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The Limits of Health and Nutrition Education: Evidence from Three Randomized-Controlled Trials in Rural China

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Abstract

This article studies whether or not health education programs targeting childhood anemia are sufficient for changing health behavior and nutrition in rural China. We conducted three different randomized-controlled trials of single and multiple face-to-face education sessions with parents and distributed written health education materials—and compare our results with a simple vitamin distribution program. Across all three studies, we find little evidence of changes in blood hemoglobin concentration or anemia status. In contrast, in our two studies that also examined a multivitamin supplementation intervention, we find meaningful reductions in anemia. (JEL codes: I12, I15, O15)

Keywords: health education, anemia, rural China, primary school students

1 Introduction

Inexpensive, highly efficacious health technologies and services exist for many leading developing country diseases. However, dissemination efforts are often weak and adoption rates in many parts of the world remain low. Prominent examples include point-of-use water disinfectants, insecticide-treated bed nets, oral rehydration therapy, dietary supplements, condoms, improved cookstoves, and basic primary health care services. Why have efforts to disseminate these technologies and services not produced greater population health gains? Given efforts by donors and international organizations in recent years, the answer cannot simply be that they are unavailable or unaffordable.

Lack of information (or knowledge) about diseases and the technologies that address them is often cited as a primary culprit (Cochrane et al. 1982; Luo et al. 2011). With this rationale, institutions at all levels—ranging from grassroots organizations to national and international agencies—have embarked on health education campaigns to promote the adoption of efficacious health technologies and practices. While some degree of health knowledge may be necessary for changing health practices, the underlying question is whether or not simply providing information is sufficient.

Despite the popularity of health education initiatives, a review of the academic literature yields a surprising dearth of rigorous evidence on their effectiveness (Dupas 2011; Miller and Hudson 2011). Only a small number of studies convincingly isolate the impact of health information alone on health behaviors. A large share of studies that aim to provide evidence on the effectiveness of health education fail to include a control group (Onyango-Ouma et al. 2005; Badruddin et al. 2008). Others bundle health education together with free or subsidized health inputs (Huttly et al. 1990; Quick et al. 2002; Luby et al. 2004; Rhee et al. 2005). Among the studies not subject to these limitations, the evidence is decidedly mixed. While some find that health education can lead to increased adoption of targeted health behaviors (Erulkar et al. 2004; Hu et al. 2005; Jalan and Somanathan 2008), others find no significant differences between health education and control groups (Kamali et al. 2003; Kremer and Miguel 2007). Moreover, changes may be more likely to occur on intensive rather than extensive margins (i.e., changing intensity of an activity rather than whether or not it is practiced at all—Dupas 2011) or to occur primarily when the utility cost of behavior change is very low (Madajewicz et al. 2007). Even when behavior change is documented, the ultimate impact on health can be questionable (Davis et al. 2011).

In this article we present new evidence on the impact of health and nutrition information on anemia rates from three large-scale randomized-controlled trials (RCTs) in rural China. Despite China's rapid economic development, prevalence rates of anemia among children in rural areas range from 20% to 60%—implying more than ten million affected children (Chen et al. 2005; Wang 2005; Wang 2007). In addition to causing debilitating fatigue and retarding growth, childhood anemia may also impair cognitive development and inhibit human capital accumulation—lowering socioeconomic status throughout the life course (Halterman et al. 2001; Stoltzfus 2001; Yip 2001; Bobonis et al. 2006). The high prevalence of childhood anemia in China and many other developing countries is remarkable given that it can (in principle) be confronted through simple, low-cost nutrition interventions.

Each of our three projects studies a different type of health education campaign designed in partnership with the Chinese government to reduce the prevalence of iron-deficiency anemia among rural primary school students. These campaigns include single and multiple face-to-face education sessions for parents at their children's schools as well as dissemination of written health education materials. Each campaign described the physical and cognitive consequences of anemia—and then outlined how anemia could be prevented at home through a balanced diet that includes iron-rich foods such as lean meats and beans, or through commercially available iron supplements.

We also emphasize that although it may be possible to infer the cause of some illnesses through a (noisy) learning process over time, learning absent health education is much less likely for anemia (given the lack of specificity of its symptoms, the difficulty of observing dietary iron content, and the lagged relationship between dietary change and discernable symptoms). Moreover, unlike many other beneficial health behaviors, the utility costs of changing anemia-related behavior are relatively low (iron-rich foods are often considered good tasting; supplements and vitamins are generally flavorless; increasing iron consumption requires little time; etc.). We therefore consider our projects to be unusually good opportunities for detecting any impact of health information on behavior or health outcomes.

2 Methods

We conducted three distinct RCTs studying three separate health education and nutrition information campaigns in rural areas of northwest China. All three campaigns targeted the parents of elementary school students in areas with high childhood anemia rates.[1] Because we employed similar techniques for sampling, data collection and empirical analysis across experiments, we provide a common description of our approach below. (Table 1 summarizes the details of each experiment.) We provide separate descriptions of the unique features of each experiment's intervention arms.

