Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China[1,2,3,4,5]

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ABSTRACT Chinese studies indicate that the growth of rural infants and children lags behind that of their urban counterparts after 4 mo of age and that the gap is widening. However, the rural areas are home to >85% of China's 300 million children. Clearly, culturally appropriate rural complementary feeding interventions are needed to close the growth and health gaps. After a 1990 survey of infants in rural Sichuan confirmed that poor infant feeding practices rather than inadequate household food resources were responsible for the growth faltering, a year-long community-based pilot nutrition education intervention ($n \cong 250$ infants each in Education and Control groups) was undertaken in four townships. The goal was to improve infant growth by improving infant feeding practices. Features of the intervention included the training and mobilizing of village nutrition educators who made monthly growth monitoring and complementary feeding counseling visits to all pregnant women and families with infants born during the intervention in the study villages. After 1 y, the Education group mothers showed significantly higher nutrition knowledge and better reported infant feeding practices than their Control group counterparts. Also, the Education group infants were significantly heavier and longer, but only at 12 mo (weight-for-age −1.17 vs. −1.93; $P = 0.004$; height-for-age −1.32 vs. −1.96; $P = 0.022$), had higher breast-feeding rates overall (83% vs. 75%; $P = 0.034$) and lower anemia rates (22% vs. 32%; $P = 0.008$) than the Control group infants. We conclude that these methods have potential for adaptation and development to other rural areas in the county, province and nation. J. Nutr. 130: 1204–1211, 2000.

KEY WORDS: • *breast feeding* • *infant growth* • *China* • *complementary foods* • *infant feeding*

Infant and child growth studies in rural China, home to >85% of China's 300 million children, indicate that the growth of rural infants and children lags behind that of their urban counterparts after 4 mo of age (Ge 1995, Ge et al. 1991, Meng et al. 1997) and that the difference has increased (Shen et al. 1996). Additionally, China's 1992 National Nutrition Survey revealed that the iron deficiency anemia prevalence of rural infants is higher than that of infants in urban areas (Ge 1995). Although China has implemented vigorous population policies in the rural areas, there is so far only rudimentary development of complementary maternal and child health services. Clearly, among those health services needing development, appropriate complementary feeding interventions are needed in the rural areas to close the growth and health gaps between urban and rural area children and decrease any functional consequences of the growth faltering found in the rural areas.

A 1990 needs assessment survey in two rural townships in Sichuan confirmed that it was poor complementary feeding practices rather than inadequate household food resources responsible for the growth faltering in this Han Chinese area (Guldan et al. 1993). The problematic feeding practices identified were the late introduction of complementary foods, as well as the poor quality of these foods, with thin low-energy rice porridge being the main complementary food. The beneficial conditions identified were mainly single-child households, high rates of breast feeding throughout the first year,

[1] This research was previously presented at the International Workshop for Improved Complementary Feeding in China, on 26 October 1999 in Chengdu, China.

[2] This research was previously presented at the 9th Asian Congress of Paediatrics on 23–27 March 1997 in Hong Kong, and an abstract entitled "Community-based nutrition promotion to overcome rural infants' growth faltering in Sichuan, China" authored by G. S. Guldan, H. C. Fan, X. Ma & and M. Y. Zhang was published in the Journal of Paediatrics and Child Health, 33: Supplement 1, Abstract FP16, p. S83.

[3] This research was previously presented at the 30th Annual Meeting of the Society for Nutrition Education on 22–26 July 1997 in Montreal, Canada. An abstract entitled "Can 'Scientific Infant Feeding' close the rural/urban infant growth faltering gap in Sichuan, China?" authored by G. S. Guldan, H. C. Fan, X. Ma & Z. Z. Ni was published in Volume 22 of the SNE Abstract Book.

[4] This research was previously presented at the Second International Workshop on Nutritional Problems and Strategies in the Asian Region, on 29–30 September 1997 in Kuala Lumpur, Malaysia. An abstract entitled "Can 'scientific infant feeding close the rural-urban infant growth-faltering gap in Sichuan, China?" authored by G. S. Guldan, H. C. Fan, X. Ma & Z. Z. Ni was published in the Australian Journal of Nutrition and Dietetics, 55: Supplement March 1998, pp. S36–37.

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widespread year-round household food production and availability and a positive attitude among mothers for learning more about better infant feeding methods.

