NUTRITION and Child Growth & Development

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Nutrition Basics

• IYCF = infant and young child feeding, to 2 years
• WHO-recommended feeding practices for:
  – Breastfeeding (early initiation; exclusive BF; continued BF)
  – Complementary feeding (e.g. amount, consistency, frequency, diversity & types of foods), including:
    • Safe preparation & storage of complementary foods (relevant to WASH)
    • Responsive feeding practices (relevant to ECD)
• Established indicators:
  – Feeding practices (8 core WHO/UNICEF indicators)
  – Anthropometric measures (e.g., weight for age, height for age, weight for height, arm circumference)
• Reduction in stunting (very short height for age) is a key goal
Key window for nutrition interventions

Preconception through pregnancy
0-6 mo: Exclusive breastfeeding
6-24 mo: Complementary feeding

Guiding principles for complementary feeding (2003; 2005)

World Health Organization
Outline

• Impact of nutrition interventions on linear growth (child’s height)
• Impact of nutrition on child development
• The need for combined interventions
Impact of nutrition on child growth
Prenatal nutrition interventions

- Iron & folic acid supplements
- Multiple micronutrient supplements
- Balanced protein-energy supplements
- Fortified foods for pregnant women

- Potential for major impact on stunting, but evidence is mixed
A. Multiple micronutrient supplements (usually compared with iron & folic acid)

*Meta-analysis in 2009 (Fall et al.):*
- Small but significant increase in birth weight (+22 g) but not birth length (+0.06 cm)
  - Measurement issues?
- 11-17% reduction in low birth weight
- Impact only evident in mothers with *higher* BMI

*Meta-analysis in 2012 (Ramakrishnan et al.):*
- Increase in mean birth weight (+53 g); data on birth length not presented
- 14% reduction in low birth weight
B. Balanced protein-energy supplementation

Meta-analysis in 2003 (Kramer & Kakuma):
• Increase in mean birth weight (+38 g) but not birth length (+0.1 cm)
• 32% reduction in small-for-gestational-age births
• Larger effect on birth weight in hungry season and in undernourished women

Meta-analysis in 2012 (Imdad & Bhutta):
• Increase in mean birth weight (+73 g); did not report birth length
• 32% reduction in LBW and 34% reduction in SGA births
• Larger effect on birth weight in undernourished women
C. Fortified foods for pregnant women

*Lipid-based nutrient supplement (LNS)* *(Huybregts et al. Am J Clin Nutr 2009), Burkina Faso*

- LNS: 373 kcal/d & similar micronutrients as MMN tablets
- LNS group (compared to MMN):
  - Birth weight +31 g (p=0.2)
  - Birth length +0.46 cm (p=0.001)
    - effect greater in mothers with BMI < 18.5 (+1.2 cm)

- Same research group previously showed that MMN (vs. control) increased birth length by 0.36 cm; thus predicted impact of LNS vs. control would be 0.46 + 0.36 = **0.82 cm** (effect size 0.33)
Exclusive breastfeeding 0-6 mo

- Large impact on infant survival
- Little evidence of impact on stunting
  - Effect may be more likely in populations with high rates of infection during the first 6 mo postpartum, where promotion of exclusive breastfeeding may reduce infection and thus be more likely to promote linear growth than in populations where such infections are less common
  - Insufficient evidence to evaluate this question at present
Complementary feeding 6-24 mo

• Several strategies:
  – Educational approaches
  – Increasing energy density of complementary foods
  – Provision of complementary food
  – Fortification

• Potential for major impact on stunting but evidence is mixed
• Educational approaches – mixed results
  – Most showed little or no impact
  – Peru study illustrated substantial potential to improve linear growth (Effect size=0.5): *emphasized consumption of nutrient-rich animal-source foods & was conducted in a population where animal-source foods were available & affordable*
  – Two recent studies (Shi et al.; Vazir et al.) show modest impact (Effect size ~0.2): *both emphasized key messages including dietary diversity and animal-source foods*
Complementary Feeding - 2

• Interventions to increase energy density – mixed results
  – Of 5 studies, 2 had positive impact but 3 had no impact on energy intake or growth
  – May be effective when traditional complementary food has low energy density & infant unable to compensate by increasing volume of food consumed or feeding frequency
Complementary Feeding - 3

