

# Recent Evidence of the Effectiveness of Educational Interventions for Improving Complementary Feeding Practices in Developing Countries

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## Summary

**Inappropriate complementary feeding practices have been identified as the major causes of malnutrition in young children in developing countries. This article reviewed literature on complementary feeding educational interventions from 1998 onwards. The purpose of this study was to provide evidence from published studies in the past decade on the effectiveness of educational intervention programs on improving complementary feeding practices in the developing world. The literature search was performed through PubMed/Medline database with the following key words: infant feeding, weaning and intervention, and identified a total of 15 original educational intervention studies. Evidence from these studies supports that educational intervention can effectively improve complementary feeding practices and child nutrition and growth. The intervention should be culturally sensitive, accessible and integrated with local resources.**

**Key words: infant nutrition, complementary feeding, educational intervention.**

## Introduction

Childhood malnutrition remains a widespread problem in the developing world. Over 50-million children under the age of 5 years in the developing world were wasted, 27% of children were underweight and 32% were stunted [1]. Malnutrition is associated with childhood deaths, diseases and infections, as well as children's delayed mental and motor development [2–6].

In most developing countries, childhood malnutrition rates rose significantly at 6 months of age when complementary foods starts being introduced [7–11]. Inappropriate complementary feeding practices such as poor quality and insufficient quantity of complementary foods have been identified as the major causes of malnutrition in young children [7–9]. The problematic complementary feeding practices are associated with caretakers' poor knowledge, lack of information and being restricted by traditional beliefs [10, 11]. It is essential to give caregivers necessary knowledge and information to alter their inappropriate feeding behaviors. Nutrition education, therefore, is a critical strategy of intervention to improve child complementary feeding practices.

Caulfield *et al.* [12] systematically reviewed literature on complementary feeding interventions through 1997. The findings from five randomized controlled trials (RCTs) revealed an increase in infant total energy intake (65–300 kcal day<sup>-1</sup>) and improvements in growth (0.04–0.46 SD). Most of the intervention programs produced positive impacts on caregivers' feeding practices and children's dietary intake and growth [12].

During the past decade, a number of educational intervention programs have been published and added new evidence for the effects of educational intervention on children's growth and nutritional status. The purpose of this review was to provide evidence from published studies since 1998 on the effectiveness of educational intervention programs on improving complementary feeding practices in the developing world.

## Methods

The literature search was firstly performed through PubMed/Medline database with the following Medical Subject Headings (MeSH) key words: 'infant' 'complementary feeding' and 'intervention'.

Then, the relevant references from the articles of interest were searched. The websites of some specialized organizations including the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) were also scrutinized.

The main criteria for study selection were epidemiological studies that used nutrition education or counseling as intervention strategy aimed at improving complementary feeding practices. We covered cross-sectional and cohort studies, as well as RCTs. The interventions could be delivered in various settings such as hospital, community or home, and by various providers including health care professionals, community leaders and peers. We excluded literature reviews, cost-benefit analysis studies and studies in developed countries. We also excluded epidemiological studies that used food supplementation alone as intervention strategy and that examined impacts on health care providers as only outcomes because they were beyond the scope of this review.

Our search identified 63 records, including 42 from original searches through PubMed plus 21 through reviewing references and relevant websites. After removing duplicates, we obtained 50 records, of which 20 were excluded based on the title or abstract review using the study selection criteria described above. A total of 30 studies were retrieved full text

and reviewed. Of the 30 records, 15 were rejected because they did not meet study inclusion criteria (e.g. not original studies, using supplementation alone as intervention strategies, cost analysis, focusing on breastfeeding, conducted in developed country, i.e. Germany, and evaluating impacts on health care providers only). After examining against the inclusion and exclusion criteria, a total of 15 studies were eligible for inclusion in this review (Fig. 1). One author originally searched these records, and two authors independently reviewed the records. Any problems regarding eligibility were discussed and agreed upon by the authors.

## Results

All these 15 intervention studies employed health education and communication strategies to disseminate knowledge and information on complementary feeding. These studies showed positive impacts on caretakers' feeding behaviors and children's dietary intake and growth. Table 1 summarizes the study sites, subjects, intervention strategies, main findings and major limitations of these studies.