This article describes a year-long community-based pilot nutrition education intervention undertaken in two townships to try to overcome these problems. These townships were located in the same rural Sichuan county as the 1990 needs assessment. The goals of the intervention were to improve complementary feeding practices and thereby improve growth by increasing parents' awareness of infants' feeding needs during this crucial period.

As part of China's multi-faceted drive toward modernization in the rural areas, the popularization of science is used as an authoritative yardstick of what is good for progress. In agriculture, courses teach farmers about "scientific farming" to increase agricultural productivity, cost efficiency and reduce labor intensity (All-China Women's Federation 1993). Young rural parents in one province have reported that they want their children to become engineers and technicians, and not farmers (All-China Women's Federation 1991a). In the child health arena, "scientific childrearing" and "scientific infant feeding" are popularized to improve infant nutrition and health, in part also to promote adherence to the one-child policy. The complementary feeding intervention described in this article also attempted to popularize "scientific infant feeding" in rural Sichuan by promoting continued breast feeding for the first year, while, after 4–6 mo, feeding adequate amounts of appropriate, energy- and nutrient-dense locally available complementary foods on a daily basis. At the same time, the researchers tried to meet the challenge of appreciating the importance of prevailing complementary feeding practices and understanding the cultural influences affecting the current strong preferences.

The intervention ($n \cong 250$ infants each in Education and Control groups in four similar rural townships of one Sichuan county) involved the recruiting, training and mobilizing of local village nutrition educators from among the local Women's Affairs Officials and Village Doctors already functioning in the villages. These village nutrition educators were the major channel of this intervention. The county in which the study was conducted was located ~70 km southwest of Chengdu, the Sichuan provincial capital. Collaborating parties were the county maternity hospital, two township hospitals, the School of Public Health at the West China University of Medical Sciences in Chengdu and the Food and Nutritional Sciences Program of the Chinese University of Hong Kong.

MATERIALS AND METHODS

One-year intervention. In the summer of 1994, county and township maternal and child health officials discussed and planned the intervention based on the 1990 needs assessment, and the two intervention and two Control group townships were selected from a county map. Complete randomization in township selection was not possible. This was because the Education and Control group townships could not be contiguous and needed to be roughly equal geographically and socioeconomically, i.e., of similar distance from the county seat as well as from major county highways. In each intervention township, a maternal and child health doctor was chosen to be responsible for the work. As each township consisted of about 12 villages, one nutrition educator was chosen from each village who would be trained and responsible for the work in her village.

Beginning in September 1994, and for 1 y thereafter, the trained nutrition educators made monthly growth monitoring and counseling visits to the households of all pregnant women and women with infants up to 1-y-old living in the study villages. The initial visits were made to homes with pregnant women and newborns only. However, throughout the year, those pregnant women gave birth, and additional women became pregnant, so the caseload grew. During the last 4 mo of the intervention period, visits were made only to homes where infants were born during the first 8 mo of the year-long intervention, so that by the time the evaluation survey was conducted, all infants who had between recruited at birth were between 4 and 12 mo of age and had been in the intervention since that time. Therefore, age at final measurement represents the length of time the infants were in the intervention.

During the visits, the nutrition educators disseminated a feeding guidebook and growth chart to each family, gave age-appropriate breast feeding and complementary feeding suggestions and advice, answered questions and weighed each infant, marking the infant's weight on the growth chart. The feeding messages aimed to improve the quality and quantity of complementary foods after 4 mo of age while continuing breast feeding throughout the first year of life. Specific messages included: breast milk alone is best food/beverage for first 4–6 mo; initiate breast feeding right after birth; bottle feeding may be dangerous, so give breast milk which is free; frequent suckling on demand is best; after 4–6 mo give daily hard-boiled egg yolk to the infant, at first mixed with some breast milk; thereafter start giving thickened rice porridge and other foods daily so baby will grow well; baby needs breast milk for at least a year and needs other foods daily after 4–6 mo to grow well and be healthy. Home-produced food and the family diets were emphasized as the basis for the complementary foods to be fed along with breast milk after 4 mo.