2.1 Sampling

We employed a random sampling strategy in each study. First, we obtained a list of all counties in our study regions (Shaanxi Province or Ningxia Autonomous Region). Second, we randomly selected study counties from those meeting the official criteria for impoverished counties.[2] Third, using official records, we created a list of all primary schools in sample counties. Fourth, we used official records and conducted our own

[1] Anemia in the survey regions is due almost exclusively to iron deficiency and not to intestinal worms. Large-scale national surveys consistently indicate hookworm prevalence of below 1% in the study regions (Xu et al. 1995).

[2] In China a *poor county* is a designation given by the National Statistics Bureau according to its internal poverty criteria.

Table 1 Overview of experiments 1–3

Location	Experiment 1 Shaanxi	Experiment 2 Shaanxi	Experiment 3 Ningxia
Sampling numbers			
Number of counties	8	10	3
Number of towns	58	56	36
Number of schools	66	60	50
Number of students at baseline	3821	1654	1016
Number of students at endline			
Total	3661	1579	929
Control	1607	766	506
Information	641	423	423
Supplementation	1413	390	–
Loss to attrition, *n* (%)	160 (5)	95 (6)	87 (9)
Details of intervention			
Date of baseline	October 2008	November 2009	November 2010
Date of endline	June 2009	June 2010	June 2011
Information intervention	Letter home to parents	One face-to-face training session with parents at the school	Two face-to-face training sessions with parents at the school
Supplementation intervention	Daily multivitamin supplementation	Daily multivitamin supplementation	None.

canvass survey to identify all schools with the following characteristics: (i) six grades (i.e., 'complete' primary schools, or *wanxiao*), (ii) boarding facilities, and (iii) 400 or more students.[3] Fifth, we randomly selected primary schools from these sampling frames. Finally, we randomly selected fourth grade students in sample schools for inclusion in the studies.

Figure 1 shows a map of the study areas. Table 1 provides more detail about each experiment's sample.

[3] These criteria were used because China's government is currently consolidating existing rural schools into new ones with these characteristics.

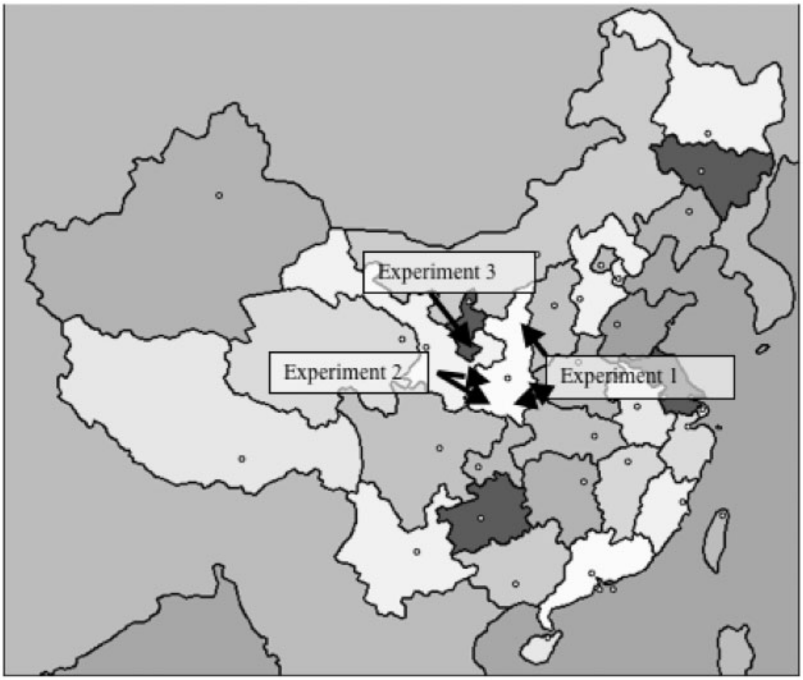

Figure 1 Map of survey areas in Shaanxi Province and Ningxia Autonomous Region.

2.2 Interventions

Each experiment included a pure control group (that is, there was no intervention) as well as the following intervention arms:[4]

Experiment 1: After testing students for anemia (described below under *Data*), we sent a letter to parents explaining what anemia is, describing different strategies to address it, and revealing their child's anemia status. Parents were told that they should pay special attention to their child's diet, and provide balanced meals containing both iron-rich foods, such as

[4] In designing and implementing each project, we paid close attention to the ethical concerns that arise when testing children for medical conditions. All three projects obtained ethical approval from the Stanford University Institutional Review Board (IRB). In accordance with IRB requirements, the children involved in the study provided oral assent for the project, while the school principals—who are the children's legal guardians while the children are in school—provided their consent. Students with severe anemia, defined by hemoglobin levels lower than 7.0 g/dl, were immediately sent to receive treatment at the local health center. All other students found to be anemic received treatment in the classroom at the time of the follow-up survey.

lean meats and bean products, as well as foods rich in vitamin C, such as fruits and vegetables. Parents were informed that commercially-available iron supplements could also address anemia and that they could consult a clinician for more information. In a second intervention arm, we supplied homeroom teachers with multivitamin supplements containing iron and instructions to give each student one vitamin per day. This second arm provides a comparison with one of the approaches to reducing anemia that the central government has approved and promoted.