Interpersonal communication such as individual counseling, home visit and group training is an important method for disseminating educational knowledge and information. For example, a study in

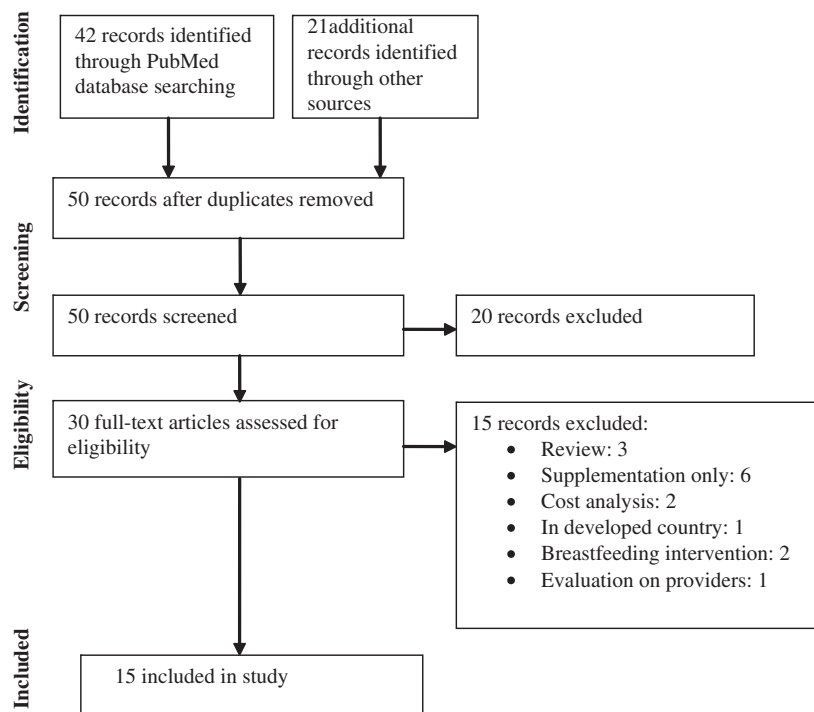


FIG. 1. Literature search and selection.

TABLE 1  
*Nutrition education intervention programs to improve infant complementary feeding in developing countries*

Site	Subjects	Intervention strategies	Main findings
India [9]	Five hundred and fifty-two in the intervention (four communities) and 473 in the control (four communities).  Followed from birth to 18 months of age.	Nutrition counseling, monthly home visits, group training, feeding demonstration, community mobilization.	Children in the intervention group got greater length gain (0.32 cm, 95% CI: 0.03–0.61) than did controls. But there was no difference in weight.  The intervention group had higher energy intakes (531 kJ day <sup>-1</sup> at 9 months and 1230 kJ day <sup>-1</sup> at 18 months).
India [13]	Sixty-nine infants aged 5–11 months each from the intervention and control were followed till 24 months.	Monthly nutrition education, growth chart.	Girls in the intervention group had a weight velocity 77 g per month greater than controls. The intervention increased feeding frequency, dietary diversity and consumption of bananas.
Bangladesh [14]	Two hundred and eighty-two moderately malnourished children aged 6–24 months from 15 communities were randomized to two intervention groups and one comparison group.	INE group received nutrition education (group training and demonstration of preparing <i>khichuri</i> ), the INE + SF group received nutrition education and food supplementation.	The WAZ score was 0.28 higher in the INE group and 0.43 higher in the INE + SF group compared to the comparison group. No significant difference in nutritional status between the INE and INE + SF groups.
Peru [15]	One hundred and eighty-seven children from six communities in intervention and 190 from six communities in control. Followed from birth to 18 months of age	Nutrition counseling, group training, demonstration of recipe preparation, recommended recipes: thick puree, adding liver, egg, fish to infant diet	The intervention group was 1.07 cm (95% CI: 0.49–1.65) taller and 0.30 kg (95% CI: 0.06, 0.53) heavier than the controls. The increment in WAZ score of the intervention group was 0.29 (95% CI: 0.1–0.47) higher, and increment in HAZ was 0.39 (95% CI: 0.21–0.56) higher.
Brazil [16]	Twenty-eight health centers were paired and randomized to treatment. Two hundred and eighteen children <18 months in intervention and 206 controls were visited 8, 45 and 180 days after initial consultation.	Nutrition education on IMCI feeding guidelines (feeding frequency, increase energy and nutrient density, add animal protein and micronutrients).	The intervention group had higher daily fat, energy and nutrient intake, and better knowledge. Among those children entered the intervention after 1 year of age, weight gain was higher in intervention group (1.48 vs. 1.14 kg); WAZ and WHZ score gain was higher in intervention group (0.3 vs. -0.1; and 0.4 vs. 0.1).
Iran [17]	Four hundred and six children aged 0–59 months from intervention group and 405 controls. Intervention lasted for 12 months.	Training influential people, girls and tribal teachers to disseminate use of eggs, vegetables and legumes.	The intervention group achieved 0.42 kg heavier in weight, 1.6 cm longer in length, 0.5 cm longer MAC, 0.45 greater WAZ, 0.41 greater HAZ and 0.266 greater WHZ than controls ( $p < 0.05$ ).

