

Guidelines for complementary feeding and effective interventions for high-burden populations

Kathryn G. Dewey, PhD

Program in International and Community
Nutrition

University of California, Davis

Age range for complementary feeding (6-24 mo) is a key window for intervention

- 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?

Development of guidelines on complementary feeding

- Brown, K.H., Dewey, K.G. and Allen, L.H. *Complementary feeding of young children in developing countries: a review of current scientific knowledge*. World Health Organization, Geneva, WHO/NUT/98.1., 1998.
- Dewey, K.G. and Brown, K.H. Update on technical issues concerning complementary feeding of young children in developing countries and implications for intervention programs. *Food Nutr Bull* 2003;24:5-28.
- Pan American Health Organization / World Health Organization. *Guiding Principles for Complementary Feeding of the Breastfed Child*. PAHO, Washington DC, 2003.
- Dewey, K.G., Cohen, R.J., Rollins, N.C. Feeding of non-breastfed children 6-24 months of age in developing countries. *Food Nutr Bull* 2004;25:377-402.
- World Health Organization. *Guiding Principles for Feeding Non-breastfed Children 6-24 Months of Age*. World Health Organization, Geneva, 2005.

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

Amount of complementary food needed

- **Guideline:** Start at six months of age with small amounts of food and increase the quantity as the child gets older, while maintaining frequent breastfeeding. The energy needs from complementary foods for infants with “average” breast milk intake in developing countries are approximately:
 - 200 kcal/day at 6-8 mo
 - 300 kcal/day at 9-11 mo
 - 550 kcal/day at 12-23 mo

Food consistency

- **Guideline:** Gradually increase food consistency and variety as the infant gets older, adapting to the infant's requirements and abilities.
 - Infants can eat pureed, mashed and semi-solid foods beginning at 6 months.
 - By 8 months most infants can also eat “finger foods” (snacks that can be eaten by children alone).
 - By 12 months, most children can eat the same types of foods as consumed by the rest of the family.
 - Avoid foods that may cause choking (i.e., items that have a shape and/or consistency that may cause them to become lodged in the trachea, such as nuts, grapes, raw carrots).

Meal frequency and energy density

- **Guideline:** Increase the number of times that the child is fed complementary foods as he/she gets older. The appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding. For the average healthy breastfed infant, meals of complementary foods should be provided:
 - 2-3 times per day at 6-8 mo
 - 3-4 times per day at 9-11 and 12-24 mo[With additional nutritious snacks offered 1-2 times/day, as desired.]

Meal frequency and energy density

- Recommended meal frequency is based on a minimum energy density of 0.8 kcal/g and functional gastric capacity of 30 g/kg/meal.
- If energy density or amount of food per meal is low, more frequent meals may be required.
- Excessive meal frequency may reduce breastfeeding frequency and breast milk intake.

Nutrient content of complementary foods

Guidelines:

- Feed a variety of foods to ensure that nutrient needs are met.
- Meat, poultry, fish or eggs should be eaten daily, or as often as possible. Vegetarian diets cannot meet nutrient needs at this age unless nutrient supplements or fortified products are used.
- Vitamin A-rich fruits and vegetables should be eaten daily.
- Provide diets with adequate fat content.
- Avoid giving drinks with low nutrient value, such as tea, coffee and sugary drinks such as soda. Limit the amount of juice offered so as to avoid displacing more nutrient-rich foods.

Percentage of each nutrient needed from complementary foods (developing countries)

<u>Nutrient</u>	<u>6-8 mo</u>	<u>9-11 mo</u>	<u>12-23 mo</u>
Calcium	29	36	69
Iron	98	98	97
Zinc	80	83	87

Percentage of each nutrient needed from complementary foods (developing countries)

<u>Nutrient</u>	<u>6-8 mo</u>	<u>9-11 mo</u>	<u>12-23 mo</u>
Vit A	16	23	31
Riboflavin	40	45	62
Vit B6	80	80	90
Vit C	7	17	27
Vit D	92	94	94

Use of vitamin-mineral supplements or fortified products for infant and mother

Guidelines:

- Use fortified complementary foods or vitamin-mineral supplements for the infant, as needed.
 - Predominantly plant-based diets provide insufficient amounts of key nutrients
 - Animal-source foods are costly and amounts consumed by infants may be insufficient
- In some populations, breastfeeding mothers may also need vitamin-mineral supplements or fortified products, both for their own health and to ensure normal concentrations of certain nutrients (particularly vitamins) in their breast milk. [Such products may also be beneficial for pre-pregnant and pregnant women].