Experiment 2: After testing students for anemia, we summoned parents to their children's schools for official parent meetings. At the meetings, a trained health professional spoke to parents about what anemia is, what its cognitive and physiological consequences are, and what strategies can be used to address it. The strategies listed included: (i) Eating a balanced diet containing both iron-rich foods, such as lean meats and bean products, as well as foods rich in vitamin C, such as fruits and vegetables; (ii) Taking a daily multivitamin supplement with iron; and (iii) Using iron-fortified flour or soy sauce during meal preparation. We also gave pamphlets about anemia to parents and posters about anemia to teachers (to hang in classrooms). In a second intervention arm, we also implemented the same supplementation intervention as in Experiment 1.

Experiment 3: After testing students for anemia, we summoned parents to their children's schools for two separate official parental meetings—one in the fall semester and another in the spring semester. At both meetings, a trained health professional presented the same information to parents as in Experiment 2. There were no other experimental arms. (i.e., there was no multivitamin supplementation intervention as in Experiments 1 and 2).

Each experiment's intervention arms are summarized in Table 1.

2.3 Data

In collaboration with nursing teams and enumerators from Xi'an Jiaotong Medical School, we collected socioeconomic information about students and their households from half of all fourth grade students in the study schools. Age information was taken from birth records in each student's matriculation folder. Students also took a form home to their parents to complete and return to the school. Enumerators collected information about principal, fourth grade homeroom teacher and schools from the principals and fourth grade homeroom teachers.

Two trained nurses also measured hemoglobin concentrations among the same half of fourth-grade students using blood samples collected through fingerpricks. Hemoglobin levels were measured onsite using a HemoCue Hb 201+ diagnostic machine. We randomly retested 10% of all sampled students as well; if the second measure differed from the original one by more than 0.3 g/dl among three or more students, we re-tested all sample students in that school. Because students in our sample were aged 8–11 years, we adopt the WHO- recommended anemia threshold of 11.5 g/dl and below for children aged 5–11 years.

Table 2 presents descriptive statistics for students in sample schools in each experiment. It also shows that balance on observable characteristics at baseline was largely achieved, with some exceptions in Experiment 2.[5]

3 Results

For each of the three experiments, Figures 2–4 show the distribution of student hemoglobin concentration by trial arm separately at baseline and follow-up. In Figure 2 there is little evidence of a discernable shift in these distributions between baseline and follow-up waves in either the control or the information arm. In Figures 3 and 4, there are more pronounced shifts to the right between waves. However, these shifts appear to be approximately the same in the control and information arms, implying little impact of information.[6] Figures 2 and 3 also show larger shifts to the right in the multivitamin supplement arms than in the control or information arms, suggesting that the supplementation strategy may have been more effective.

For each experiment, Tables 3–5 then show unadjusted and adjusted OLS regression estimates for changes in hemoglobin concentration (between baseline and follow-up) in the first three columns. The first row of each table shows estimates for the information arm relative to the control. The first column shows unconditional estimates, and the second and third columns show estimates conditional on region dummies (column 2) and on region dummies as well as individual and household controls (column 3). In all three tables, the hemoglobin estimates for the information arm are indistinguishable from the control group.[7] In contrast, multivitamin

[5] We cannot reject balance on all observable characteristics shown when applying a Bonferroni correction for multiple comparisons; 56 tests of significance implies a significance threshold of approximately 0.0018 to recover an underlying significance level of $\alpha = 0.10$).

[6] Shifts between baseline (near the beginning of the school year) and follow-up (near the end of the school year) would be consistent with commonly observed seasonal effects related to harvest cycles and extraordinary meat consumption during Spring festival.

[7] The exception may be columns 2 and 3 of Table 3. The information arm estimate appears to change with the inclusion of region dummies, and although not statistically distinguishable from zero at conventional significance levels, these estimates fall just shy of conventional thresholds. This sensitivity to the inclusion of region dummies may be related to some suggestion in Table 1 that balance in observable characteristics at baseline was not fully achieved.