(continued)

TABLE 1  
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Site	Subjects	Intervention strategies	Main findings
Viet Nam [18]	Forty-six households were selected from four PANP communities and 25 from comparisons. Two children from each household, one in PANP program, another not.	Nutrition counseling, group training, community mobilization.	The WAZ was 0.63 higher and the WHZ was 0.74 higher in the intervention group than the comparison. The intervention group performed better in feeding frequency and hand-washing practices.
Viet Nam [19]	Twelve communities were randomized to treatment. One hundred and nineteen children 5–25 months each in intervention and comparison. Followed for 6 months.	Nutrition education, growth monitoring.	The intervention group had higher consumption of all food groups and higher nutrient and energy intakes. Did not report effects on growth.
West Africa [20]	Two cross-sectional surveys (before/after intervention): 1807 children 6–35 months at baseline and 1676 at the second survey.	Nutritional education, growth monitoring and food supplementation.	The wasting rate of the intervention group decreased from 13.7 to 8.6%, compared to from 11.3 to 10.8% in the control group.
Malawi [21]	Eighty-seven and 42 breastfed children aged 9–23 months from three intervention villages and one control village.	Four nutrition education sessions, individual counseling, use of soaked pounded maize flour, enriching maize porridge with egg, banana, oil, etc.	The intervention group had larger quantity of complementary foods and higher diet intake of energy, animal protein and micronutrient. Did not report growth data.
China [10]	Two hundred and fifty infants from two intervention townships and 245 from two control townships, recruited at birth and evaluated at 4–12 months	Monthly growth monitoring, nutrition counseling to pregnant women, complementary food recipes	The intervention group had higher WAZ (−1.17 vs. −1.93) and HAZ (−1.32 vs. −1.96), lower anemia rate (22 vs. 32%) and higher breast-feeding rate (83 vs. 75%) at 12 months.
China [22]	Three hundred and fifty-two newborns of Dai minority in Yunnan Province.	Nutrition education, growth monitoring, demonstration of preparing weaning food, integrated management of childhood diseases.	Weight was increased by 0.83 kg among male infants aged 4–5 months, 0.64 and 0.42 kg between 12–13 and 15–16 months. Prevalence of underweight decreased from 20.5% to 13.7% between 6 and 11 months, from 39.0% to 26.4% at 12–17 months.
India [23]	Four hundred and eighteen infants 4 months of age were randomized to intervention or comparison groups and followed until 12 months.	Two intervention groups: food supplementation (milk cereal supplement packet) and nutritional counseling.	Food supplementation increased energy intakes (1212–2257 kJ) and weight increment (250 g, 95% CI: 20–480 g); no effects on length; nutritional counseling alone had no impacts on weight and length, but increased energy intakes (280–752 kJ).

(continued)

TABLE 1  
*Continued*

Site	Subjects	Intervention strategies	Main findings
Bangladesh [24]	One hundred children 12–24 months of age were in the intervention group and 102 comparable children were enrolled in control group. They were followed until 5 months post-intervention.	Weekly education sessions on child nutrition, child self-feeding and parent's responsive feeding	Children in intervention group gained 0.34 kg more weight than controls. Child self-feeding behavior, diet variety and mother's knowledge were better in the intervention than control group.
Pakistan [25]	Three hundred and seventy-five children aged 6–24 months were recruited from 36 health centers and assigned to intervention or control. They were followed for 180 days post-intervention.	Health care providers received training on feeding counseling using the Integrated Management of Childhood Illness (IMCI) module, then they discussed with mothers regarding the recommended foods and frequency of feeding.	The intervention group had significantly higher weight-for-age score than the control group (−1.14 vs. −1.65). Mothers in the intervention group achieved better knowledge.

