An Educational Intervention to Promote Appropriate Complementary Feeding Practices and Physical Growth in Infants and Young Children in Rural Haryana, India[1]

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ABSTRACT Complementary feeding practices are often inadequate in developing countries, resulting in a significant nutritional decline between 6 and 18 mo of age. We assessed the effectiveness of an educational intervention to promote adequate complementary feeding practices that would be feasible to sustain with existing resources. The study was a cluster randomized controlled trial in communities in the state of Haryana in India. We developed the intervention through formative research. Eight communities were pair matched on their baseline characteristics; one of each pair was randomly assigned to receive the intervention and the other to no specific feeding intervention. Health and nutrition workers in the intervention communities were trained to counsel on locally developed feeding recommendations. Newborns were enrolled in all of the communities (552 in the intervention and 473 in the control) and followed up every 3 mo to the age of 18 mo. The main outcome measures were weights and lengths at 6, 9, 12, and 18 mo and complementary feeding practices at 9 and 18 mo. All analyses were by intent to treat. In the overall analyses, there was a small but significant effect on length gain in the intervention group (difference in means 0.32 cm, 95% CI, 0.03, 0.61). The effect was greater in the subgroup of male infants (difference in mean length gain 0.51 cm, 95% CI 0.03, 0.98). Weight gain was not affected. Energy intakes from complementary foods overall were significantly higher in the intervention group children at 9 mo (mean ± SD: 1556 ± 1109 vs. 1025 ± 866 kJ; $P < 0.001$) and 18 mo (3807 ± 1527 vs. 2577 ± 1058 kJ; $P < 0.001$). Improving complementary feeding practices through existing services is feasible but the effect on physical growth is limited. Factors that limit physical growth in such settings must be better understood to plan more effective nutrition programs. J. Nutr. 134: 2342–2348, 2004.

KEY WORDS: • *complementary feeding* • *educational intervention* • *child growth* • *gender* • *cluster randomization*

More than 60% of children living in South Asia are malnourished (1). Malnutrition increases the risk of child mortality; it is associated with >50% of child deaths (2) in addition to impairing child development (3). Identifying approaches to reduce the prevalence of malnutrition particularly in the vulnerable first 2 y of life is a priority in developing countries.

Malnutrition rates increase between 6 and 18 mo, the period of complementary feeding (4). Inappropriate practices such as the delayed introduction of complementary foods, low energy and nutrient density of foods offered, feeding in small amounts at meals, and food restrictions due to cultural beliefs are common even in parts of southeast Asia where incomes and food availability have improved steadily over the last decade (1). Other contributory factors for childhood malnutrition in young children are low birth weight and high morbidity (4).

An important public health question is whether educational programs to improve complementary feeding will accelerate the decline in undernutrition. Educational interventions were shown to improve feeding practices, but few of these studies were randomized controlled trials (5). Furthermore, studies tended to be on a small scale, and the strategies adopted may not be sustainable in primary health care systems that work under considerable resource constraints.

In this community-randomized controlled trial we evaluated an intervention that is likely to be sustainable even when applied on a large scale. The intervention was carefully designed, building on existing health and nutrition services, the

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involvement of a local nongovernment organization, and the specific feeding problems identified. We promoted recognition of malnutrition as a problem, complementary feeding initiation at 6 mo of age using foods that were available in homes and acceptable to mothers, appropriate portion size of feeds, optimal meal frequency and food density, and encouraging the child to eat. The effect of the intervention was measured on child feeding practices and growth between 6 and 18 mo of age. We also assessed whether promotion of appropriate complementary feeding practices had a differential effect in subgroups based on gender, caste, family income, and parental education. In the same trial, exclusive breast-feeding was promoted for the first 6 mo of life; those findings were reported separately (6).

SUBJECTS AND METHODS

Study setting. The setting was the state of Haryana, one of the major producers of wheat and milk in India. The communities selected are located 3–5 km from the main highway. The literacy rates are low; 50% of women and 15% of men have never been to school (7). Common occupations for men are agriculture and employment in factories.

