From the Field:
Improving fetal and infant growth in vulnerable populations

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Outline

• Fetal and infant growth in vulnerable populations
  - Growth faltering begins prenatally
  - Continues until about 24 mo of age
• Impact of small-quantity lipid-based nutrient supplements (SQ-LNS) consumption in Ghana
• Final recommendations
At birth, for most regions of the world, average weight-for-age z-scores are already below the WHO standard.

- Z-scores decline moderately, then peaks at ~24 mo

At birth, average height/length-for-age z-scores are well below WHO standard, for most regions of the world.

• Z-scores decline sharply until ~ 24 mo

Growth faltering has many causes

Inadequate nutrient intakes are a major cause of fetal and infant growth faltering.

**Maternal, eg.**
- Inadequate GWG
- Protein/energy
- Multiple micronutrients
- Iodine

**Child, eg.**
- Protein/energy
- Zinc

**Intra-uterine growth restriction**

**Impaired growth (stunting, underweight, wasting)**
One reason for inadequate dietary intakes is the high nutrient needs during pregnancy and lactation.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>NPNL</th>
<th>Percentage increase over NPNL RDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pregnancy</td>
</tr>
<tr>
<td>Protein</td>
<td>46 g</td>
<td>54</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>700 µg</td>
<td>10</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>75 mg</td>
<td>13</td>
</tr>
<tr>
<td>Vitamin B₆</td>
<td>1.3 mg</td>
<td>46</td>
</tr>
<tr>
<td>Folate</td>
<td>400 µg</td>
<td>50</td>
</tr>
<tr>
<td>Iodine</td>
<td>150 µg</td>
<td>47</td>
</tr>
<tr>
<td>Iron</td>
<td>18 mg</td>
<td>50</td>
</tr>
<tr>
<td>Zinc</td>
<td>8 mg</td>
<td>38</td>
</tr>
</tbody>
</table>

Adu-Afarwuah et al, 2017
Also, the high nutrient needs during infancy and childhood are difficult to meet.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>RDAs for adult male (per kg body weight)</th>
<th>% increases in DRIs for infants and young children</th>
<th>6 mo²</th>
<th>12 mo²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy⁴</td>
<td>44 kcal⁵</td>
<td></td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>Protein</td>
<td>0.7 g</td>
<td></td>
<td>65</td>
<td>43³</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>13 μg</td>
<td></td>
<td>292</td>
<td>300</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>1.3 mg</td>
<td></td>
<td>292</td>
<td>300</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>0.2 mg</td>
<td></td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Thiamin</td>
<td>0.02 mg</td>
<td></td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>0.02 mg</td>
<td></td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Niacin</td>
<td>0.2 mg</td>
<td></td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Vitamin B₆</td>
<td>0.02 mg</td>
<td></td>
<td>-50</td>
<td>50</td>
</tr>
<tr>
<td>Folate</td>
<td>5.7 μg</td>
<td></td>
<td>44</td>
<td>46</td>
</tr>
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<td>0.03 μg</td>
<td></td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td>Calcium</td>
<td>14 mg</td>
<td></td>
<td>79</td>
<td>93</td>
</tr>
<tr>
<td>Copper</td>
<td>13 μg</td>
<td></td>
<td>92</td>
<td>77</td>
</tr>
<tr>
<td>Iodine</td>
<td>2 μg</td>
<td></td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Iron</td>
<td>0.1 mg</td>
<td></td>
<td>-100</td>
<td>1000³</td>
</tr>
<tr>
<td>Magnesium</td>
<td>6 mg</td>
<td></td>
<td>-33</td>
<td>33</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>10 mg</td>
<td></td>
<td>30</td>
<td>190</td>
</tr>
<tr>
<td>Selenium</td>
<td>1 μg</td>
<td></td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.2 mg</td>
<td></td>
<td>50</td>
<td>50³</td>
</tr>
</tbody>
</table>

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Our project developed the Small-quantity lipid-based nutrient supplements (SQ-LNSs) for enriching local diets (1)