Feeding during and after illness

- **Guideline:** Increase fluid intake during illness, including more frequent breastfeeding, and encourage the child to eat soft, varied, appetizing, favorite foods. After illness, give food more often than usual and encourage the child to eat more.

Systematic review of the efficacy and effectiveness of complementary feeding interventions

[Mat Child Nutr 2008;4:24-85](#)

Kathryn G. Dewey, PhD

Seth Adu-Afarwuah, PhD

Program in International and Community Nutrition
University of California, Davis

Supported by the Mainstreaming Nutrition Initiative
with funding from the World Bank

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

Source	Efficacy trials	Effectiveness studies/program reports
PubMed	12	0
Snowball technique	11	7
Personal contacts	6	6
Total (42)	29	13

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

Author, date	Site	N	ES, weight	ES, length
Bhandari, 2001	India	188	0.14	0.08
Bhandari, 2004	India	829	0.02	0.05
Penny, 2005	Peru	338	0.34*	0.49*
Roy, 2005	Bangladesh	183	0.58*	0.09
Santos, 2001	Brazil	404	0.09	0.04
Vitolo, 2005	Brazil	397	-	NS

Impact on growth outcomes via educational approaches: effectiveness/program studies

Author, date	Site	N	ES, weight	ES, length
Gulden, 2000	China	495	0.96*	0.64*
Guyon, 2005	Madagascar	NA	-0.06	0.14
Kilaru, 2005	India	242	0.16	-
Maluccio, 2004	Nicaragua	NA	-	0.12

Impact on growth outcomes via provision of complementary food

Author, date	Site	N	ES, weight	ES, length
Adu-Afarwuah, 2006	Ghana	194	0.31*	0.26*
Beckett, 2000	Indonesia	78	0.03	0.02
Kuusipalo, 2006	Malawi	112	0.51*	0.67*
Lartey, 1999	Ghana	190	0.57*	0.69*
Obatolu, 2003	Nigeria	60	2.99*	1.81*
Oelofse, 2003	South Africa	30	-0.02	-0.04
Owino, 2007	Zambia	106	0.30	0.37*
Santos, 2005	Brazil	191	0.10	-0.02

Blue font: fortified complementary foods; Red font: lipid-based supplements

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

Author, date	Site	N	ES, weight	ES, length
Bhandari, 2001	India	178	0.32*	0.25
Roy, 2005	Bangladesh	189	0.66*	0.32 [^]

[^]significant in children < 15 mo and low in WAZ or LAZ at baseline

Impact on growth outcomes via comp. food + education: effectiveness/program studies

Author, date	Site	N	ES, weight	ES, length
Gartner, 2007	Senegal	1676	NS	NS
Hossain, 2005	Bangladesh	2388	NS	NS
Lutter, 2008	Ecuador	319	0.24*	0.14
Lopez de Romana, 2000	Peru	NA	NA	NS
Rivera, 2004	Mexico	650	NA	0.12 [^]
Schroeder, 2002	Vietnam	230	0.18 ^{^^}	0 ^{^^}

