Systematic review of the efficacy and effectiveness of complementary feeding interventions

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Complementary feeding is a key window for intervention

- Age range of complementary feeding (6-24 mo) is the time of peak incidence of
  - Growth faltering
  - Micronutrient deficiencies
  - Morbidity, e.g. diarrheal disease

- After 2 years, difficult to reverse effects of malnutrition
  - Stunting
  - Effects on brain function due to micronutrient deficiency?

- A food-based, comprehensive approach may be more effective and sustainable than programs targeting individual nutrient deficiencies
Guiding principles for complementary feeding of the breastfed child  
(PAHO/WHO 2003)

1. Age of introduction of complementary foods
2. Maintenance of breastfeeding
3. Responsive feeding
4. Safe preparation & storage of complementary foods
5. Amount of complementary foods needed
6. Food consistency
7. Meal frequency and energy density
8. Nutrient content of complementary foods
9. Use of vitamin/mineral supplements or fortified products
10. Feeding during and after illness
Scope of Review

- Interventions in developing countries that targeted children 6-24 mo
- Outcomes measured: growth, morbidity, child development, micronutrient intake, micronutrient status
- Studies that assessed only the impact on feeding practices were not included
- Generally focused on reports from 1996-2006
## Number of papers included

<table>
<thead>
<tr>
<th>Source</th>
<th>Efficacy trials</th>
<th>Effectiveness studies/program reports</th>
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Intervention Strategies

- Education as the main treatment
- Complementary food or a food product offering extra energy (with or without added micronutrients) provided as the only treatment
- Provision of food combined with some other strategy, usually education for mothers
- Fortification of complementary foods (central or home-fortification) with micronutrients (with no difference in energy provided to intervention vs. control groups)
- Increased energy density and/or nutrient bioavailability of complementary foods via simple technologies
Effect size (ES) =

Difference betw. intervention & control groups

Pooled SD
Impact on growth outcomes via educational approaches: efficacy trials

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<th>Author, date</th>
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### Impact on growth outcomes via educational approaches: effectiveness/program studies

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## Impact on growth outcomes via provision of complementary food

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Impact on growth outcomes via comp. food + education: efficacy trials

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^significant in children < 15 mo and low in WAZ or LAZ at baseline
Impact on growth outcomes via comp. food + education: effectiveness/program studies

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^significant only in children < 6 mo at baseline

^^significant only in children < 15 mo and underweight or stunted at baseline
Impact on growth outcomes via fortification of comp. foods: efficacy trials

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Impact on growth outcomes via interventions to increase energy density of complementary foods

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Effect size for weight growth of different intervention strategies

ED = Education; FD = Complementary food; FD+ED = Education + complementary food; FT = Fortification of comp. foods; EN = Increased energy density

Excluding Obatolu, 2003 (outlier)
Effect size for linear growth of different intervention strategies

ED = Education; FD = Complementary food; FD+ED = Education + complementary food; FT = Fortification of comp. foods; EN = Increased energy density

Excluding Obatolu, 2003 (outlier)
Impact of complementary feeding interventions on morbidity outcomes

- Only 10 of 42 papers presented data on morbidity.
- Most showed no impact, but generally not designed or powered to evaluate morbidity as a primary outcome.
Impact of complementary feeding interventions on morbidity outcomes

- 4 studies showed reduced morbidity:
  - Education only; Brazil (Vitolo, 2005)
    - Reduced diarrhea and URI
  - Food + education; Vietnam (Schroeder, 2002)
    - Reduced URI
  - Fortified CF; India (Sazawal, 2007)
    - Reduced diarrhea, LRI and fever
  - Fortified CF; Pakistan (Sharieff, 2006)
    - Reduced diarrhea and fever
Impact of complementary feeding interventions on morbidity outcomes

- 2 studies showed increased morbidity:
  - Food + education; India (Bhandari, 2001)
    - Increased fever & dysentery
    - Possibly due to reduced breastfeeding
  - Increased energy density (Moursi, 2003)
    - Increased URI
Impact of complementary feeding interventions on child development

- Only 4 of 42 papers presented data on development.

  - % walking at 12 mo:
    - 25% in non-intervention group
    - 36% with foodlet; 39% with Sprinkles; 49% with fat-based fortified product

- No significant impact of fortification in South Africa (Oelofse, 2003) or India (Dhingra, 2004).

