorne Effect.

Data collection

Hb levels were measured at baseline and again at the end of the school year. Two trained nurses from Xi'an Jiaotong University's School of Medicine assessed Hb levels tests onsite using the HemoCue Hb 201 + system. These portable instruments are known to provide rapid, in-the-field measurements of Hb levels with high degrees of accuracy. The WHO recommends a cutoff of 115 g/L for children aged 5-11 and a cutoff of 120 g/L for children aged 12-14 (World Health Organization, 2001). Given that a large proportion of our sample falls in this age range and that Hb levels borderline for anemia have also been shown to affect cognitive functioning (Halterman *et al.*, 2001), we use the 120 g/L cutoff for our analysis of anemia. Thus, any student with Hb levels at or below 120 g/L was classified as anemic (or iron deficient) for our analysis.

Data on basic demographic information about the students (including gender, family structure and boarding status) were also collected from the students via a survey instrument that was filled out by the students themselves. Enumerators from the research team supervised the collection of the data in the classroom. School data, as reported by the principal and the fourth-grade homeroom teachers, were also collected by enumerators.

Statistical analysis

We rely on descriptive statistics and regression analysis (ordinary least squares (OLS) – using a difference-in-difference approach) to estimate how Hb levels changed in the parental training treatment schools relative to control schools. In both the descriptive and regression analysis, we control for the clustering of the error terms for observations from the same schools.

The most basic OLS model we use is:

$$\mathrm{Y_{ijk}} = \mathrm{a0} + \mathrm{a1}^{*}\mathrm{Training\ \ Intervention_{jk}} + \mathrm{e_{ijk}} \tag{1}$$

where Y_{ijk} is the difference (between baseline and endline) in the Hb level for student i in school j in county k. The independent variable, *Training Intervention*$_{jk}$, is a dummy variable that is equal to one if the student is in a school in which parents received training, and zero otherwise. The base group in the regression is the group of students in the control schools. Note that the parameter $a1$ estimated from equation (1) will be exactly the same as the observed gap between the treatment and control groups in the descriptive statistics.

The model to carry out the regression analysis using OLS with county dummy variables (μ_k) is:

$$\mathrm{Y_{ijk}} = \mathrm{a0} + \mathrm{a1}^{*}\mathrm{Training\ \ Intervention_{jk}} + \mu_{\mathrm{k}} + \mathrm{e_{ijk}} \tag{2}$$

In essence, after adding county dummies, the coefficient $a1$ becomes the average within-county effect of the treatment.

Adding control variables

To improve estimation efficiency and control for any observable differences that existed between the control and treatment schools during the baseline, we run a series of multivariate (adjusted) models in order to estimate the net effect of the treatments on the outcome variable, Hb level. In the analysis we use six models (in order of increasing comprehensiveness). We successively add gender (female – 1; male – 0); the interaction between gender and *Training Intervention*; boarding status (boarding school student – 1; living at home – 0); student age (in months); mother's level of education (in years of educational attainment); and the presence of the mother (if mother lived at home – 1; if not – 0). The model that includes all six controls (gender; gender × Training Intervention; boarding status; student age; mother's education and presence of mother), is referred to as the *full model*. The inclusion of the interaction term between gender and the *Training Intervention* variable allows us to examine the heterogeneous effects. The general model can be written as:

$$\begin{aligned}\mathrm{Y_{ijk}} = {} & \mathrm{a0} + \mathrm{a1}^{*}\mathrm{Training\ \ Intervention_{jk}} + \mathrm{a2}^{*}\mathrm{Z_{jk}} \\ & + \mathrm{a3}^{*}\mathrm{Training\ \ Intervention}^{*}_{\mathrm{jk}}\mathrm{Z_{jk}} + \mu_{\mathrm{k}} + \mathrm{e_{ijk}}\end{aligned} \tag{3}$$

where Z_{jk} is some combination of the control variables defined in this paragraph and *Training Intervention*$_{jk}$ * Z_{jk} is a variable that will allow us to look at heterogeneous effects. In the analysis that follows (next section), we interact training with gender and define $a3$ as impact of treatment on female students, relative to that of male students.

Results

Baseline counts

Although incomes across China have risen, we find that anemia is still widespread (based on our baseline testing of the students in October 2008). Across all of the schools surveyed (combining all ten counties), we found the average Hb level was 127.24 g/L (Table II, row 1, column 1). Hb levels in our sample were normally distributed with a standard deviation of 11.0 g/L. Using the anemia cutoff of 120 g/L we estimate that across all schools and counties, 301 of the 1,169 students that we surveyed were anemic, resulting in a prevalence rate of 25.75 percent (Table II, row 2, column 1).