Primary health centers provide health care; each serves a population of ~30,000 through 2 or 3 medical officers, auxiliary nurse midwives, and other ancillary staff. There are 6 subcenters (population ~5000) attached to each primary health center. Private practitioners trained in the biomedical or, more often, indigenous systems of medicine also serve this population. A local village based worker, the "Anganwadi worker," belonging to the Integrated Child Development Services Scheme (8) offers preschool education and a food supplement to the attendees at her home, the "Anganwadi Center." These services are used mainly for children > 3 y old because unlike younger children, they can be left at the center by themselves.

Intervention development. Formative research commenced in April 1998 and concluded with a baseline survey in all of the communities at the end of a year. Using qualitative research methods, information was sought on community characteristics, children's nutritional status, and feeding practices. Insight was obtained into what foods were available in households, which foods were offered to young children, how often, and in what quantities. In addition, information was gathered on assistance provided to children while feeding and perceptions underlying appropriate or inappropriate feeding practices. Potential channels for the delivery of the intervention within the existing services were identified. The routine interactions of different categories of workers with families were observed to learn how they could be used for nutritional counseling without disrupting their other work. Feeding recommendations were developed using a standard approach that included assessment of child feeding practices, identification of common feeding problems, and locally appropriate ways to solve these (9). Household trials were conducted to test acceptability of different recommendations (9).

The nutrition recommendations were converted to nutrition messages in the local vernacular with the assistance of a communications agency. The channels for delivery of these messages and the points at which children would receive nutrition counseling were determined through interactive sessions with the workers and the district health and nutrition authorities.

The intervention. In the intervention communities, the opportunities used for counseling on complementary feeding were as follows: monthly home visits for new births until aged 12 mo and weighing once every 3 mo for children < 2 y old conducted by Anganwadi workers, immunization clinics run by the auxiliary nurse midwives, and sick child contacts with health care providers. The messages were also discussed at the monthly meetings conducted by the auxiliary nurse midwives with community representatives; these representatives held neighborhood meetings once a month with caretakers of children < 2 y old. Routine services were provided in the control sites. According to national policy, workers are required to advise on the initiation of complementary feeding at 4–6 mo, the types of foods to be fed, and the frequency of feeding. The formative research showed that home visits occurred occasionally and when they did, the focus was on family planning and immunization; only occasionally were recommendations given on foods that should be fed to young children. A previous assessment showed that Anganwadi workers had inadequate knowledge about appropriate child feeding practices (10).

Training of the health and nutrition workers in the intervention communities lasted for 3 d; 50% of the time was used for hands-on training. The training was based on the Integrated Management of Childhood Illnesses training manual on nutrition counseling and included imparting communication skills, detection of feeding problems, and negotiation with the mother on possible solutions that she would adopt among a locally adapted set of feeding recommendations (9,11). The intervention messages included starting complementary foods at 6 mo of age, the specific foods, meal frequencies and amounts to be fed at different ages while continuing to breast-feed, ways to encourage children to eat more, hand washing before a meal, and continuing feeding during illness (**Table 1**).

At each counseling contact, the health worker assessed the infant's feeding, identified specific problems, and then counseled the caretaker, allowing her to choose from the recommendations those that were feasible and acceptable to her. Complementary feeding was

TABLE 1

Complementary feeding recommendations[1]

	Child age	
	6 mo–1 y	1–2 y
Breast-feeding	Continue	Continue
Complementary feeding	At 6 mo start with 0.5 katori[2] of recommended foods 3 times (breast-fed child) or 5 times (non-breast fed child). Gradually increase the quantity to 1 katori by 9 mo.	Give: 1.5 katori of recommended foods 5 times/d.
Help	Make child sit in your lap and feed child yourself.	Help child eat and finish all food.
Hygiene	Wash child's and own hands with soap before a meal.	Wash child's and own hands with soap before a meal.
Sick child	Continue feeding all foods in recommended amounts.	Continue feeding all foods in recommended amounts.

[1] It is recommended that the following foods be given: 1) undiluted sweetened milk with mashed *roti*/rice/biscuit/bread; 2) thick *dal* with added oil with mashed *roti*/rice/bread or *khichri* with added oil. Add vegetables to the meal; 3) *sevian* or *dalia* or *halwa* or *kheer* prepared in milk or other milk-based preparations; 4) mashed or fried potatoes or potato *subzi* without spices; 5) banana or biscuits or *cheeku* or mango or papaya as snacks; 6) all family foods to children aged 1–2 y.