- Provision of extra energy increased mental scores in Indonesia, but only in the subgroup with low initial length-for-age (Pollitt, 2002).
Impact of complementary feeding interventions on micronutrient intake

- Education alone can increase intake of Fe (by ~24%) and Zn (by ~26%)

- Soaking + germination had no significant effect in Tanzania (Mamiro, 2004)

- Fortification strategies can have a much larger impact
  - Fe intake increased by 145-207%
  - Zn intake increased by 201-271%
  - Vit A intake increased by 107-2300%
Impact of complementary feeding interventions on Fe status

- Education alone improved Fe status in some sites (India; China) but not others (Brazil; Nicaragua)
  - Overall impact +4 g/L Hb, -5 PP anemia

- Provision of Fe-fortified food
  - Overall impact +4-6 g/L Hb, -13-17 PP anemia (12 studies)

- Home fortification
  - Overall impact +8 g/L Hb, -21 PP anemia (7 studies)
Only 5 studies reported plasma Zn

Four studies evaluated a fortified comp. food (3-6.5 mg/d Zn); none had signif. impact

One study (South Africa) showed increased plasma Zn with home-fortification (10 mg/d Zn)
Impact of complementary feeding interventions on vitamin A status

- 7 studies reported vitamin A status
- All involved a fortified comp. food or home fortification
- Amount of vitamin A provided ranged widely: 83-658 ug RE/d
- Significant increase in serum vitamin A in 4 of the 5 studies with fortified comp. foods
- No significant impact in 2 studies of home-fortification, probably due to vit A supplementation programs
Conclusions

- No single universal “best” package of components in complementary feeding interventions
- Impact is context-specific
  - Initial prevalence of malnutrition
  - Degree of household food insecurity
  - Energy density of traditional complementary foods
  - Availability of micronutrient-rich local foods
Conclusions - Growth

- Growth may not be the most sensitive indicator of impact
- Impact may be greater in younger age groups: should begin CF programs during infancy
- Effect sizes generally modest (0.1-0.5), but potential larger if optimal design and implementation (0.5-0.6)
Conclusions – Growth (cont.)

- Educational approaches more likely to have impact if there is an emphasis on nutrient-rich animal-source foods

- Provision of food – variable results
  - Greater impact in Africa & S Asia – due to food insecurity?
  - 2 studies compared food + education vs. education only: somewhat greater impact when food included
Conclusions – Growth (cont.)

- Most of the foods provided were fortified, so can’t distinguish impact of increased energy/protein/fat from micronutrients.
  - In Ghana, impact on weight gain partially explained by increased energy intake, but impact on length gain related to change in plasma fatty acid profile.

- Micronutrient fortification alone has little effect on growth.
  - Exception: relatively large study in India in which many children stunted at baseline & fortified product resulted in reduced morbidity.
Conclusions – Growth (cont.)

- Interventions to increase energy density – results mixed
  - 3 of 5 studies had no impact on energy intake or growth
  - 2 of 5 studies had positive impact on growth

- May be effective when traditional CF has low energy density & infant unable to compensate by increasing volume of food consumed or feeding frequency
Conclusions - Morbidity

- Few studies had adequate N to evaluate morbidity
- Mixed results
  - Beneficial impact in 4 studies
  - Adverse impact in 2 studies
- CF interventions need to include counseling on maintaining breastfeeding, responsive feeding and hygienic practices
Conclusions - Development

- Very few studies evaluated behavioral development
- Promising results in Ghana using specially designed fortified fat-based complementary foods
- Future evaluations of CF interventions should include assessment of child development – may be more sensitive than growth
Conclusions - Micronutrient intake

- Very difficult to achieve adequate Fe intake from local foods without fortification, at 6-12 mo
- Fortification increased Fe intake by 5-11 mg/d
- Can achieve adequate Zn and Vit A intakes from local foods, but requires careful attention to dietary choices
- Fortification can help ensure Zn and Vit A intakes when nutrient-rich local foods are costly or unavailable (e.g. seasonally)
Conclusions – Micronutrient status

- Education can have a positive impact on Fe status if Fe-rich foods are emphasized.
- A larger impact on Fe status can be expected from use of fortified products (reduction of 13-21 percentage points in prevalence of anemia).
- Little or no impact of fortification on plasma zinc – due to low absorption?
- Results mixed regarding fortification with Vit A
  - Positive impact in several studies
  - Little impact in some studies, probably due to concomitant vit A capsule distribution programs.
Overall Conclusions

- Educational approaches can be effective, but in many situations a greater impact may be seen when combined with home-fortification or provision of fortified foods.

- To be most cost-effective and avoid displacement of breast milk, the amount of food provided should be modest: no more than 200 kcal/d at 6-12 mo.

- Biggest challenge: going to scale with a combination of the most cost-effective components, while assuring adequate delivery and sustainability.