Table 2 Descriptive statistics and balance

Variables	All students	Control group	Information group	Supplement group	Difference: info -contrl	Difference: suppl-contrl	Difference: suppl. - info
Experiment 1							
Hemoglobin (g/dl)	12.26	12.36	12.26	12.17	−0.092 (0.18)	−0.191 (0.16)	−0.098 (0.16)
Anemia prevalence (%)	22.3	21.3	19.7	24.6	−1.63 (4.73)	3.35 (4.63)	4.97 (4.82)
Boarding students (%)	37.2	35.1	39.9	38	4.82 (9.36)	2.85 (6.82)	−1.97 (9.68)
Age (months)	122	122.4	121.4	121.9	−1.03 (0.90)	−0.49 (1.16)	0.54 (1.03)
Female (%)	44.2	45.9	42.9	43.4	−2.95 (3.05)	−2.44 (2.17)	0.51 (2.97)
Mother's edu (years)	7.83	7.76	7.95	7.86	0.19 (0.21)	0.1 (0.16)	−0.09 (0.22)
Mother stays at home (%)	78.7	79.1	77.7	78.8	−1.37 (2.58)	−0.31 (2.13)	1.06 (2.53)
Mother self-empl/wage-earning	12.1	12.4	12.3	11.7	−0.06 (2.39)	−0.64 (2.11)	−0.58 (2.37)
Experiment 2							
Hemoglobin (g/dl)	12.69	12.73	12.72	12.59	−0.01 (0.13)	−0.14 (0.13)	−0.13 (0.16)
Anemia prevalence (%)	13.9	13.6	13	15.6	−0.57 (3.08)	2.06 (2.99)	2.63 (3.75)
Boarding students (%)	40.3	43.8	47.1	29.2	3.37 (6.84)	−14.59 (5.96)*	−17.96 (6.53)**
Age (months)	121.2	121.9	122.3	119.1	0.40 (1.29)	−2.80 (1.04)**	−3.20 (1.24)*
Female (%)	47.5	48.6	46.8	46.3	−1.86 (2.23)	−2.29 (2.41)	0.43 (2.18)
Mother's edu (years)	6.5	6.3	6.3	7	0.04 (0.30)	0.64 (0.40)	0.68 (0.39)
Mother stays at home (%)	77.3	77.1	80.7	74.7	3.58 (3.13)	−2.42 (3.50)	−6.00 (3.73)
Mother self-empl/wage-earning	8.5	7.7	6.3	11.5	−1.41 (1.54)	3.84 (2.00)	5.25 (2.15)*
Experiment 3							
Hemoglobin (g/dl)	13.24	13.23	13.26	–	0.024 (1.56)	–	–
Anemia prevalence (%)	6.5	5.3	7.8	–	2.47 (1.96)	–	–
Boarding students (%)	7.3	5.7	9	–	3.27 (3.01)	–	–
Age (months)	131.7	132.9	130.4	–	−2.56 (2.36)	–	–
Female (%)	47.1	48.8	45.2	–	−3.61 (3.65)	–	–
Mother's edu (years)	3.4	3	3.8	–	0.86 (0.49)	–	–
Mother stays at home (%)	90.7	90.9	90.4	–	−0.57 (1.76)	–	–
Mother self-employed/wage-earning	14.2	15.2	13.2	–	−1.98 (2.82)	–	–

Notes: Standard errors in parentheses clustered at the school level. *$p < 0.05$, **$p < 0.01$. We cannot reject balance on all observable characteristics shown when applying a Bonferroni correction for multiple comparisons; 56 tests of significance implies a significance threshold of approximately 0.0018 to recover an underlying significance level of $\alpha = 0.10$).