[2] A katori is a 150-mL bowl.

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also promoted at group activities though women's groups meetings and neighborhood meetings. Feeding demonstrations, i.e., preparation of complementary foods by representatives and feeding them to children, were a regular feature of these meetings. The aim was to show appropriate consistency and amount of food and to demonstrate that young children could eat the recommended portions if encouraged to do so by their mothers. Village rallies by children, school debates on optimal complementary feeding practices, street side plays, and nutrition fairs were organized in the intervention villages by the local authorities. Posters were designed for display at physician clinics; flip books, a feeding recommendation card for ready reference, and a counseling guide containing a list of feeding problems along with locally acceptable solutions were developed. A mother and child card listing the feeding recommendations was given to all mothers antenatally or at the first home visit. Four workers, one for each of the intervention communities, were selected by the local health authorities from an existing nongovernment organization to support the government team in the community-based components of the intervention.

Monitoring. The intervention delivery was monitored by the local authorities at the monthly reviews of health- and nutrition-related activities and they gave feedback to the workers. Consistent with an effectiveness design, the investigator's role was restricted to measurement of specific outcomes by which the outcome was assessed.

Sample size. The number of communities required for this trial was determined using methods appropriate for community randomized trials (12). Data from the baseline survey in the 8 communities were used for making assumptions for the values in the control group and in estimating the inflation factors due to community randomization. Energy intakes for the control group (means ± SD) were 1003 ± 836 kJ at 9 mo and 2570 ± 1086 kJ at 18 mo with inflation factors of 1.31 and 1.32, respectively. Control weight and length at 12 mo were 7.8 ± 1.08 kg and 70.2 ± 2.9 cm with an inflation factor of 1.48 and 2.63, respectively.

A sample size of 450 infants per group enabled us to detect with 90% power and 95% confidence a 250-g difference in weight between the intervention and control groups and a 1-cm difference in length at 12 mo, a 50-kcal (209 kJ) increase in non-breast milk energy intake at 9 mo and a 100-kcal (418.4 kJ) increase at 18 mo of age.

Ethical approval. Before selection of the study sites, collaboration was sought from the local health and related authorities who became partners in the endeavor. The study had the approval of the ethics committees of the All India Institute of Medical Sciences and the WHO.

Randomization. A baseline survey was conducted in all households with children < 2 y old, and a total score was computed for each community on the bases of different socioeconomic indicators, child mortality and recent morbidity rates, and the prevalence of wasting and stunting. The 8 communities were paired on the basis of similar scores. To allocate 1 community of each pair to the intervention group, the 2 communities were listed in alphabetical order. A statistician, not involved with the study, generated 4 single-digit random numbers using a random numbers table; the first listed community in a pair was allocated to the intervention group if the random number was 0–4 and the second if it was 5–9.

Impact evaluation. Births occurring in the study villages were identified through Anganwadi workers and community informants from October 1999 to June 2000. Newborns were enrolled if they were local residents and informed written consent was obtained. A baseline form containing details of the child and family characteristics was also completed. Mothers and infants were visited at home by workers who were not involved in the delivery of the intervention at 3, 6, 9, 12, 15, and 18 mo of age to ascertain exposure to different channels, the details of counseling received at these contacts, and morbidity experienced by the infant in the 3 mo before the visit. Twice weekly visits were made for up to 1 mo in an attempt to contact those not available at a visit. Weights (using SECA scale, sensitivity 0.1 kg) and lengths (with locally manufactured infantometers, sensitivity 0.1 cm) were obtained at birth (if identified within 7 d) and at each of the 3 monthly home visits. Twenty-four hour dietary recalls were conducted by trained nutritionists at the 9 and 18 mo home visits.

Standardization exercises for inter- and intraobserver variability in weights and lengths were performed in which each child was measured twice (10 sets of 10 children each aged <2 y). The study commenced when all field workers obtained identical readings in both their weight measurements for a child and were in perfect agreement with the "gold standard" (a supervisor). For length, a difference of up to ± 0.5 cm between the readings of a field worker and the "gold standard" was considered acceptable. The 24-h non-breast milk energy intakes were estimated for 10 children by the 7 nutritionists available and the group mean was calculated for each child. The 3 nutritionists whose values were closest to the group mean were selected to conduct the recalls. They then conducted 24-h dietary recalls on 10 children each of age groups 0–6, 7–12, 13–18, and 19–24 mo until there was a 50-kcal (209 kJ) or less difference among nutritionists on the estimates for 5 consecutive children. The accuracy of weighing scales was checked daily against known standard weights and that of infantometers by using standard steel rods.

