Nutrition, Care and Education

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On behalf of REAP team
The diet of children: grain / grain / grain …
Children eat almost no red meat / no green vegetables / no fruit … is this affecting educational performance?
Is eating “grain / grain / grain” a problem?

• In fact, if this is what students are eating, could it be that they have micronutrient deficiencies?
• One of the most common nutritional problems in developing countries is ANEMIA …
• If children have anemia, it is well known that it can affect:
  – Cognitive ability
  – Physical health
  – Psychological health
  – Behavior
  – AND EDUCATIONAL PERFORMANCE
Is anemia a problem in rural China

• This was the first step in our research program …

• In 2008, we set out to do one of the first large scale canvas survey in Shaanxi …

• What did we do?
The first step in studying the prevalence of anemia was to choose a random sample of schools … we worked closely with the Shaanxi gov’t to create a sampling frame … and then chose 66 schools in 8 counties ..
We conducted field testing for anemia …
### Table 1. The distribution of sample schools and students across counties

<table>
<thead>
<tr>
<th>By County</th>
<th>Number of schools</th>
<th>Number of students</th>
<th>Percentage of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>66</td>
<td>3849</td>
<td>100</td>
</tr>
<tr>
<td>Baihe</td>
<td>7</td>
<td>387</td>
<td>9.3</td>
</tr>
<tr>
<td>Jiaxian</td>
<td>6</td>
<td>245</td>
<td>5.9</td>
</tr>
<tr>
<td>Shanyang</td>
<td>8</td>
<td>488</td>
<td>11.8</td>
</tr>
<tr>
<td>Suide</td>
<td>6</td>
<td>363</td>
<td>8.8</td>
</tr>
<tr>
<td>Xunyang</td>
<td>21</td>
<td>1,234</td>
<td>29.7</td>
</tr>
<tr>
<td>Yangxian</td>
<td>9</td>
<td>572</td>
<td>13.8</td>
</tr>
<tr>
<td>Ziyang</td>
<td>4</td>
<td>308</td>
<td>7.4</td>
</tr>
<tr>
<td>Zhashui</td>
<td>5</td>
<td>243</td>
<td>5.9</td>
</tr>
<tr>
<td>County</td>
<td>Hemoglobin level (g/L)</td>
<td>Number of student with anemia</td>
<td>Percentage of students w/ severe anemia</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Total sample</td>
<td>122.2</td>
<td>1501</td>
<td>21.7</td>
</tr>
<tr>
<td>Baihe</td>
<td>121.6</td>
<td>91</td>
<td>23.5</td>
</tr>
<tr>
<td>Jiaxian</td>
<td>124.7</td>
<td>36</td>
<td>14.7</td>
</tr>
<tr>
<td>Shanyang</td>
<td>123.4</td>
<td>86</td>
<td>17.6</td>
</tr>
<tr>
<td>Suide</td>
<td>123.4</td>
<td>66</td>
<td>18.2</td>
</tr>
<tr>
<td>Xunyang</td>
<td>119.0</td>
<td>406</td>
<td>32.9</td>
</tr>
<tr>
<td>Yangxian</td>
<td>123.6</td>
<td>98</td>
<td>17.1</td>
</tr>
<tr>
<td>Ziyang</td>
<td>131.2</td>
<td>23</td>
<td>7.5</td>
</tr>
<tr>
<td>Zhashui</td>
<td>127.1</td>
<td>33</td>
<td>13.6</td>
</tr>
</tbody>
</table>

Table 2. The distribution of hemoglobin levels and anemia

39% of sample have Hb levels below 120

Data source: Authors’ survey
Standard deviation $\approx 8$
So, what did we then do to try to solve anemia … and study its effect on education

**Randomized Control Trial**

[like in agriculture or medicine]

our questions:

- Will iron supplements lead to less anemia?
- If parents knew about their children’s nutritional status, would there be less anemia?

Does lower anemia lead to better school performance?

*Three Stages*

1. Baseline survey
2. POLICY EXPERIMENT
3. Evaluation survey

- treated
- control

RCT's
66 School Study … in 8 Poorest Counties in Shaanxi

In 24 Schools ($\approx 1400$ fourth grade students) $\rightarrow$ We gave students a direct supplement with 1 vitamin per day

In 12 Schools ($\approx 800$ fourth grade students) $\rightarrow$ We send the parents a letter, informing them of whether or not their child had anemia

In the other 30 Schools ($\approx 1800$ fourth grade students) $\rightarrow$ we did nothing: these are our CONTROL schools

We first took our 66 schools … and divided them into three distinct identical sets of schools
Step 1: Baseline survey (October 2008):
Again: we did in-the-field testing for anemia …
We also did a baseline survey for math scores …

Standardized Math Test
Psychological Tests
(as well as other tests)
In the 24 vitamin schools, we gave 1 over-the-counter vitamin / day (these could be bought in any supermarket in Beijing)

Vitamins have 5 mgs of iron …

Vitamins given to students from November to May
In the 12 “information-only” schools, we tried to inform the parents of their child’s anemia status.

The letter was simple and told the parent:

“What is anemia?
What are its effects?
What should you do? ➔ go to a doctor / eat better diet

Note: children in these schools received NO vitamins
Dear ______________________ (student name) ’s parents!