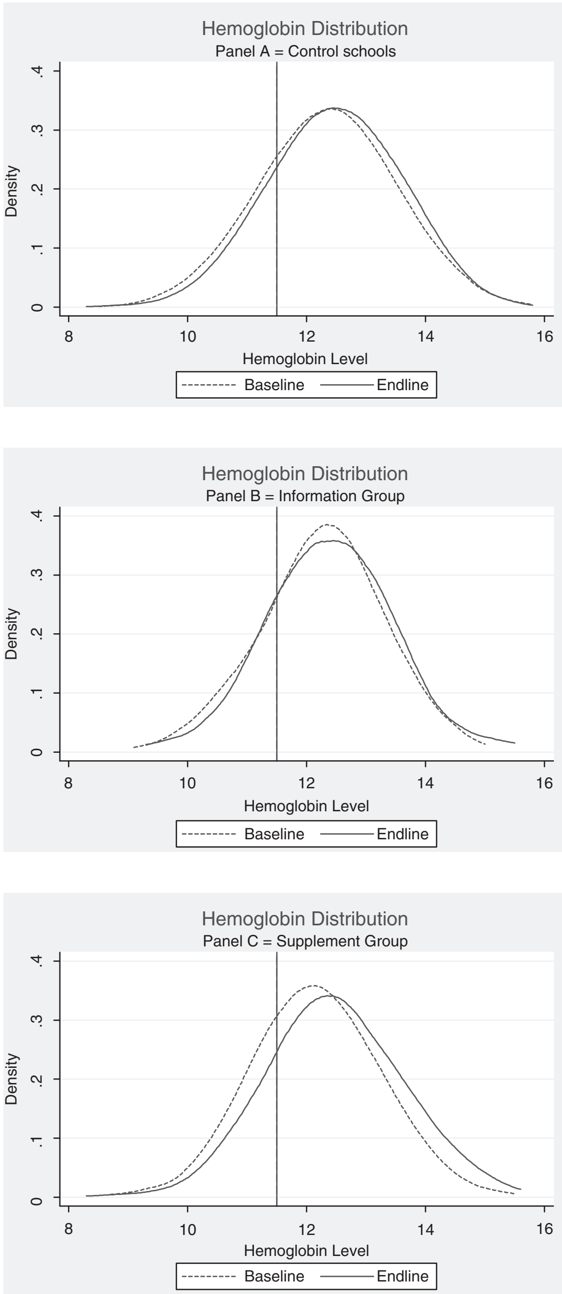

Figure 2 Student hemoglobin distribution at baseline and follow-up in Shaanxi, October 2008 and June 2009 (Experiment 1). *Source*: Experiment 1 (see Section 2).

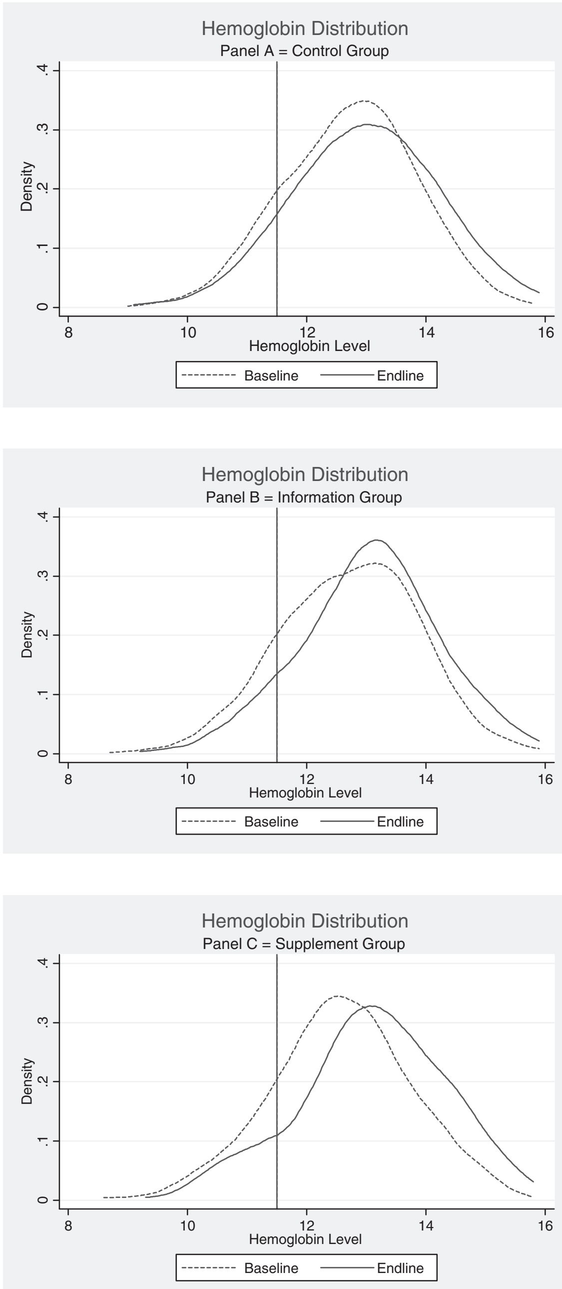

Figure 3 Student hemoglobin distribution at baseline and follow-up in Shaanxi, November 2009 and June 2010 (Experiment 2). *Source*: Experiment 2 (see Section 2).