When looking at the differences in Hb levels across different types of students, we find that there are differences when examining male and female students (Table III). When examining all students at baseline (before any intervention occurred), the Hb levels of male students was 128.03 (row 1, column 1). The Hb level of female students was 126.41 (row 1, column 2). Statistical tests (row 1, column 3) demonstrate that the difference (1.62 Hb points) is statistically significant at the 1 percent level. Clearly, female students are starting at a lower Hb level than their male counterparts.

The differences in Hb levels between male and female students may be related to differences in the levels of food (Table IV). According to our baseline data, female students eat less fish, meat, eggs, and bean products than male students (row 1). For example, the share of male students who report eating meat everyday (3.85 percent) was higher than the share of female students who do the same (2.80 percent). Differences in the intake of foods that can ameliorate anemia existed in both the Training Treatment Schools and the Control Schools at baseline (rows 2 and 3).

	Male students (1)	Female students (2)	Difference between male and female students (3)
		Hb level (g/L)	
1. Full sample	128.03	126.41	1.62 (2.82)***
By treatment			
2. Information	127.95	126.36	1.60 (1.51)
3. Control	128.08	126.44	1.64 (2.41)**
		Anemia rate (%)	
4. Full sample	23.45	28.15	− 4.69 (1.99)*
By treatment			
5. Information	25.34	27.78	− 2.44 (0.58)
6. Control	22.34	28.34	− 6.00 (2.08)**

Notes: *, ** and *** indicate significantly different from 0 at the 10, 5 and 1 percent levels, respectively; Anemia is defined as having a Hb level under 120 g/L
Source: Authors' survey

Table III.
Hb levels (g/L) and anemia rates across treatment groups at time of baseline survey in November 2009, by gender

	Fish or meat			Egg			Tofu or bean product		
	Male	Female	Difference between male and female students	Male	Female	Difference between male and female students	Male	Female	Difference between male and female students
	Percentage of sample students who report eating the food every day								
1. Full sample	3.85	2.8	1.05	36.01	31.74	4.27	6.53	6.29	0.24
By treatment									
2.Information	3.62	3.03	0.59	40.27	34.34	5.93	7.69	7.07	0.62
3. Control	3.99	2.67	1.32	33.51	29.95	3.56	5.85	5.88	− 0.03

Source: Authors' survey

Table IV.
Self-reported food consumption at time of baseline survey in November 2009, by gender

Effect of training intervention: descriptive statistics

By comparing baseline Hb levels with those taken during the endline survey (a full six months after the baseline survey and after the parental training), it can be seen that Hb levels rose for the full sample. The average Hb level at endline was 130.03 (Table V, row 1, column 1), 2.80 Hb points higher than at baseline (Table V, row 1, column 4).

Interestingly, the overall rise in Hb levels is almost the same as (in fact, slightly less than) the rise in Hb levels in the control group. In the control group, the Hb level at endline, 130.26 (Table V, row 3, column 1), is 3.00 Hb points higher (column 4) than the Hb level at baseline, 127.26 (Table II, row 1, column 3). There are several reasons why average Hb levels in the control group may have risen. It could be due to seasonality (for some reason, diets may improve in the spring, the time of the evaluation survey, versus the fall, the time of the baseline survey). It could also be that diets are gradually improving over time, as China's economy is growing and rural incomes are rising (CNBS, 2010). Whatever the cause, the rise in Hb levels among students in the control schools underlines the importance of having a control group: in order to be able to more precisely evaluate the effect of the treatment on the students in the Parental Training Schools.

When comparing differences over time between students in the treatment school with differences over time between students in the control schools (this can be called difference in differences, or DD, analysis), we find little evidence of the effect of parental training. In fact, the rise in Hb levels in the treatment schools was 2.44 Hb points. The rise in the control schools was actually higher, 3.00 Hb points. Since these two point estimates were statistically indistinguishable, we conclude that, according to our descriptive statistics, there is no effect of parental training on the nutritional outcomes of students in the sample schools.

While these results seem to suggest that parental training was not very useful in improving student nutrition, when comparing the results of the DD analysis for male and female students separately, there appears to be a somewhat different outcome. In fact, the rise in Hb levels of female students in the treatment schools between the baseline and evaluation surveys (3.42) was more than twice the rise of male students (1.56 – Table V, row 2, columns 5 and 6). The difference in the rise (1.86 = 3.42-1.56) was also higher than the difference between male and female students in the control group (0.60 = 3.30-2.70), and this difference is significant. In other words, while there is little evidence of an impact on male students, there is an impact on female students.

Effect of training intervention: multivariate results

The results of the multivariate analysis giving the estimation coefficients for equations (1)-(3) are largely consistent with the descriptive statistics in terms of the overall impact and the impact on the female students (Table VI). According to our analysis (and consistent with the findings in Table II), there is no impact of the parental training treatment on students' overall Hb levels. In the estimation of equation (1), the coefficient on the information treatment, −0.56 (row 1, column 1) is exactly the same as that in the descriptive statistics (Table V, row 2, column 7). In short, according to the simple OLS model, there is no statistically significant effect of parental training on the Hb levels of the students in the sample.