Analysis. A meal was defined as all of the foods eaten by the child within a 45-min interval. Diarrhea was defined as the passage of frequent loose or liquid stools or as the child suffering from "dast" (the local term for diarrhea) reported by the mother. Data were analyzed using Stata, version 6. All results reported are adjusted for cluster randomization (using the "cluster" option of the "regress" command) and for mothers working outside home, weights and lengths at 6 mo, and the breast-feeding status at 6 mo. For the 24-h dietary recall and anthropometry, odds ratios or differences in means with their 95% CI were estimated. All analyses were by intention to treat. Differences were considered significant at $P < 0.05$. Values presented in the text are means ± SD.

RESULTS

A total of 1115 infants born between October 1999 and June 2000 were identified from the 8 communities. Of these, 1025 were available at the baseline visit, 552 in the intervention and 473 in the control group (**Fig. 1**). The children available in the intervention and control communities for the measurement of outcomes at 6, 9, and 18 mo of age were 468 (84.8%) and 412 (87.1%), 451 (81.7%) and 403 (85.2%), and 435 (78.8%) and 394 (83.3%), respectively (Fig. 1). The baseline characteristics of the children enrolled in the cohort in the intervention and control communities were similar, except for the proportion of mothers working outside home, which was higher in the intervention communities (**Table 2**).

Intervention delivery. Intervention exposures are reported for the previous 3-mo intervals as elicited through interviews at infant ages 9 and 18 mo. At the 9-mo visit, a higher proportion of infants in the intervention compared with those in the control communities had one or more of the following contacts in the last 3 mo: home visits by Anganwadi workers (67 vs. 31%; $P < 0.0001$), attendance at weighing sessions (47 vs. 1%; $P < 0.0001$), immunization sessions (77 vs. 85%; $P = 0.095$), and visits to primary health centers or private practitioners (77.8 vs. 80.4%; $P = 0.579$). Over a fourth of caretakers in the intervention communities had attended one or more meetings conducted by auxiliary nurse midwives (27 vs. 0.2%; $P < 0.0001$).

Caretakers in the intervention communities reported being counseled more frequently at these contacts; the proportion who spontaneously recalled being counseled on optimal complementary feeding practices was 34 vs. 0.2% ($P < 0.0001$) at the immunization sessions, 43 vs. 0.5% ($P < 0.0001$) at home visits, and 36 vs. 0% ($P < 0.0001$) at the weighing sessions, in the intervention and control communities, respectively. Primary health center physicians or private practitioners rarely (1.5 vs. 0%; $P = 0.02$) counseled in this setting. When a visit to any of the above channels was considered, 444 (98.4%)