- Provision of complementary food – mixed results
  - Average effect size ~0.2-0.3, but wide range
    - May depend on food security of target population
    - May depend on nutrient quality of food provided
  - Two studies directly compared food + education vs. education only (both in S Asia): somewhat greater impact when food included
• Fortification (or improved bioavailability) *alone* has little effect on linear growth
  – Exception: fortified vs. unfortified milk powder in India
• Combination of macro- and micro-nutrients in may have a larger impact
• Nutrient quality of fortified products is likely to be important
  – Amount and bioavailability of nutrients needed for growth
  – Inclusion of milk
  – Essential fatty acids
Summary of impact of nutrition interventions on stunting

- Nutrition interventions (alone) have had a modest impact on linear growth
  - Need to be realistic about expected impact of nutrition interventions
- However, impact on % with very low height (stunting) may be larger than effect on mean height
Impact of nutrition on child development
Potential mechanisms for the effect of nutrient deficiency on children’s cognitive, motor, and socio-emotional development

From: Prado & Dewey, A&T Technical Brief
1) Adequate nutrition during pregnancy and the first two years is necessary for normal brain development, laying the foundation for future cognitive and social ability, school success, and productivity.

2) Priority should be given to the prevention of:
   - Severe acute malnutrition
   - Intrauterine growth retardation
   - Stunting
   - Iron-deficiency anemia
   - Iodine deficiency
3) There is growing evidence for beneficial effects on ECD of:
- Breastfeeding promotion
- Pre- and post-natal multiple micronutrient supplementation
- Pre- and post-natal supplementation with essential fatty acids
- Fortified food supplements provided during pregnancy and to the child from 6 to 24 mo

4) An integrated approach is likely to be most effective for promoting optimal child development, i.e., interventions that combine improved nutrition with other strategies such as enhancing the home environment and the quality of caregiver-child interaction.
The need for combined interventions

- Nutrition, infection control & care
- Prenatal + postnatal (and possibly pre-conception)
- Macronutrients + micronutrients: Adequate supply of macronutrients may be needed to ensure growth response to micronutrients
How nutrition can reduce the negative impact of infections on child growth

1. Strengthening the immune system, thereby reducing the severity and duration of infections
2. Providing extra amounts of nutrients to compensate for poor absorption during infection, losses during diarrhoea, reallocation due to immune system activation or reduced appetite during infection
3. Providing nutrients for catch-up growth following infection, particularly those needed to build lean body tissue such as protein, potassium, magnesium, phosphorus, zinc and sodium
4. Preventing poor appetite caused by micronutrient deficiencies, thereby facilitating catch-up growth
5. Favoring the growth of beneficial bacteria in the gut that enhance gut function and immune defenses
Trials with combined nutrition + infection control are underway

- **WASH Benefits** (water, sanitation and hygiene interventions: singly, combined or in combination with nutrition intervention)
- **SHINE** (independent and combined effects of improved water, sanitation and hygiene and improved infant feeding)

Both target mainly the postnatal period
Little evidence on impact of combined pre- and postnatal nutrition interventions

- Key trials conducted in 1970s
- INCAP trial in Guatemala
  - Fortified food (atole) with high milk content
- Bogota study in Colombia
  - Child’s food ration included milk
- Intervention trial with fortified food supplements provided both pre- and postnatally not attempted since
Trials with combined pre- and postnatal nutrition are underway

• iLiNS Project: iLiNS-DYAD trials in Malawi and Ghana
  – Efficacy of maternal LNS given during pregnancy & first 6 mo postpartum + child LNS given 6-18 mo

• The Early Nutrition and Immune Development (ENID) Trial in the Gambia
  – Efficacy of prenatal and infancy nutritional supplementation, focused on infant immune development

• Rang-Din Nutrition Study in Bangladesh
  – Program efficacy study with 4 arms – one arm includes maternal LNS given during pregnancy & first 6 mo postpartum + child LNS given 6-24 mo
Next steps?

• Evaluate impact of combined prenatal and postnatal nutrition, ECD enrichment and prevention/control of infection throughout the 1000 days
  – Efficacy
  – Effectiveness

• Understand role of pre-conception nutrition (trials underway)

• Understand role of maternal mental health