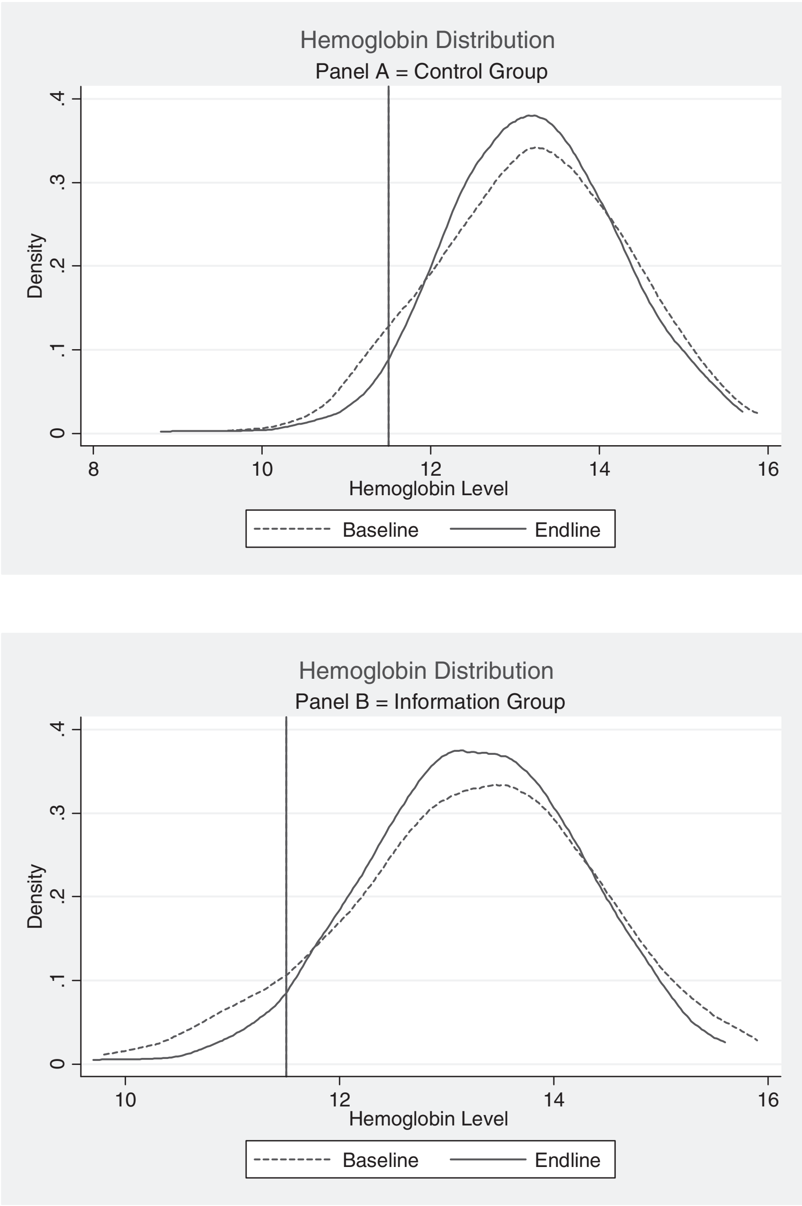

Figure 4 Student hemoglobin distribution at baseline and follow-up in Ningxia, November 2010 and June 2011 (Experiment 3). *Source*: Experiment 3 (see Section 2).

supplementation was associated with meaningful increases in hemoglobin concentrations (roughly 0.2 and 0.5 g/dl in Tables 3 and 4, respectively).

The last three columns of Tables 3–5 show marginal probabilities for anemia status calculated using probit model estimates. The overall pattern of results is similar. Consistent with insignificant hemoglobin concentration estimates, the information arm estimates for anemia status are also insignificant and generally close to zero. The estimates for multivitamin supplementation in Tables 3 and 4 are negative and somewhat larger in magnitude (albeit indistinguishable from zero at conventional significance levels), providing mixed evidence that the hemoglobin gains shown in the left three columns of Tables 3 and 4 translate into meaningful reductions in anemia.[8]

To investigate heterogeneous intervention effects across the distribution of hemoglobin concentration, Figures 5–7 plot 95% confidence intervals for quantile regression estimates at every percentile for each experiment. In all three figures the confidence intervals for the information arm overlap with zero across the hemoglobin distribution, implying no discernable effects relative to the control groups. The same is largely true for multivitamin supplementation in Experiment 2 (Figure 6). However, the multivitamin intervention in Experiment 1 appears to have produced gains in hemoglobin in the right tail of the distribution (Figure 5), presumably because these students have diets richer in micronutrients that aid in iron absorption (like vitamin C).

In summary, providing fourth grade teachers with multivitamins containing iron throughout the academic year increased mean student hemoglobin concentrations significantly (albeit with more questionable impact on anemia rates), while adopting any of several strategies to educate parents about anemia appears to have had little effect.

4 Discussion

In this article we report the results of three RCTs studying health education campaigns aiming to reduce anemia among rural primary school students in northwest China. Across all three studies, we find little evidence of changes in blood hemoglobin concentration or anemia status. In contrast, in our two studies that also examined a multivitamin supplementation intervention, we find meaningful reductions in anemia.[9]

[8] We address the behavioral challenges of using inexpensive, efficacious technologies like multivitamin supplements to improve health in other work (Miller et al. 2011).

[9] It is nonetheless important to note that weak principal incentives and other behavioral obstacles may limit the impact of vitamin distribution to principals. The effectiveness of complementary behavioral interventions is unknown.

Table 3 The impact of intervention arms on student hemoglobin concentration and anemia status in Experiment 1

