Economic Consequences of Micronutrient Deficiencies and Potential Economic Benefit of Fortification

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Malnutrition: A Cause or Consequence of Poverty?

- People are Basic Unit of Economic Growth
- Association of poverty and malnutrition.
  - Inverse relation of GDP & Malnutrition
- Two-way Dynamic
  - Poverty is not simply root cause of hunger.
  - Malnutrition causes and reinforces poverty.
Economic Growth Is Not Enough

- More purchasing power and more food reduces malnutrition but...
  - ... doubling GDP reduced malnutrition only 2% from 25% to 23%

- Public investment in nutrition interventions can close this gap of GDP growth and improved nutrition.

**Rising GDP & Malnutrition: A Modest Trickle-Down Effect**

Source: Alderman (2004)
Vitamin and Mineral Deficiency Contributes to:

- More than one-third of all deaths in children under the age of 5
- Stunting of an estimated 195 million children under age 5 in developing countries
- Undeveloped cognitive capacity, productivity and earning potential
Leading economists, meeting every four years, ranked micronutrient interventions among their top three recommendations in 2004, 2008, and 2012.

“One of the most compelling investments is to get nutrients to the world’s undernourished. The benefits from doing so – in terms of increased health, schooling, and productivity – are tremendous.”

Nobel laureate economist Vernon Smith, part of 2012 Copenhagen Consensus Expert Panel

# The Copenhagen Consensus: Highest Benefit Cost Ratio

<table>
<thead>
<tr>
<th>Solution</th>
<th>Challenge</th>
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</thead>
<tbody>
<tr>
<td>1. Micronutrient supplements for children (A &amp; Zn)</td>
<td>Malnutrition</td>
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<td>2. The Doha development agenda</td>
<td>Trade</td>
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<td>3. <strong>Micronutrient fortification</strong></td>
<td>Malnutrition</td>
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<td>4. Expanded immunization coverage for children</td>
<td>Diseases</td>
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<td>5. Biofortification</td>
<td>Malnutrition</td>
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<td>6. Deworming, other nutrition programs in school</td>
<td>Malnutrition</td>
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<td>7. Lowering the price of schooling</td>
<td>Education</td>
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<td>8. Increase and improve girl’s schooling</td>
<td>Women</td>
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<td>9. Community-based nutrition programs</td>
<td>Malnutrition</td>
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**Nobel Prizewinning Economists:** Finn Kydland, Robert Mundell, Douglass North, Thomas Schelling, Vernon L. Smith
Iron Deficiency as Cause of Anemia

How much anemia is iron deficiency related?

“anemia prevalence can generally be taken as indicator of extent and trends of iron deficiency.” (WHO)

Regional Situation

- No Malaria
- Limited VAD
- Limited Hookworm and parasites

Provisional Estimate of Iron deficiency as cause of anemia: 90%
Costs of Anemia

Anemia leads to:

- 17% *lower productivity* in heavy manual labor
- 5% *lower productivity* in other manual labor
- Estimated 2.5% loss of earnings due to *lower cognitive skills*
### Iron Deficiency Anemia

<table>
<thead>
<tr>
<th>Year</th>
<th>Perinatal Mortality Future Productivity</th>
<th>Adult Anemia Current Productivity</th>
<th>Childhood Anemia Future Productivity</th>
<th>Total IDA</th>
<th>Death &amp; Disability Future Productivity</th>
<th>Medical &amp; Welfare Current Expenses</th>
<th>Total Folic Acid</th>
<th>Total Projected Damage</th>
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</thead>
<tbody>
<tr>
<td>2009</td>
<td>$1.57 $76.61 $4.77 $82.95 $1.39 $0.34 $1.73</td>
<td>$1.9% $90.5% $5.6% $98.0% $1.6% $0.4% $2.0%</td>
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<td>2010</td>
<td>$1.58 $77.37 $4.82 $83.78 $1.40 $0.34 $1.75</td>
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<td>2011</td>
<td>$1.60 $78.15 $4.87 $84.62 $1.42 $0.35 $1.77</td>
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<td>2012</td>
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<td>2013</td>
<td>$1.63 $79.72 $4.97 $86.32 $1.45 $0.35 $1.80</td>
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<td>2014</td>
<td>$1.65 $80.52 $5.02 $87.18 $1.46 $0.36 $1.82</td>
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<td>2015</td>
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<td>2016</td>
<td>$1.68 $82.13 $5.12 $88.93 $1.49 $0.37 $1.86</td>
<td>$1.9% $90.5% $5.6% $98.0% $1.6% $0.4% $2.0%</td>
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<tr>
<td>2017</td>
<td>$1.70 $82.96 $5.17 $89.82 $1.51 $0.37 $1.87</td>
<td>$1.9% $90.5% $5.6% $98.0% $1.6% $0.4% $2.0%</td>
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<tr>
<td>2018</td>
<td>$1.72 $83.79 $5.22 $90.72 $1.52 $0.37 $1.89</td>
<td>$1.9% $90.5% $5.6% $98.0% $1.6% $0.4% $2.0%</td>
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<td><strong>Total</strong></td>
<td><strong>$16.4</strong> <strong>$801.5</strong> <strong>$49.9</strong> <strong>$867.8</strong> <strong>$14.5</strong> <strong>$3.6</strong> <strong>$18.1</strong></td>
<td><strong>16.4%</strong> <strong>90.5%</strong> <strong>5.6%</strong> <strong>98.0%</strong> <strong>1.6%</strong> <strong>0.4%</strong> <strong>2.0%</strong></td>
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Average Premix Cost for 1 Metric Ton

**Wheat Flour:**
US$ 3 to fortify with iron, folic acid, and other B vitamins

**Ground Maize:**
US$ 4 to fortify with iron, zinc, vitamin A, folic acid, and other B vitamins

**Rice:**
US$ 6 to US$ 20 to fortify with iron, zinc, vitamin A, folic acid, and other B vitamins

One metric ton of flour is about 2,200 pounds, as pictured here. FFI photo.
Examples of Fortification Impact

- Cognitive Impact of iron on children
- Impact of Folic Acid fortification in Canada Two-way Dynamic

- Poverty is not simply root cause of hunger.
- Malnutrition causes and reinforces poverty.
Behavioral & Cognitive Impact on Children

- **Indonesia**: Pollitt et al (1993) - Mental: 18.4, Motor: 18.8
- **USA**: Oskig & Honig (1983) - Mental: 6.8, Motor: 7.5
- **Chile**: Walters (1989) - Mental: 1.6, Motor: 9.3
- **Costa Rica**: Lozoff (1985) - Mental: 10, Motor: 9.3

*Added Points on Bayley Scales*
Oman: Pre-Post Fortification National Decrease in Anemia 18-32%
Canada Folic Acid Fortification: 37-78% Decrease in NTDs and Cost savings of about $1 million annually

The number of specialized operations on children born with NTDs in Canada at Toronto Sick Children’s Hospital has dropped from 52 per year before folic acid fortification to <5 per year.
Chile Folic Acid Fortification: 40% Decrease in NTDs
Cost-Benefit Ratio for Preventing Spina Bifida

1:12  Chile
1:30  South Africa
1:48  United States