The results of the estimation of equation (2) are consistent with those of the estimation of equation (1). After adding a set of county dummies, although the point

Table V.
Difference in Hb levels, by gender and treatment group

	Endline survey (June 2010)			Difference between endline and baseline surveys			Difference in difference between information and control group and between endline and baseline surveys		
	All students (1)	Male students (2)	Female students (3)	All students (4)	Male students (5)	Female students (6)	All students (7)	Male students (8)	Female students (9)
Hb level (g/L)									
1. Full sample	130.03	130.31	129.75	2.80	2.28	3.34	NA	NA	NA
By treatment									
2. Information	129.64	129.51	129.78	2.44	1.56	3.42	−0.56	−1.14	0.12
3. Control	130.26	130.78	129.74	3.00	2.70	3.30	NA	NA	NA

Source: Authors' survey

Table VI. Effect of training intervention on change in Hb levels between baseline and endline

Independent variables	Dependent variable: change in Hb level before and after intervention (1)	(2)	(3)	(4)	(5)
Treatment variables					
1. Training (1 = student in training school; 0 – not)	−0.56 (−0.29)	1.87 (1.08)	1.88 (1.08)	0.95 (0.5)	0.83 (0.43)
Student characteristics and interaction terms					
2. Gender (1 = female; 0 = male)			0.76 (1.27)	0.03 (0.05)	0.09 (0.12)
3. Training * Gender				2.02 (1.83)*	1.99 (1.75)*
4. Boarding student (1 = boarding student; 0 – non-boarding student)					1.11 (1.56)
5. Student's age (in months)					0.02 (0.84)
Parent characteristics					
6. Education of mother (years)					−0.08 (−0.63)
7. Mother lives at home (1 = yes; 0 = no)					0.32 (0.42)
8. *County dummies*	No	Yes	Yes	Yes	Yes
9. Constant	3.00	1.05	0.67	1.04	−1.74
	(2.32)**	(0.69)	(0.44)	(0.65)	(−0.44)
10. Observations	1,169	1,169	1,169	1,169	1,169
	0.00	0.154	0.155	0.156	0.16

Notes: *, ** and *** indicate significantly different from 0 at the 10, 5 and 1 percent levels, respectively; clustered standard deviations are used
Source: Authors' survey

estimate of the coefficient ($a1$ in equation (1)) is positive, the t-ratio associated with the coefficient is low (Table VI, row 1, column 2). The interpretation of these results is that whether we look at the average of the within-county effect of the treatment (from column 2) or at the overall effect of the treatment (from column 1), parental training does not appear to be leading to significant nutritional/health improvements. Such a finding is consistent with a large number of studies (Jacob and Lefgren, 2004; Guang-Han *et al.*, 2005). Educational training is not always effective in changing behavior – even when the message is clear and even when there are clear benefits to changing behavior.

Consistent with the descriptive statistics, when we add a gender variable control and an interaction term between gender and the treatment variable ($Training\ Intervention_{jk}\ ^{*}\ Z_{jk}$), we see that there is an effect of parental training on female students (Table VI, row 3, column 4). According to our findings, the Hb levels of female students are 2.02 points higher than that of male students, and this is statistically significant. When running the same regression with anemia rates (not shown for brevity), we can see that anemia rates of female students fall by nearly 15 percent. Although parental training did not help all students in general, it did appear to have helped female students. This result holds up (+1.99, statistically significant at the 10 percent level) when we add other covariates (row 3, column 5).

Mechanism of the impact

So what is the mechanism at work? Two tables in the Appendix (Tables A1 and AII) may tell part of the story. Table AI shows that compared to the control group, parents in the treatment group did learn more about anemia relative to those in the control group (row 3). In both the baseline and treatment groups, parents were asked about their knowledge of anemia (column 1), including questions on the causes of anemia, the kinds of food that will help reduce it (columns 2 and 3) and anemia's effect on grades and educational performance (columns 4 and 5). In all cases, the point estimates of the share of parents that answered correctly rose more in the treatment group than in the control group. Parents were apparently learning.

So why was there only an effect of the treatment on female students? The answer may be that parents only take action when they learned that their behavior may have been hurting their children. If their child, in their opinion, was not in danger of being anemic, then they did not take action by improving their child's nutrition. Since as shown in Table IV, the initial Hb levels of male students were higher than those of female students, it may have been that the parents of male students did not believe their son needed additional nutrients. In contrast, the lower initial Hb levels of female students may have induced parents to take action. And, Table AII shows exactly that. In the case of meat, eggs and bean products, while the parents of all students increased their daily provision, the parents of female students increased the provision of all three of these foods even more than the parents of male students.