Independent variables	Dependent variable: change in hemoglobin level baseline to follow-up			Dependent variable: anemia status at follow-up		
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment variables						
1. Information arm	0.016 (0.056)	0.040 (0.054)	0.025 (0.055)	−0.001 (0.018)	−0.003 (0.017)	−0.001 (0.018)
2. Multivitamin supplement arm	0.187 (0.044)**	0.214 (0.042)**	0.202 (0.043)**	−0.012 (0.014)	−0.013 (0.014)	−0.010 (0.014)
Student characteristics						
3. Boarding student dummy (1 = boarding student; 0 = non-boarding student)			0.129 (0.041)**			0.028 (0.013)*
4. Gender (1 = female; 0 = male)			−0.06 (0.039)			0.014 (0.012)
5. Student's age (in months)			−0.003 (0.002)			−0.001 (0.0006)
Parent characteristics						
6. Mother stays at home (1 = yes, 0 = no)			0.04 (0.047)			0.019 (0.014)
7. Education of mother (years)			−0.028 (0.027)			−0.004 (0.009)
8. Mother self-employment or wage earning job (1 = yes, 0 = no)			0.168 (0.061)**			−0.036 (0.018)
Regional dummies	*No*	*Yes*	*Yes*	*No*	*Yes*	Yes
9. Constant	0.121 (0.03)**	0.846 (0.05)**	1.211 (0.24)**	NA	NA	NA
10. Observations	3661	3661	3661	3661	3661	3661
11. R^2	0.01	0.10	0.11	0.002	0.08	0.09
12. p-value: Supplement = Information	0.002**	0.001**	0.002**	0.49	0.35	0.52

Notes: Data source—Experiment 1 (see Section 2). Standard errors in parentheses clustered at the school level. $*p < 0.05$, $**p < 0.01$. The last row reports p-values for tests of equality between the information and multivitamin supplementation arms. Columns 1–3 report OLS estimates for student hemoglobin concentration; Columns 4–6 present marginal probabilities for anemia status calculated using probit model estimates.

Table 4 The impact of intervention arms on student hemoglobin concentration and anemia status in Experiment 2

Independent variables	Dependent variable: change in hemoglobin level baseline to follow-up			Dependent variable: anemia status at follow-up		
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment variables						
1. Information arm	−0.066 (0.19)	0.284 (0.15)	0.275 (0.15)	−0.020 (0.024)	−0.030 (0.020)	−0.031 (0.020)
2. Multivitamin supplement arm	0.177 (0.18)	0.514 (0.16)**	0.516 (0.16)**	−0.013 (0.022)	−0.028 (0.019)	−0.028 (0.018)
Student characteristics						
3. Boarding student dummy (1 = boarding student; 0 = non−boarding student)			0.106 (0.06)			−0.0001 (0.015)
4. Gender (1 = female; 0 = male)			0.053 (0.06)			0.031 (0.014)
5. Student's age (in months)			0.001 (0.002)			−0.0002 (0.0005)
Parent characteristics						
6. Mother stays at home (1 = yes,0 = no)			0.030 (0.07)			0.018 (0.014)
7. Education of mother (years)			−0.012 (0.05)			0.0005 (0.009)
8. Mother self-employment or wage earning job (1 = yes, 0 = no)			0.274(0.11)*			−0.032 (0.020)
Regional dummies	No	Yes	Yes	No	Yes	Yes
9. Constant	0.304 (0.13)*	0.132 (0.14)	−0.052 (0.36)	NA	NA	NA
10. Observations	1579	1579	1579	1579	1579	1579
11. R^2	0.01	0.13	0.14	0.001	0.04	0.05
12. p-value: Supplement = Information	0.20	0.12	0.10	0.72	0.93	0.87

Notes: Data source—Experiment 2 (see Section 2). Standard errors in parentheses clustered at the school level. *$p < 0.05$, **$p < 0.01$. The last row reports p-values for tests of equality between the information and multivitamin supplementation arms. Columns 1–3 report OLS estimates for student hemoglobin concentration; Columns 4–6 present marginal probabilities for anemia status calculated using probit model estimates.

Table 5 The impact of the intervention arms on student hemoglobin concentration and anemia status in Experiment 3

Independent variables	Dependent variable: change in hemoglobin level baseline to follow-up			Dependent variable: anemia status at follow-up		
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment variables						
1. Information arm	0.004 (0.14)	0.018 (0.13)	0.023 (0.13)	0.006 (0.013)	0.006 (0.013)	0.008 (0.012)
Student characteristics						
2. Boarding student dummy (1 = boarding student; 0 = non-boarding student)			−0.112 (0.21)			−0.004 (0.017)
3. Gender (1 = female; 0 = male)			−0.026 (0.73)			0.007 (0.010)
4. Student's age (in months)			0.003 (0.003)			−0.0002 (0.0005)
Parent characteristics						
5. Mother stays at home (1 = yes,0 = no)			0.033 (0.17)			0.020 (0.013)
6. Education of mother (years)			0.053 (0.046)			−0.011 (0.007)
7. Mother self-employment or wage earning job (1 = yes, 0 = no)			−0.157 (0.094)			−0.0001 (0.015)
Regional dummies	No	Yes	Yes	No	Yes	Yes
8. Constant	−0.004 (0.10)	0.294 (0.12)**	−0.171 (0.44)	NA	NA	NA
9. Observations	929	929	929	929	929	929
10. R^2	0.00	0.04	0.04	0.001	0.001	0.02

Notes: Data source—Experiment 3 (see Section 2). Standard errors in parentheses clustered at the school level. *$p < 0.05$, **$p < 0.01$. Columns 1–3 report OLS estimates for student hemoglobin concentration; Columns 4–6 present marginal probabilities for anemia status calculated using probit model estimates.