Throughout the year of the intervention, three training sessions were conducted for the village educators. The training sessions lasted one-half to 1 d each and were held in each intervention township. The content of these sessions focused on preparing for breast feeding; exclusive breast feeding for the first 4–6 mo; initiating breast feeding soon after birth; feeding colostrum; beginning complementary feeding with egg yolk and proceeding to other foods daily; breast feeding's benefits and procedures; the purposes and methods of monthly infant weighing; training in the use of the growth chart and weighing scale; and appropriate complementary foods and feeding and hygiene practices for the first year of life. The final two sessions also focused on good two-way communication skills for educating household members. The basis of the training was a small colloquial infant feeding book (Guldan 1993) written for parents and parents-to-be which stressed the same topics and whose messages were consistent with relevant infant-feeding and growth messages of UNICEF, WHO and UNESCO in China (UNICEF, WHO AND UNESCO 1989).

A portable bar scale was carried by each nutrition educator on her monthly visit to the infants' homes. The scale, adapted from commonly used marketing scales familiar to all households but with several safety features, was specifically manufactured for rural Maternal and Child Health (MCH)[7] work in China and weighs infants up to 12 kg. During each monthly visit, the infant's weight was marked on the local growth chart. The purpose of the weighing was to emphasize the growing infant's continuous needs and rapidly increasing weight rather than to obtain the exact weight. This emphasis was also selected because, during the colder months, no heated location was available to weigh the infants accurately without clothing and blankets. The workload of each village educator grew throughout the year as more infants were born and followed.

Evaluation survey. After 1 y of intervention in September 1995, all infants born during the intervention period and their caregivers in the Education and Control townships were bused to the county MCH hospital where the caregivers were questioned about their infants' current diet. Also, the infants' weights (to the nearest 0.1 kg) and lengths (to the nearest 0.1 cm) were measured according to standard WHO procedures. The weights were measured with the same MCH bar scale used during the intervention, and recumbent lengths were measured using a length board built to WHO specifications and with a movable foot board. The same two trained anthropometrists performed all measurements during the evaluation survey. Both were experienced pediatricians, retrained according to WHO methods for

[7] Abbreviations used: CDC, Center for Disease Control; HAZ, height-for-age; MCH, Maternal and Child Health; NCHS, National Center for Health Statistics; WAZ, weight-for-age Z-scores; WHZ, weight-for-height Z-scores.

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TABLE 1

Age and gender composition of infants in Education and Control groups

	Control group	Education group
	n (%)	
Gender		
Males	118 (48.2)	111 (44.4)
Females	127 (51.8)	139 (55.6)
Age, mo		
4	23 (9.4)	7 (2.8)
5	21 (8.6)	28 (11.2)
6	25 (10.2)	22 (8.8)
7	21 (8.6)	29 (11.6)
8	34 (13.9)	23 (9.2)
9	21 (8.6)	33 (13.2)
10	29 (11.8)	47 (18.8)
11	45 (18.4)	36 (14.4)
12	26 (10.6)	25 (10.0)
Total	245 (100.0)	250 (100.0)

this survey. A fingertip capillary blood sample was taken for hemoglobin determination using the cyano-methemoglobin method with an electronic counter Model XF-1 produced by the Nanjing Semiconductor Electronic Instrument Factory (Jiangsu province, China). The instrument was calibrated with a standard solution. The infants' feeding practices and diets were investigated using a food frequency listing and a single-day 24-h recall interview. In addition to their feeding practices, caregivers were also asked about their infant feeding knowledge and other household health-related behaviors, as well as a few questions about the intervention.

Data management and analysis. Double entry of data were used in order to check for data entry accuracy. For most statistical tests (SPSS Version 7.0; SPSS, Chicago, IL), infants in the Control and Education intervention groups were compared using Chi-Square and *t* tests. The infants in the two groups were compared with respect to their growth, hemoglobin levels, diet, reported feeding practices and caregivers' knowledge. Some of the analyses were conducted by comparing all Control and Education group infants together, but in other analyses, the infants were grouped by month of age. Further analyses were also conducted with the infants grouped into three 3-mo age groups representing 4–6, 7–9 and 10–12 mo of age.

We also performed multiple regression analyses to determine how much treatment explained variation in hemoglobin levels and growth after adjusting for variation in the mother's education and household income source. For the latter, dummy variables were created for each source of household income. As age was highly related to the three growth variables, two-way interactions for infant age by treatment and also another for mother's education by treatment were also examined.