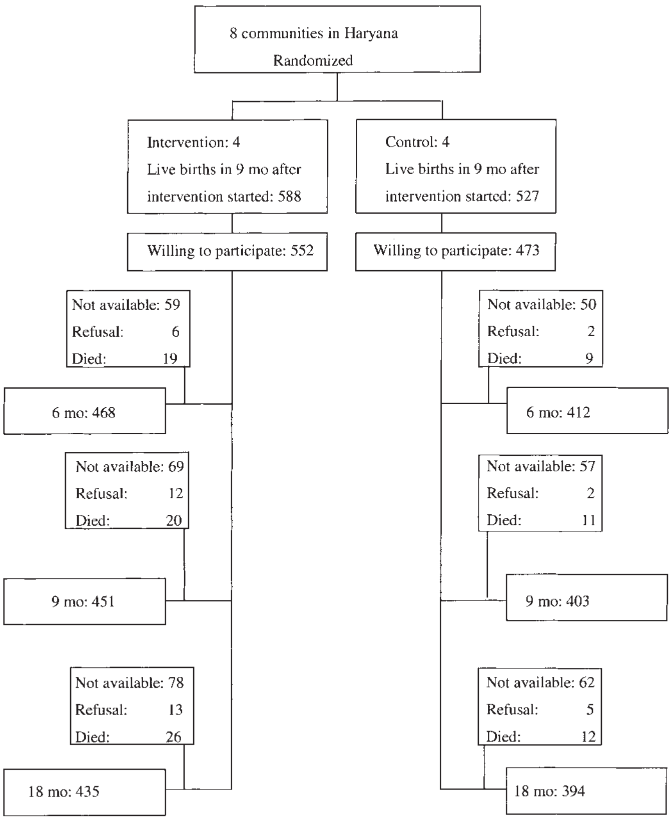

FIGURE 1 Trial profile.

children in the intervention communities had visited at least 1 potential source of complementary feeding counseling 1 or more times during the 6- to 9-mo period, and 344 (76.3%) had been counseled at least once. In the control communities, 393 (97.5%) children had visited a source, but only 3 had been counseled. The trends for exposure to different channels and the counseling received at age 18 mo were similar to those at 9 mo (data not shown). The exposure to different channels also did not vary by child's sex (data not shown).

Effect on physical growth. Anthropometric data for the study groups at different ages were adjusted for cluster randomization, mother working outside the home, weight and length at 6 mo, and breast-feeding status at 6 mo (**Table 3**). Overall, the intervention did not affect the attained weights, the proportion of children with weight-for-age Z-score less than −2 SD at 12 and 18 mo, or the increments in weight between 6 and 12, and 12 and 18 mo. The crude and adjusted results were similar (Table 3).

The intervention group children had a higher attained length at 12 mo ($P = 0.035$) and a higher increment in length between 6 and 12 mo of age ($P = 0.035$). The proportion of children with height-for-age Z-score less than −2 SD did not differ between the 2 groups (Table 3). In an additional model, after adjustment for exclusive breast-feeding instead of any breast-feeding at 6 mo, the results were virtually unchanged (difference in mean length gain 0.34 cm; 95% CI, 0.04, 0.64).

We decided a priori to examine the effect of the intervention in subgroups on the bases of gender, caste, income, and parental literacy. A test of interaction for comparison of means revealed a significant ($P < 0.02$) interaction between gender and the intervention effect on length at 12 mo of age (13). No significant interactions were found for caste, income, or parental literacy.

In the subgroup of male infants, the intervention resulted in a 0.51 cm higher attained length at 12 mo (95% CI, 0.03, 0.98, $P = 0.039$), a 0.51 cm greater length increment between 6 and 12 mo (95% CI, 0.03, 0.98, $P = 0.039$), and 8% fewer children with a height-for-age Z-score less than −2 SD ($P = 0.391$). Similarly, among males, the intervention resulted in a 0.37 cm higher attained length at 18 mo (95% CI, 0.08, 0.66, $P = 0.02$). In the subgroup of female infants, there were no significant differences or clinically relevant differences between the intervention and control groups.

Effects of the types of foods fed to children. Intakes of cereal legume gruels or mixes (i.e., cereals and legumes both cooked separately but mixed at the time of feeding), milk cereal

TABLE 2

Baseline characteristics of children enrolled in the intervention and control communities[1]

Characteristic	Intervention (n = 552)	Control (n = 473)
Males, *n (%)*	288 (52.2)	253 (53.5)
Born at home, *n (%)*	399 (72.3)	334 (70.6)
Birth weight, *kg* (n = 498, 424)[2]	2.70 ± 0.44	2.70 ± 0.41
Birth length, *cm* (n = 496, 422)	47.22 ± 2.26	47.18 ± 2.17
Weight at 6 mo, *kg* (n = 466, 411)	6.39 ± 1.01	6.42 ± 0.94
Length at 6 mo, *cm* (n = 466, 411)	63.60 ± 2.93	63.61 ± 2.67
Breast-fed at 6 mo, *n (%)* (n = 451, 403)	433 (96.0)	376 (93.3)
Exclusively breast-fed at 6 mo, *n (%)* (n = 464, 411)	193 (42)	16 (3.9)
Age of mother, *y*	23.6 ± 4	23.6 ± 4
Literate, *n (%)*		
Mother, (n = 552, 473)	309 (55.9)	260 (54.9)
Father (n = 552, 473)	474 (86.0)	420 (89.1)
Mothers working outside of home, *n (%)*	228 (41.3)	162 (34.2)
Maternal weight, *kg* (n = 497, 418)	48.1 ± 6.7	47.8 ± 7.1
Height, *cm*		
Mother (n = 502, 420)	153.5 ± 6.1	153.6 ± 5.8
Father (n = 259, 252)	166.2 ± 6.3	166.1 ± 6.3
Yearly family income (Rupees)[2] in thousands	52,898 ± 53,935	54,967 ± 57,770

[1] Values are means ± SD unless indicated otherwise.
[2] 1 Rupee = 0.021$US.