Malawi used group training and individual counseling to promote knowledge and behavior change on food selection and preparation [21]. Such training and counseling mainly targeted caregivers, usually the mothers of the children, and focused on disseminating knowledge and messages on child feeding included texture and quantity of weaning foods, feeding frequency, hygienic methods of food preparation and storage, and feeding during and after illness.

Besides including major caregivers as intervention targets, some studies also involved family members and community leaders in the intervention. In Iran, for example, nutrition information was delivered through trained influential people, tribal teachers and educated daughters in the family. The intervention significantly improved children's energy and protein intakes as well as their weight and height [17]. A study in rural India mobilized community leaders to disseminate complementary feeding knowledge. The intervention led to greater length gain and higher energy intakes among infants [9]. An integrated nutrition program conducted by the Save the Children (SC) in Viet Nam also used community mobilization strategy in helping mothers of young children adopt basic childcare skills and preparation of energy-dense meals. The intervention produced positive impacts on food hygiene, meal frequency, and weight and length growth [18].

The major issue in complementary feeding in developing countries where food is secured is the caretakers' lack of knowledge about what foods are beneficial for infant's health and development, and how to prepare these foods. Therefore an important intervention strategy in complementary feeding practices is to improve weaning food recipes and give young children more animal source protein such as meats, fish and eggs. In Peru, researchers developed

the recipes such as thick puree and adding liver, egg, fish to infant diets. The intervention group achieved greater weight gain and linear growth [15]. An intervention program in Bangladesh demonstrated preparation of improved recipes through group training and explained the benefits of specific foods on child growth, which helped addressing caregivers' concerns about adopting such recipes [14]. A study in Brazil found that through instructing the caretakers of young children to increase feeding frequency, animal protein and the energy and nutrient density of meals, the children's diet intakes and weight gain were improved [16]. The intervention in Sichuan, China also enhanced consumption of foods from animal sources, and improved children's weight and length [10]. Results from these studies provided supportive evidence to some extent for the positive effects of animal source foods on child growth.

A few studies also used growth monitoring as an intervention strategy, which helped health care providers and caregivers identify problems in child growth and adjust their feeding practices. For example, the intervention in India used growth chart and monthly nutrition education delivered by locally trained counselors to caretakers of infants aged 5–11 months. The intervention significantly improved complementary feeding behaviors, feeding frequency and diet diversity, as well as weight gain [13]. The intervention among infants of Dai minority in Yunnan, China used growth monitoring in addition to nutrition counseling, enhanced complementary food recipes and integrated management of childhood diseases as intervention approaches. The study showed a reduced prevalence of underweight among enrolled children [22]. The SC conducted a similar intervention program in a rural community of Viet Nam and revealed that the

treatment children had better dietary energy intake than comparison children did [19].

For some studies, the intervention strategies included both nutrition education and food fortification, making it hard to distinguish the individual effect of nutritional education approach. For instance, a study in West Africa integrated nutritional education, growth monitoring and food supplementation in the intervention, it is hard to decide which strategy contributed to the reduced prevalence of wasting in the intervention group [20]. A study by Bhandari *et al.* [23] in India, however, used multiple intervention and comparison groups to identify effectiveness of education and food supplementation individually. The study had two intervention groups (fortified cereal and nutritional counseling vs. nutritional counseling alone) and two control groups (receiving the same number of home visits as the intervention groups vs. receiving no intervention at all). The researchers found that food supplementation alone improved energy intake and weight gain, whereas the nutritional counseling alone had effects on energy intakes but no significant effects on weight and length gain.

### Discussion

Many factors have contributed to malnutrition in infancy, but lack of necessary knowledge and information particularly during the complementary feeding period have been identified as critical causes of poor quality and insufficient quantity in children's diets in food secured environment. Evidence from these published studies suggested that educational interventions produced positive effects on caretakers' knowledge and behaviors as well as on children's dietary intake and nutrition.

Although these studies adopted different intervention approaches, they employed at least one of the following strategies: (i) equipping caregivers with knowledge and skills necessary to perform the behavior change; (ii) raising caregivers' awareness of the benefits of behavior change; and (iii) increasing the social support from the family and community to boost behavior change. For example, the study in Bangladesh focused on explaining the role of specific food on child growth and helping caregivers understand the benefits of adopting the enhanced recipes [14]. The study in Iran employed community leaders, siblings and tribal teachers to disseminate intervention messages [17]. These strategies led to sustainable changes in the traditional concepts and practices in complementary feeding in the study regions.