Weight-for-age (WAZ), weight-for-height (WHZ) and height-for-age (HAZ) Z-scores were calculated using the U.S. Centers for Disease Control (CDC) Anthropometric Software Package which was derived from the National Center for Health Statistics (NCHS) Reference Data, as is recommended for international reference use by the WHO. The resulting Z-scores were used to represent the infants' growth. Feeding on the day before the interview and feeding frequency during the past month were used to represent the infant feeding practices. Anemia was defined as hemoglobin <110 g/L. The protocol complied with the Helsinki Declaration of 1975 and as revised in 1983.

RESULTS

Characteristics of the sample. The sample surveyed included 245 infants in the Control group and 250 in the Education group, with response rates of 83 and 88%, respectively, of all eligible infants followed throughout the intervention period in the two areas. The infants' gender and age breakdowns in the two groups appear in **Table 1**. Mothers, the major caregivers of most of the infants, were the caregivers participating in the survey for 89% of the infants in the Control group, and 90% in the Education group.

The parents had received mainly lower or upper secondary education. The mean number of years of father's education in the Education and Control groups did not differ and was about 8 y. The mean number of years of the mother's education, however, differed slightly but significantly ($P = 0.001$) at 7.4 $\pm$ 2.1 y in the Control group and 8.0 $\pm$ 2.0 y in the Education group. The proportion of the two main sources of household income, which were (i) agricultural products or (ii) family member residing outside the village, also differed significantly ($P < 0.001$) in the two groups: in the Education group only 28% of households obtained their income mainly from agricultural production, and 44% reported obtaining most of their income from a family member residing outside. The corresponding figures for the Control group were 46 and 22% respectively, reversing the pattern. Additionally, "business" as the main source of household income was reported by 14% of the Control group households and 18% of the Education group households. More than 90% of the infants in both groups were reported to be the only infants in their households.

Growth. In both groups, growth was remarkably similar for the infants who had been in the study for less than 1 y. The mean Z-scores declined with increasing age until 10 or 11 mo of age. However, at those ages, while the mean Z-scores for the Control group 11- and 12-mo-old infants continued to drop, those in the Education group showed an upward trend, so that at 12 mo, the Education group infants had significantly better growth in weight and length than the Control group infants (WAZ −1.17 vs. −1.93; $P = 0.004$; HAZ −1.32 vs. −1.96; $P = 0.022$) (See **Figs. 1**,**2** and **3**.). Also, an examination of the distribution of WAZ and HAZ scores indicated significant ($P < 0.05$) improvements, in that there were fewer infants with moderate and severe malnutrition, i.e., fewer with WAZ or HAZ below −2 in the Education group than in the Control group (see **Table 2**). No significant differences were seen in the WHZ scores between the two groups.

WAZ was predicted by infant age in months, maternal

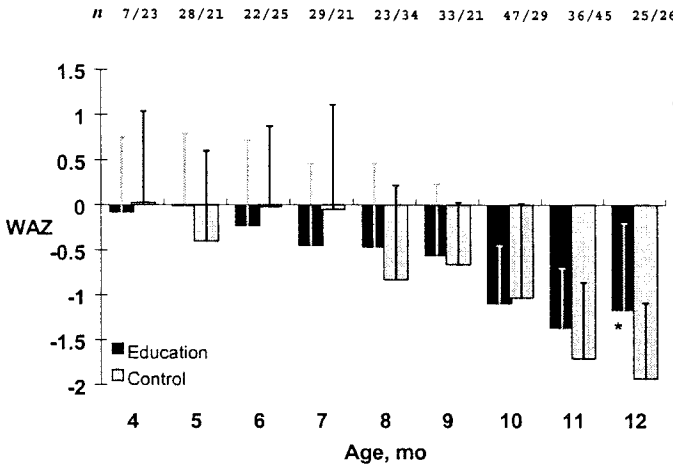

FIGURE 1 Mean WAZ (weight-for-age Z-score, National Center for Health Statistics references) and SD at each month of age in Education ($n = 250$) and Control ($n = 245$) groups. Bar lengths represent the means at each month of age. Infants in the Education group received intervention (see the Materials and Methods section) from birth. Asterisk (*) indicates significant ($P = 0.004$) difference at 12 mo only.