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TABLE 3

Attained weight and length, increments and proportion of underweight and stunted children in the intervention and control communities at different ages[1]

	Intervention	Control	Odds ratios or difference in means (95% CI)[2]
At 12 mo			
Attained weight, *kg*	7.83 ± 1.10	7.83 ± 1.04	0.04 (−0.06, 0.15)
Attained length, *cm*	70.36 ± 3.14	70.10 ± 2.74	0.32 (0.03, 0.61)
Children with WAZ less than −2 SD, *n (%)*	215 (52.1)	187 (48.6)	1.17 (0.75, 1.82)
Children with HAZ less than −2 SD, *n (%)*	171 (41.4)	164 (42.6)	0.92 (0.62, 1.37)
At 18 mo			
Attained weight[2], *kg*	8.73 ± 1.14	8.73 ± 1.02	0.02 (−0.09, 0.14)
Attained length[2], *cm*	75.66 ± 3.38	75.49 ± 3.17	0.24 (−0.29, 0.76)
Children with WAZ less than −2 SD, *n (%)*	220 (54.2)	193 ± 52.9	1.06 (0.70, 1.60)
Children with HAZ less than −2 SD, *n (%)*	203 (50.1)	187 (51.2)	0.94 (0.64, 1.37)
Increments			
6–12 mo			
Weight, *kg*	1.42 ± 0.65	1.38 ± 0.66	0.04 (−0.06, 0.15)
Length, *cm*	6.68 ± 1.98	6.41 ± 1.77	0.32 (0.03, 0.61)
12–18 mo			
Weight, *kg*	0.90 ± 0.65	0.91 ± 0.65	−0.01 (−0.11, 0.10)
Length, *cm*	5.34 ± 2.04	5.40 ± 1.88	−0.04 (−0.54, 0.47)

[1] Values are means ± SD unless otherwise indicated. WAZ, weight-for-age Z-score; HAZ, height-for-age Z-score.
[2] Adjusted for mothers working outside home, cluster, weight and length at 6 mo, and breast-feeding status at 6 mo.

gruels or milk cereal mixes (cereals cooked separately to which milk is added), and of undiluted milk were higher ($P < 0.001$) in 9-mo-old children in the intervention communities (**Table 4**). At this age, the recommended snacks were also fed more often ($P < 0.0001$) to children in the intervention communities. Similar patterns were seen at 18 mo, but the differences between the 2 groups were less pronounced for cereal legume gruels or mixes and for snacks than those at 9 mo, possibly because these are commonly given foods at this age (Table 4).

The 24-h breast-feeding frequency in the control children at 9 mo was 6.6 ± 3.0 and it was 7.8 ± 3.0 in the intervention group ($P = 0.01$); the breast-feeding frequency was similar in the 2 groups at 18 mo of age. The proportion of children breast-fed at 9 mo was 90.8% in the control communities and 94.7% in the intervention communities ($P < 0.01$). The proportion of children breast-fed was similar at 18 mo of age (72.2 vs. 70.8%, $P = 0.66$).