As researchers from the Xi’an Jiaotong University, whom have recently conducted a study (“Child Nutrition and Education”) at your child’s school, we would like to firstly thank you for supporting our work! As part of this study, we tested your child for anemia, and are including the results below:

According World Health Organization (WHO) standards, hemoglobin levels lower than 115g/L indicate anemia. Based on our test results, your child’s hemoglobin levels are ____________________g/L, which indicates that your child is moderately anemic. Anemia can negatively affect a child’s development, physical strength and endurance, attention span, cognitive thinking and memory, which all impact educational effectiveness and academic achievement. Anemia also can affect disease susceptibility and spread. Therefore, parents should be particularly attentive about their child’s anemia – early identification of anemia allows faster prevention.

Since your child is anemic, we suggest you pay close attention to his/her eating habits: 1) give your child iron-rich foods, including liver (pig, cow, sheep, etc.); animal blood; lean meats (pork, beef, lamb, etc.); fish and shrimp; and bean products (tofu, soy milk, etc) (ideally make sure your child eats one bowl of meat, an egg or an equivalent amount of bean products), and also use iron-fortified soy sauce. 2) Simultaneously, consume fresh vegetables and fruits for sufficient Vitamin C (every day, your child should eat an apple or the equivalent of another fruit). 3) Schedule accordingly three meals per day, and correct bad habits of eating imbalanced meals. Also, it is important to prevent intestinal worm infections (if necessary, de-worming medication is available), and to keep physically fit.

Regarding your child’s moderate anemia, we strongly recommend you seek your doctor for medical assistance as soon as possible, to raise your child’s hemoglobin levels and ensure your child’s health! Currently, common iron supplements include: LiuSuanYa iron, FuMaSuan iron, PuTaoTangSuanYa iron, LiFeiNeng (if there are side effects, please seek medical attention). Best wishes for your child’s healthy development!

Respectfully yours,

Xi’an Jiaotong University Medical Center
12.10.2008
30 control schools

Zero: no vitamins /
no letter …
Evaluation Survey (stage 3)

Will iron supplements ⇒ less anemia?
If parents know ⇒ less anemia?

Lower anemia ⇒ Better school performance?

Stage 3
Evaluation survey (June 2009)
Re-taking the standardized academic tests and Psy test…
… after 5 months of vitamins + letter to parent.
Re-taking the Hb Test (June 2009)
Still anemic or not?
Results
## Findings (all students)

Total reduction in moderate rates of anemia (iron deficiencies):

<table>
<thead>
<tr>
<th></th>
<th>Initial levels</th>
<th>Final levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt; 120 hb)</td>
<td>39%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Severe anemia fell from 21.7 percent to 15.3 percent
Testing results of Hypotheses (for children in vitamin schools, Hb count increase significantly compare to children from control schools)

Difference statistically significant at 95% level of confidence

<table>
<thead>
<tr>
<th>Hemoglobin</th>
<th>vitamins</th>
<th>letter to parents</th>
<th>control</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Smaller, but also statistically significant effect of providing information to the parents.
Information ➔ Hemoglobin by Anemia Quantiles

For those children that live at home

Hemoglobin Counts

Quan_0.10  Quan_0.20  Quan_0.30  Quan_0.40  control

(most anemic)
Unfortunately, information intervention have no significant effect on boarding students.
More importantly, we also found positive effects on Standardized Math test Scores in vitamin intervention school.

Difference statistically significant at 95% level of confidence

However, no statistically significant effect on math test score by providing information to the parents.
Interesting, Positive effects on the psychological health of students in vitamin intervention school also be found.
Is about 0.2 shift in standard deviation of the standardized math test distribution a large effect?

• The Tennessee STAR program reduced class size from twenty-two to fifteen $\Rightarrow$ improved test scores by about 0.21 standard deviations (Krueger and Whitmore 2001).

• The Indian Balsakhi Program that provided tutoring for under-performing children in grade 3 or 4 $\Rightarrow$ improved test scores by 0.27 standard deviations (Banerjee et al 2007).

• A merit scholarship program for girls in Kenya $\Rightarrow$ increased test scores by 0.28 standard deviations (Kremer, Miguel, and Thornton 2009)
Maybe some of the “real impacts” is almost unable to be measured …

• Lets look at one short video … and see some of these “real impacts” …
In summary

• We believe REAP has discovered a very fundamental problem ➔ Anemia is a problem in Rural Shaanxi …

• It is problem of poor nutrition in schools … it is problem of the knowledge of parents …

• We also found that improving nutrition leads to improvements in educational performance …
Anemia is not just a problem in rural Shaanxi Province in 2008 [results of REAP studies]

<table>
<thead>
<tr>
<th>Province</th>
<th>Survey time</th>
<th>Anemia rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ningxia</td>
<td>2009</td>
<td>31%</td>
</tr>
<tr>
<td>Qinghai</td>
<td>2009</td>
<td>52%</td>
</tr>
<tr>
<td>Shaanxi</td>
<td>2009</td>
<td>32%</td>
</tr>
<tr>
<td>Shaanxi</td>
<td>2010</td>
<td>30%</td>
</tr>
<tr>
<td>Sichuan</td>
<td>2010</td>
<td>32%</td>
</tr>
</tbody>
</table>
• What has been the impact of our work?

• What are we going to do to build on the first phase of the work?

In fact, I am not going to tell you now … In the next presentation, Dr. Zhang Huiping from Ningxia University will describe both our policy impact … and the work that we are doing now [a lot of which is supported by Ford Foundation]
Thank you!

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• http://reap.stanford.edu
• http://www.reapchina.org