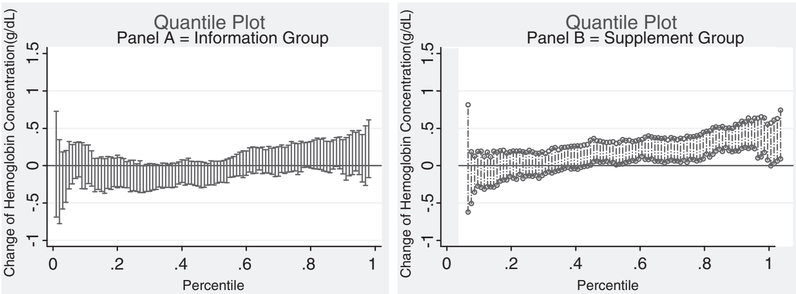

Figure 5 Quantile regression estimates of for the effect of information and vitamin supplementation on change in hemoglobin levels before and after the study intervention in Shaanxi, October 2008 to June 2009. *Source*: Experiment 1 (see Section 2). *Note*: Upper and lower bounds represent 95% confidence intervals.

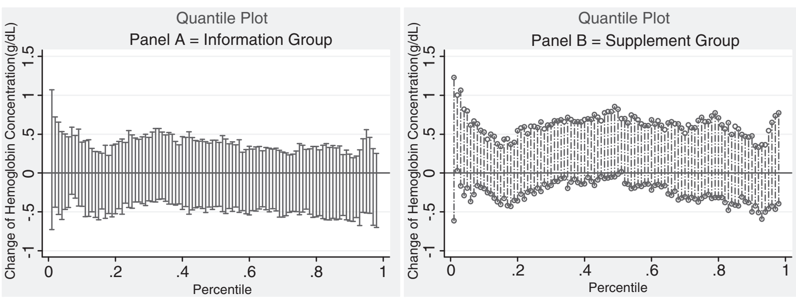

Figure 6 Quantile regression estimates for the effect of vitamin and information on change of Hemoglobin levels before and after the study intervention in Shaanxi, November 2009 to June 2010. *Source*: Experiment 2 (see Section 2). *Note*: Upper and lower bounds represent 95% confidence intervals.

Our findings are not consistent with the conventional wisdom that health education campaigns are effective (or sufficient by themselves) in changing health behaviors or improving health outcomes in developing countries. Other economic and behavioral factors are likely to be central and deserve greater attention (Mobarak et al. 2011).

More research on the reasons why health education campaigns often fail is also needed. As noted earlier, there is variation in their success across targeted health technologies and behaviors as well as contexts (Quick et al. 2002; Erulkar et al. 2004; Luby et al. 2004; Hu et al. 2005; Kremer and Miguel 2007; Madajewicz et al. 2007; Jalan and Somanathan 2008; Dupas 2011). Identifying and understanding the specific behavioral

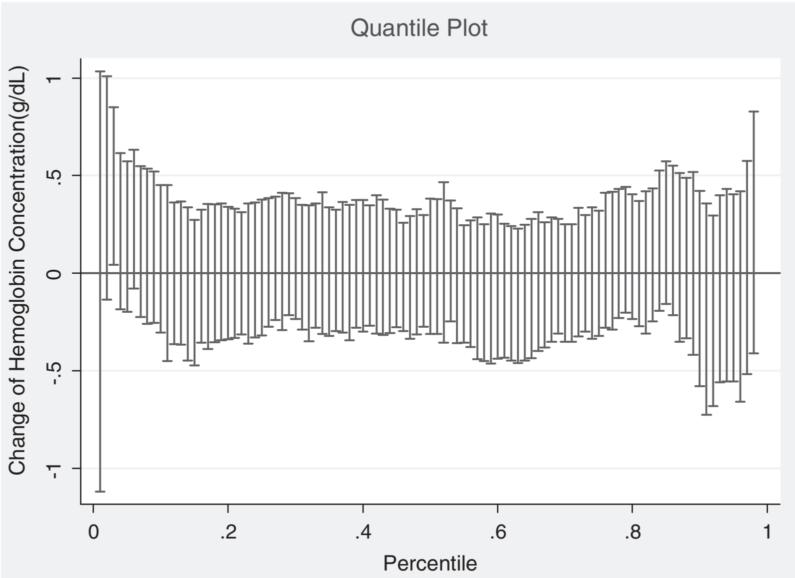

Figure 7 The 95% confidence intervals for quantile regression estimates by hemoglobin concentration percentile, Experiment 3. *Source*: Experiment 3 (see *Methods* section of text). *Note*: Upper and lower bounds represent 95% confidence intervals.

mechanisms that distinguish these mixed results is essential if effective health information campaigns are to be designed (Montalvao et al. 2011)

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