The 24-h frequency of feeding non-breast milk meals and

TABLE 4

Types of foods consumed by children in the intervention and control communities from the 24-h dietary recall at 9 and 18 mo of age[1]

	9 mo		18 mo	
	Intervention (*n* = 451)	Control (*n* = 403)	Intervention (*n* = 435)	Control (*n* = 394)
	n (%)			
Adoption of recommended recipes				
Cereal legume gruel or mix	126 (27.9)	32 (7.9)*	216 (49.6)	125 (31.7)*
Milk cereal gruels or mix	161 (35.6)	45 (11.1)*	145 (33.3)	59 (14.9)*
Undiluted milk	247 (54.8)	73 (18.1)*	263 (60.5)	51 (12.9)*
Added oil/butter	39 (8.6)	2 (0.5)†	105 (24.1)	23 (5.8)*
Snacks	272 (60.3)	186 (46.2)*	253 (58.2)	213 (54.1)
Foods consumed				
Cereals alone or mixed with other foods				
Commercially available bread	53 (11.8)	7 (1.7)*	100 (23.0)	42 (10.7)*
Home-made bread	287 (63.6)	249 (61.8)	357 (82.1)	340 (86.3)
Rice	31 (6.9)	9 (2.2)‡	36 (8.3)	30 (7.6)
Potatoes	51 (11.3)	19 (4.7)*	126 (29.0)	87 (22.1)*
Legumes	81 (18.0)	27 (6.7)†	129 (29.7)	94 (23.9)†
Any milk	414 (91.8)	333 (82.6)†	429 (98.6)	378 (95.9)
Meat or egg	2 (0.4)	—	2 (0.5)	—
Vegetables	30 (6.7)	8 (2.0)‡	113 (26.0)	95 (24.1)
Fruits	73 (16.2)	48 (11.9)	195 (44.8)	159 (40.4)

[1] Symbols indicate different from the intervention group at that age: * $P < 0.001$; † $P < 0.001$; ‡ $P < 0.05$.

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the total energy intakes from non-breast milk sources are shown in (**Table 5**). The meal frequencies ($P = 0.001$) and the energy intakes ($P < 0.001$) were higher in the intervention communities at 9 and 18 mo of age. The increase in energy intake was due to increased intake of milk, other foods, and the addition of extra oil to the food in the intervention communities at both 9 and 18 mo of age (Table 5).

Analyses of intervention effect on breast-feeding and complementary food intake were performed by gender in an effort to explain the mechanisms underlying the significant interaction of gender with the effect on length. There was no interaction between gender and intervention effect on breast-feeding frequency, proportion breast-fed, or the proportion consuming undiluted milk, cereal legume gruels or mixes, or vegetables and fruits. There was no interaction of gender with the overall energy intake at 9 or 18 mo. However, the difference between the intervention and control groups in energy intake from milk at 18 mo of age was greater for males (505 ± 283 vs. 297 ± 178 kJ) than females (458 ± 273 vs. 320± 162 kJ; test of interaction, $P = 0.002$).

Responsive feeding and hygiene practices. At 9 mo, 34.8% mothers in the intervention group reported that they actively encouraged their child to eat more compared with 7.7% in the control group ($P < 0.0001$). At 18 mo, a higher proportion also reported encouraging their children to eat (89.7 vs. 49%; $P < 0.0001$). At this age, the practices that were reported more often in the intervention than the control communities included feeding with love and affection (41 vs. 11%; $P < 0.0001$), trying repeatedly if the child did not eat (15.4 vs. 1%; $P < 0.0001$), mother feeding the child herself (34.9 vs. 26.4%; $P < 0.0001$), making the child sit in the mother's lap (18.2 vs. 6.6%, $P < 0.0001$), and feeding the child with other family members (12.4 vs. 2.5%; $P < 0.0001$). There was no interaction between gender and intervention effect on any of the responsive feeding behaviors (data not shown).

The proportion of mothers who reported washing their hands before feeding the child (94.5 vs. 59.9%; $P < 0.0001$) and their child's hands before feeding (87.8 vs. 42.4%; $P = <0.0001$) was higher in the intervention group at 18 mo of age.

Morbidity experience. The reported prevalences of common illnesses in the previous 7 d did not differ in the 2 groups at 9, 12, 15, and 18 mo of age. At 12 mo of age, for instance, the prevalence of diarrhea was 16.8 vs. 13.1% ($P = 0.174$); cough 19.5 vs. 20.4% ($P = 0.797$); and fever 15.2 vs. 13.6% ($P = 0.522$) in the intervention and control communities. There was no interaction of gender with intervention effect on morbidity at any of the assessments.