[^]significant only in children < 6 mo at baseline

^{^^}significant only in children < 15 mo and underweight or stunted at baseline

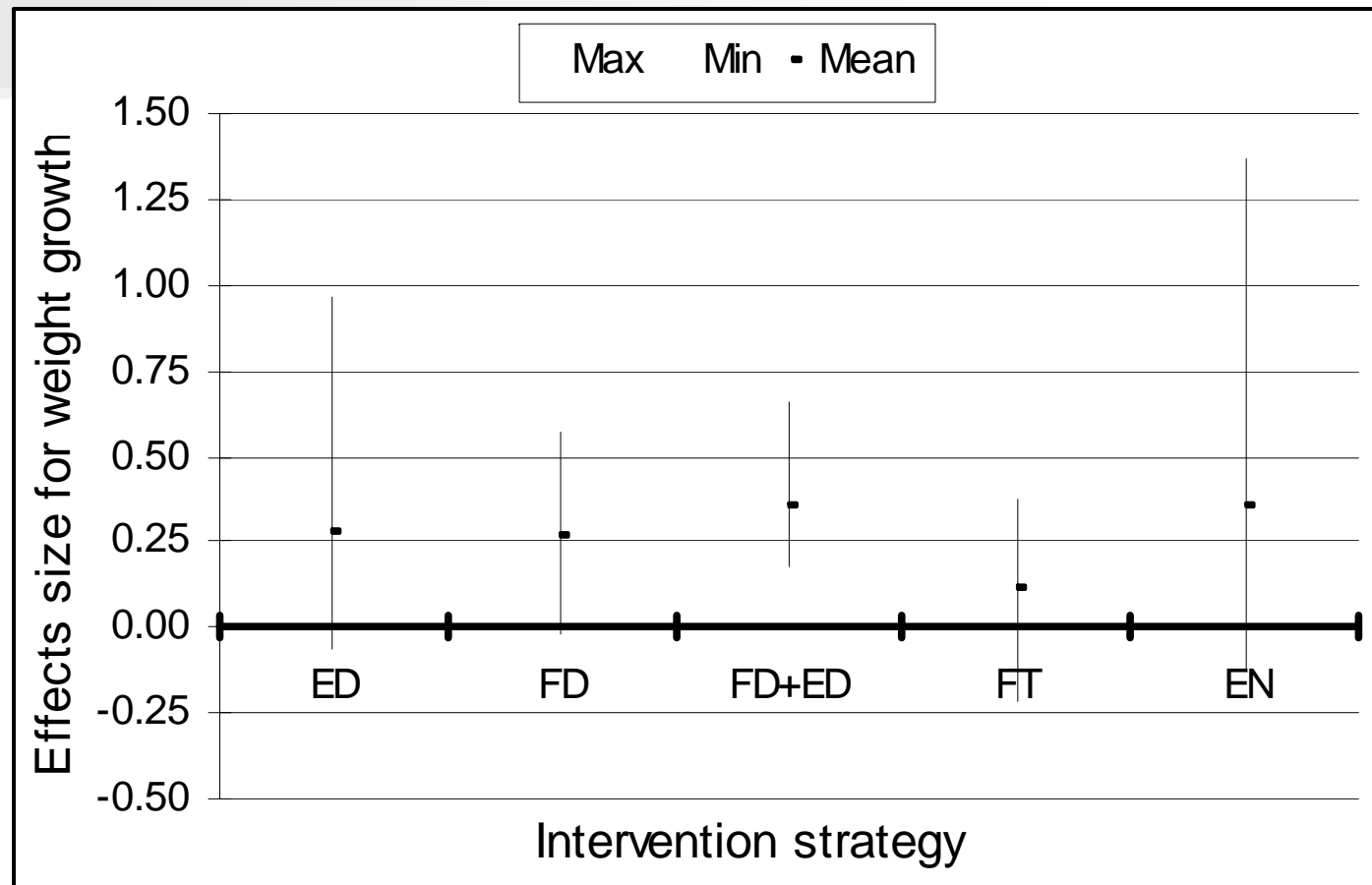
Impact on growth outcomes via fortification of comp. foods: efficacy trials

Author, date	Site	N	ES, weight	ES, length
Adu-Afarwuah, 2007	Ghana	296	0.03	-0.02
Dhingra, 2004	India	570	0.37*	0.45*
Faber, 2005	South Africa	292	0.00	0.11
Giovannini, 2006	Cambodia	127	-0.22	0.07
Lartey, 1999	Ghana	190	0.20	0.08
Smuts, 2005	South Africa	99	0.29	0.05

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

Author, date	Site	N	ES, weight	ES, Length
Hossain, 2005	Bangladesh	100	0.25	0.32
John, 1993	India	42	1.37*	0.71*
Mamiro, 2004	Tanzania	258	NA	-0.04
Moursi, 2003	Congo	75	-0.13	0.40*
Owino, 2007	Zambia	113	-0.07	-0.25