However, there was substantial heterogeneity in the results for the impact on child growth from different studies. Some studies found that the intervention improved both length and weight [10, 15, 17]

while others only found improvement in length [9, 13] or weight alone [14, 16, 18, 23–25]. The increase in attained length attributed to the intervention varied from 0.32 cm [9] to 1.6 cm [17], and the increase in attained weight ranged from 250 g [23] to 830 g [22]. Some studies did not report attained weight and length, instead they only reported Z-scores [10, 14, 18, 25], growth velocity [13], increment in weight and length between two follow-up visits [16, 24] or prevalence of wasting, underweight and stunting [20]. The varied results of the effects of the intervention on child growth could possibly be explained by the following reasons:

- Differences in the age of the children at enrollment and follow-up period: Some interventions initiated at newborn period [9, 15] while others started later at 6 or 9 months of age [14, 21]; the study in Brazil measured immediate impacts of the intervention (8, 45 and 180 days after the intervention) [16] while the study by Mackintosh *et al.* [18] in Viet Nam measured long-term effects (3–4 years after the intervention). The differences in the enrollment age and length of follow-up time may lead to varied results of the intervention effects.
- Preexisting children's growth and nutritional status: For instance, the studies in Viet Nam and West Africa enrolled a high percentage of malnourished children with the baseline prevalence of underweight at 34% [20], wasting 14% [20] and stunting 43% [19]; in the Bangladesh study, all subjects were moderately malnourished at the beginning of the intervention [14]; whereas the studies in China and India had a low baseline prevalence of wasting (1%) [23] or stunting (16%) [22]. The intervention effects could be influenced by children's baseline nutrition status.
- Social and economic context where the intervention took place: For example the study in Peru was conducted among periurban population who had good food availability and ready access to professional health service [15]; whereas the study in poor communities in India where local families could not afford animal foods found low consumption of animal foods and predominantly cereal-based weaning diets even after the intervention [9].
- Different intervention strategy and intensity: Some studies not only provided group training, individual counseling and growth monitoring to the caretakers, but also mobilized the community through educating influential community leaders and key family members [9, 17, 18]; a few interventions formulated enhanced weaning food recipes [10, 14, 15] or used food supplementation [20, 23]; some interventions also addressed other health needs such as integrated management of childhood diseases [22].

- Methodological aspects such as randomized design and method of dealing with clustered data: A few studies did not use longitudinal design, instead they used pre- and post-intervention comparison from two cross-sectional surveys and could not establish causal effect [13, 18, 20]; some studies did not randomly assign treatment, being unable to effectively balance the intervention and control groups [10, 21]; one study did not control possible confounding factors which could contribute to the difference between the treatment and control groups [17]; a few studies did not account for clustering effects when analyzing clustered data [14, 16, 17] which resulted in artificially smaller standard error, over-narrow confidence intervals and spuriously significant findings [26].
- Possible publication bias: Studies with positive results are more likely to be accepted and published. These published literature may not represent all intervention studies that have been done. Moreover, the authors may tend to report the favorable results. Among the 15 literature reviewed, only five reported the impacts of the intervention on attained weight and length. One thing in common is that they all had positive effects on either weight or length or both. The remaining eight studies did not report attained weight and length, instead they used Z-scores [10, 14, 18], growth velocity [13], increment in weight and length [16], prevalence of malnutrition [20] or did not report growth data at all [21, 19]. We do not know whether these interventions had positive findings or the authors just did not report negative results.

All above factors may have influenced the conclusions of the literature and the interpretation of their results. A carefully designed, well-implemented and rigorously analyzed study is therefore needed to provide more conclusive evidence of the effectiveness of an educational intervention.

To sum up, evidence from these studies supports that educational intervention can effectively improve complementary feeding practices and thereby enhance child nutrition and growth. The effective intervention strategies that are learned from previous successful studies include: (i) the intervention should be culturally sensitive, accessible and integrated with local resources. When developing the intervention plan, researchers should get a good understanding of how local people prepare complementary foods, whether local foods are sufficient to meet nutrient requirements, what are the major problems in complementary feeding, and whether the intervention strategies are acceptable, affordable and convenient for local families; (ii) effective interpersonal communication is an important element in such an intervention targeting changing caregivers' feeding behaviors; (iii) the intervention should not only target major

caregivers (usually mothers of young children), but also involve other family members and community members to create a supportive environment for facilitating behavior change and maintenance; and (iv) the intervention should be implemented through existing healthcare services to make sure greater sustainability of the intervention over the long term.

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