DISCUSSION

In rural north India, through a pragmatic and potentially sustainable educational intervention to promote appropriate complementary feeding practices for infants 6–18 mo of age, it was possible to achieve high coverage, resulting in improvements in infant and young child feeding practices and energy intakes. There was no effect, however, on weight gain and only a small improvement (0.18 SD units) in linear growth between 6 and 12 mo. The improvement in physical growth was less than that expected from the substantial increases in energy intakes.

Several factors may have limited the intervention effect on physical growth. These include low consumption of foods of animal origin, gender-related differences in intervention effect, and the inability to reach some households repeatedly, or not at all. The diets of infants and young children in our setting were predominantly cereal based, and most children consumed only small amounts of milk (cross-sectional baseline survey, data not shown). It is also conceivable that intrauterine development due to maternal malnutrition or other stresses may have effects on growth in postnatal life that are not easily reversible. Further, a possible overreporting of intakes by caretakers may explain the discrepancy between the food intake and growth data. Dietary intakes, based on direct observations, were shown to be significantly lower than those estimated from 24-h recalls in intervention trials (14).

Intervention trials promoting education, coupled with effective communication strategies with or without food supplements, were reviewed by Caulfield (5). Five efficacy trials with supplemental food showed an additional 272–1254 kJ/d energy intake resulting in improvements in weight of 0.1–0.5 SD, and in 4 of these trials in which data were reported, from 0.04 to 0.35 SD in length (5).

Two recent efficacy trials in China and Brazil are of particular interest because nutritional counseling was given without food supplements (14,15). In these trials, locally appropriate complementary foods including foods rich in animal proteins and micronutrients were promoted. In the Chinese trial, intervention group infants were significantly heavier and longer at 12 mo of age (14), and the magnitude of the effect was greater than in our study. The consumption of foods of animal origin such as eggs, fish, chicken, or meat and of vegetables and fruits was more frequent in the Chinese study,

TABLE 5

Twenty-four hour frequency of intake of complementary foods and non-breast milk energy by children at 9 and 18 mo of age in the intervention and control communities[1]

	9 mo		18 mo	
	Intervention (n = 451)	Control (n = 403)	Intervention (n = 435)	Control (n = 394)
Meal frequency, *n/24 h*	4.4 ± 1.5	3.9 ± 1.7†	5.9 ± 1.2	5.4 ± 1.3†
Energy intake, *kJ/24 h*				
All foods	1556 ± 1109	1025 ± 866*	3807 ± 1527	2577 ± 1058*
Oil	134 ± 167	58 ± 88*	335 ± 326	184 ± 205*
Milk	837 ± 757	607 ± 678†	2021 ± 1167	1289 ± 715*
Other foods	586 ± 544	364 ± 314†	1448 ± 686	1104 ± 556*

[1] All values are means ± SD. Symbols indicate different from the intervention group; * $P < 0.001$; † $P < 0.01$.

and baseline weights and lengths of children were better (14). In the Brazilian trial, in which the intervention focused on children seeking care at health facilities, children ≥ 12 mo of age had significantly improved intake of fats and in weight gain (15). There were no significant increases in overall energy and protein intakes or lengths (15). In a previous individually randomized Indian study, nutrition counseling did not affect the physical growth of children between 4 and 12 mo of age, whereas significant improvement in energy intakes was reported (16). Viewed together, the available studies suggest that the effect of educational interventions may vary depending on the baseline characteristics of the participants and other factors such as the types of foods available.

The observed effect on length and not on weight gain in this study warrants examination. There are some possible explanations worth considering. First, breast-feeding practices during the 6- to 9-mo period improved as a result of promoting exclusive breast-feeding during the first 6 mo of life and continued breast-feeding thereafter. Breast-feeding was reported to have a stronger effect on linear growth than on weight gain during late infancy and preschool years (17,18). Second, hygiene promotion was a part of the intervention, and improving hygiene and sanitation were also reported to improve linear growth (19). Third, the complementary foods whose reported intake was substantially increased were milk-based gruels or cereal-pulse mixes, which may improve nutrient quality in this setting (20).

This study has important implications for complementary feeding programs. Although it shows that educational interventions can improve feeding practices, the effect of such interventions on physical growth varies in different settings. Research should focus on explaining why the growth effect of nutritional interventions is limited in some regions such as south Asia. Finally, interventions that require behavior modification toward improving child feeding practices must pay greater attention to gender bias in such settings.

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