Small-quantity lipid-based nutrient supplements (SQ-LNSs) is nutrient-dense

• Typically 20 g/day
• Currently women (LNS-P&L) and children (LNS I&C).
• Includes 22 vitamins & minerals usually 1x – 2x RDA or Adequate Intakes (AI) or maximum amount that can be added (eg. Ca, P, K, Mg)
• Essential fatty acids (linoleic acid and alpha-linolenic acid)
• Protein, fat, and 118 kcal energy
• Mixed with small amount of home-prepared food

We designed the iLiNS-DYAD trial to evaluate the efficacy of LNS for pregnant & lactating women plus LNS for children 6-18 mo

<table>
<thead>
<tr>
<th>Group</th>
<th>Pregnancy</th>
<th>Lactation</th>
<th>6-18 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNS</td>
<td>LNS-P&amp;L</td>
<td>LNS-P&amp;L</td>
<td>LNS-I&amp;C</td>
</tr>
<tr>
<td>MMN</td>
<td>MMN</td>
<td>MMN</td>
<td></td>
</tr>
<tr>
<td>IFA</td>
<td>Fe + Folic acid</td>
<td>Placebo (Ca)</td>
<td></td>
</tr>
</tbody>
</table>

Main hypotheses:

1) SQ-LNS consumed in pregnancy promotes fetal growth

2) ”Comprehensive SQ-LNS use” promotes healthy growth by 18 months of age
Findings: SQ-LNS and Fetal growth (1)

- Prenatal SQ-LNS supplementation:
  - Increased birth weight compared with IFA and MMN
    - (including WAZ, and BMI2Z, and trend toward reducing LBW).
  - In pairwise comparison with IFA
    - increased mean birth wt by +85 g (WAZ +0.19 and BMI2Z +0.21)
    - reduced risk of LBW by 39%
Findings: SQ-LNS and Fetal growth (2)

• Effect of SQ-LNS more pronounced in first-time mothers:
  
  ➢ Increased mean birth length, weight, and head circumference when compared to IFA.
  
  ➢ Similar differences when comparing with MMN.
Findings: SQ-LNS and child growth by 18 mo of age

- SQ-LNS provided through much of the “first 1000 days”:
  - Increased attained length and weight compared to IFA group
    - +0.85 cm; +0.28 in LAZ; +0.30 kg; +0.24 in WAZ
  - Reduced the prevalence of stunting compared to IFA (8.9% v. 15.1%).
Length-for-age z-score from birth to 18 mo of age

### Graph

- **Birth**, **3 mo**, **6 mo**, **12 mo**, **18 mo**

### Axes
- **Length-for-age z-score**
  - Birth: -0.6
  - 3 mo: -0.6
  - 6 mo: -0.6
  - 12 mo: -0.6
  - 18 mo: -0.6

### Lines
- **LNS**
- **MMN**
- **IFA**

### Values
- **-0.4**
- **-0.8**
- **-1.2**
Conclusions

SQ-LNS consumption:

• improved birth outcomes among primiparous women; the impacts were consistent for weight, length, head circumference

• reduced stunting by 18 mo of age; impact is attributable to differences in size at birth
Interpretation (1)

• Prenatal SQ-LNS supplementation may help offset the influence of risk factors for small birth size in vulnerable women.

• Low rate of stunting by 18 mo of age (12%) in Ghana suggests fewer constraints on child growth, hence nutrition-only interventions may be effective.
Research recommendation

• Investigate reasons for response to LNS intervention in some but not in other contexts

• In contexts such as Ghana, would milk-containing LNS be more efficacious than LNS without milk?

• Assess LNS interventions in the context of programmatic initiatives that integrate nutrition into more comprehensive strategies
Action recommendations

• Use of SQ-LNS in programs should be preceded by a needs assessment/situation analysis

• Program planners should begin with a smaller-scale program, before taking it to scale.

• LNS intervention may be accompanied by adequate access to health care and/or better sanitation and hygiene or stronger response
Acknowledgments

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Thank you