Impact of Legumes vs. Corn-Soy Flour on Environmental Enteric Dysfunction and Stunting in Rural Malawian Children

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Stunting

• Stunting is referred to as being short for age

• Causes:
  • Inadequate infant and young child feeding
  • Clinical and subclinical infections

• Consequences of stunting:
  • Premature deaths
  • Long-term cognitive defects
  • Lower adult economic productivity
  • High health cost
  • For girls: increased risk of stunted children.
Environmental Enteric Dysfunction (EED)

- Chronic inflammatory state of the gut
- Has non-specific cause
  - Linked unsanitary living conditions
- Asymptomatic
- Is virtually ubiquitous among people living in rural areas
- First three years of life is a high risk period
What happens in EED

• In EED there are abnormal changes in Structure and Function of the small intestine

<table>
<thead>
<tr>
<th>Structural change</th>
<th>Functional change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flattening of villous</td>
<td>Reduced nutrient absorption</td>
</tr>
<tr>
<td>Inflamed and permeable</td>
<td>Microbial translocation</td>
</tr>
</tbody>
</table>
Measuring EED

• Most commonly measured by dual sugar absorption tests

  • Drink non-metabolized sugars of different sizes (Lactulose and Mannitol)

  • Collect urine produced over a 4 hour period

  • measure relative concentrations of the sugars in urine

  • higher ratios indicative of increased intestinal permeability
Why Legumes?

• Diets enriched in legumes decrease markers of inflammation

• May serve as a major source of protein and micronutrients
  • carbohydrate consumption often predominates in complementary feeding

• Accessible and cheap
  • grows well in Africa
  • are culturally accepted
  • drought-tolerant crop
Hypothesis and outcomes

Hypothesis:
• legume supplement in children will improve their height and L:M ratios compared to those on standard food supplements.

Intervention:
• Cowpeas,
• Common beans,
• Corn Soy blend (control)

Outcomes:
• Change in height
• Change in L:M ratios
Trial Setting

- Healthy children aged 6 to 23 months
- Limera and Nthenda, in southern Malawi
- Randomised to cowpea, common beans, or corn-soy blend
Trial Procedures

Enrolment & randomization

• anthropometric measurements
• dual sugar absorption test
• stool sample collection
• refilling of flour

Week 2
Study 1 (6-11 months old)

Week 6

Week 12
Week 24
Week 36
Week 48

Study 2 (12-35 months old)

Week 2
Week 6
Week 18
Week 30
Week 42

Stool and anthropometric visits + flour refill

Home compliance visits

Dietary recalls

Other Visits

Study 1 (6-11 months old)
Study 2 (12-35 months old)
Trial profile

Study 1: 248 enrolled
Study 2: 370 enrolled

Study 1: 304 approached
Study 2: 400 approached

Study 1 Exclusions (n=56)
- 33 MAM
- 3 SAM
- 2 medical condition
- 16 over age
- 1 moved
- 1 refused

Study 2 Exclusions (n=30)
- 14 MAM
- 11 over age
- 5 sample size saturated

Study 1: 9 lost to follow up
Study 2: 7 lost to follow up

Group A
Study 1: n=91
Study 2: n=139

Group B
Study 1: n=93
Study 2: n=114

Group C
Study 1: n=96
Study 2: n=139

Study 1: 12 lost to follow up
Study 2: 9 lost to follow up

Study 1: 64 in cohort, 18 completed
Study 2: 132 in cohort

Study 1: 64 in cohort, 17 completed
Study 2: 105 in cohort

Study 1: 67 in cohort, 18 completed
Study 2: 133 in cohort
## Study 1 Baseline characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Study 1 (6-11 months old)</th>
<th>Overall (n=246)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, %</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Age, months</td>
<td>5.8 ±0.26</td>
<td></td>
</tr>
<tr>
<td>Length, cm</td>
<td>63.7±2.48</td>
<td></td>
</tr>
<tr>
<td>Weight, kg</td>
<td>7.1±0.74</td>
<td></td>
</tr>
<tr>
<td>Weight-for-height, z score</td>
<td>0.4±0.89</td>
<td></td>
</tr>
<tr>
<td>Weight-for-age, z score</td>
<td>-0.6±0.86</td>
<td></td>
</tr>
<tr>
<td>Height-for-age, z score</td>
<td>-1.2±1.04</td>
<td></td>
</tr>
<tr>
<td>Children stunted (height-for-age &lt;-2), %</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>
## Study 2 Baseline characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Study 2 (12-23 months old)</th>
<th>Overall (n=356)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, %</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Age, months</td>
<td>17.7±3.7</td>
<td></td>
</tr>
<tr>
<td>Length, cm</td>
<td>76.5±4.85</td>
<td></td>
</tr>
<tr>
<td>Weight, kg</td>
<td>9.6±1.30</td>
<td></td>
</tr>
<tr>
<td>Weight-for-height, z score</td>
<td>-0.1±0.90</td>
<td></td>
</tr>
<tr>
<td>Weight-for-age, z score</td>
<td>-0.8±0.96</td>
<td></td>
</tr>
<tr>
<td>Height-for-age, z score</td>
<td>-1.6±1.15</td>
<td></td>
</tr>
<tr>
<td>Children stunted (height-for-age &lt;-2), %</td>
<td></td>
<td>36</td>
</tr>
</tbody>
</table>
Study 2 Baseline characteristics by study arm

**Sex distribution**
- Female: Group A, Group B, Group C
- Male: Group A, Group B, Group C

**Age distribution**
- Age, mo: Group A, Group B, Group C

**Length distribution**
- Length: Group A, Group B, Group C

**HAZ distribution**
Stored biological samples (15,904 vials)

<table>
<thead>
<tr>
<th></th>
<th>Spoiled</th>
<th>In Malawi</th>
<th>Shipped</th>
<th>Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine</td>
<td>0</td>
<td>2956</td>
<td>2480</td>
<td>5436</td>
</tr>
<tr>
<td>Stool</td>
<td>1400</td>
<td>2868</td>
<td>6200</td>
<td>10468</td>
</tr>
</tbody>
</table>

- Spoiled
- In Malawi
- Shipped
- Collected
Trial progress

• Study 1:
  • 62 (21%) follow up completed
  • 52 to be enrolled

• Study 2:
  • enrollment completed
  • majority now between week 24 and week 30 of follow up

• Projected end date: Dec 2016