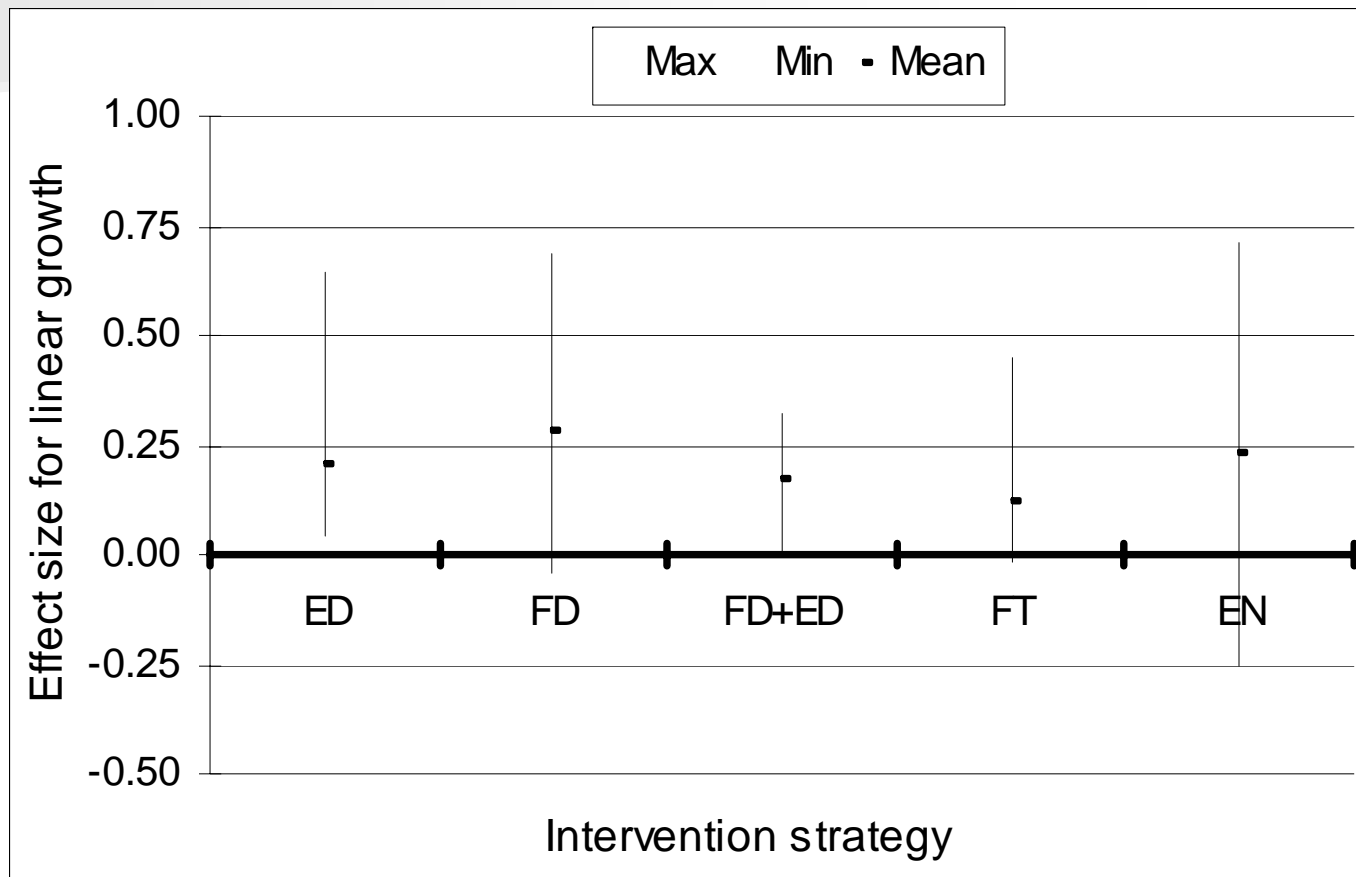
Effect size for weight growth of different intervention strategies



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

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 - 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 – 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)

Overall Conclusions

- Educational approaches can be effective, but in many situations a greater impact may be seen when food or food supplements provided
- 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
- Quality of foods provided may be more important than quantity
 - Micronutrient adequacy
 - Lipid content?
 - Inclusion of milk?