Summary and conclusions

In this paper we report the results of a randomized controlled trial that examined the effect of parental training on students in poor, rural schools in ten counties of Shaanxi Province. In the experiment, after measuring baseline consumption and Hb levels of students in 45 schools, we then randomly assigned a subset of 15 schools to receive a parental training intervention, in which the parents of fourth graders received training on the nature of anemia, its cure, and the consequences of not curing it. The other subset of parents (in the remianing 30 schools) received no training, acting as a control group. The outcome variable (difference in Hb levels between the baseline and endline surveys) was analyzed using both descriptive statistics and multivariate analysis. Heterogeneous analysis was carried out for male and female students (since the initial Hb levels of female students were lower than those of male students).

The results for the descriptive and econometric results were robust and consistent with the literature. In general, we did not find an impact on students when we trained their parents. In the descriptive results and all of the models, there was no difference in the change of Hb levels between control and treatment students. Parents in the treatment group did learn more about anemia than parents in the control group; however this did not change their behavior.

We did find, however, that there was an impact of the training on female students. In both the descriptive and econometric results we found that the Hb level of female students rose more (and significantly so) than that of male students (which was unchanged between the baseline and endline surveys). Our data show that the parents of female students may have recognized from the training that they were not providing their daughters with a healthy enough diet and responded by increasing the daily provision of meat, fish, eggs and beans.

Taken by itself, one of the policy implications of this study is that malnutrition is still a serious problem in China. It is worse among female students than male students. When parental training is given, the health status of girls improves but the health status of boys is unchanged. Parental training may not be the best way to fight anemia, but it can help narrow the nutrition gap between girls and boys.

Overall, however, the results of other studies Van Thuy *et al.* (2003) and Luo *et al.* (2012) suggest that there may be better ways to address anemia. When students were given a daily multivitamin with iron as part of a large-scale randomized controlled trial in rural China, anemia prevalence dropped significantly, among both boys and girls. The impacts were larger. The impacts were broader. Although parental training is slightly cheaper than vitamin supplementation, it is largely ineffective. The cost of passing out vitamins is only a fraction of the daily subsidies already given to students in poor rural schools; therefore, we view it as an affordable option. In light of the results reported here on the limited effectiveness of parental training programs, we suggest that parental training be used only as an add-on to programs that directly address malnutrition.

Note

1. The control group is larger than the treatment group because in the larger experiment there was a third set of schools in a second treatment arm. These schools are not included in this study as we did not collect food consumption data from these students. Statistical power considerations required that the number of schools in the control group be larger than the total number of schools in the treatment arms.

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(The Appendix follows overleaf.)

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Appendix

Classification	Fish or meat Eat everyday	Fish or meat Eat once every 2-3 days	Egg Eat everyday	Egg Eat once every 2-3 days	Tofu or bean product Eat everyday	Tofu or bean product Eat once every 2-3 days
Full sample						
Control group: change in percent response between endline (June 2010) and baseline (November 2009)	−0.91	−1.72	20.89	−7.81	−1.28	−1.91
Training group: change in percent response between endline (June 2010) and baseline (November 2009)	3.22	−0.19	33.9	−7	−0.76	2.84
Difference between changes in control and training group (%)	4.13	1.53	13.01	0.81	0.52	4.75
Female students						
Control group: change in percent response between endline (June 2010) and baseline (November 2009)	−1.33	−1.60	20.32	−9.1	−2.67	−6.69
Training group: change in percent response between endline (June 2010) and baseline (November 2009)	3.54	−1.51	42.43	−13.13	−0.50	3.03
Difference between changes in control and training group (%)	4.87	0.09	22.11	−4.03	2.17	9.72

Source: Authors' survey

Table AI.
Effect of training on change in self-reported food consumption

Table AII.
Effect of training on change in parental nutrition knowledge

Classification	What are the causes of iron deficiency anemia in children?	Which kind of foods are rich in Heme iron and the most easily absorbed	What foods can assist in non-Heme iron absorption	Does anemia affect student achievement?	Primarily through which pathway does eliminating anemia affect student achievement?
Full samples					
Control group: change in percent response between endline (June 2010) and baseline (November 2009)	0.1	−9.09	23.89	−0.52	−2.39
Training group: change in percent response between endline (June 2010) and baseline (November 2009)	5.2	3.45	24.4	1.54	3.5
Difference between changes in control and training group (%)	5.1	12.54	0.51	2.06	5.89
Female students					
Control group: change in percent response between endline (June 2010) and baseline (November 2009)	4.58	−13.41	24.03	−3.38	−2.08
Training group: change in percent response between endline (June 2010) and baseline (November 2009)	5.13	4.34	32.23	11.11	3.15
Difference between changes in control and training group (%)	0.55	17.75	8.2	14.49	5.23

Source: Authors' survey