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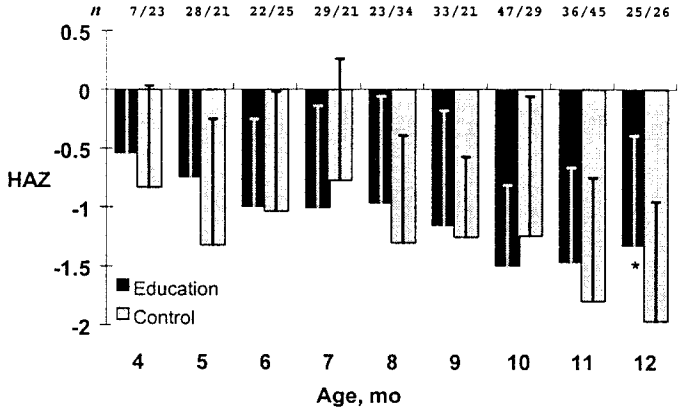

FIGURE 2 Mean HAZ (height-for-age Z-score, National Center for Health Statistics references) and SD at each month of age in Education (n = 250) and Control (n = 245) groups. Bar lengths represent the means at each month of age. Infants in the Education group received intervention (see the Materials and Methods section) from birth. Asterisk (*) indicates significant (P = 0.022) difference at 12 mo only.

education, sources of household income and the two interaction variables, but only infant age and the interaction term representing infant age and treatment were statistically significant, explaining 26% of the variation. When HAZ was regressed on the same variables, 9% of the variation in HAZ was explained by infant age, source of household income from business and the interaction term between the treatment and the mother's education. When WHZ was regressed on the same variables, 30% of the variation was explained by infant age and the age and treatment interaction.

Hemoglobin. Significantly higher mean hemoglobin levels (116.9 ± 10.8 vs. 113.4 ± 11.7 g/L; P = 0.001) and significantly lower anemia rates (22% vs. 32%; P = 0.008) were found in the Education group as compared to the Control group. The multiple regression involving hemoglobin level regressed on month of age, treatment, mother's education and source of income showed that only the treatment was significant, explaining 29% of the variation. **Figures 4** and **5** show

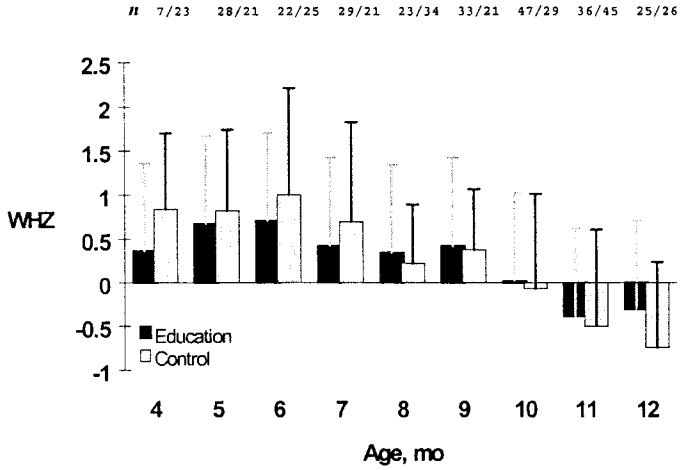

FIGURE 3 Mean WHZ (weight-for-height Z-score, National Center for Health Statistics references) and SD at each month of age in Education (n = 250) and Control (n = 245) groups. Bar lengths represent the means at each month of age. Infants in the Education group received intervention (see the Materials and Methods section) since birth. No differences between Education and Control groups were significant at any age.

TABLE 2

Infants at different levels of WAZ and HAZ in the Control and Education groups after the intervention

	WAZ		HAZ	
Z-score range	Control	Education	Control	Education
	n (%)			
≥2	3 (1)	0	0	0
1–1.99	11 (5)	11 (4)	1 (0.4)	0
−1.00–0.99	190 (78)	221 (88)	183 (75)	210 (84)
−1.99–0.99	34 (14)	18 (7)	49 (20)	35 (14)
≤−2	7 (3)	0	12 (5)	5 (2)
Sig. P[1]	P = 0.002		P = 0.046	

[1] Significance of P of χ^2 test of association between group and Z-score level. Height-for-age (HAZ) and weight-for-age (WAZ) Z-scores were calculated using the U.S. Centers for Disease Control Anthropometric Software Package which was derived from the National Center for Health Statistics Reference Data.

the hemoglobin levels and anemia rates, respectively, at each month of age in the two groups.

Breast feeding practices and awareness. Although only 23% of mothers in the Education group (vs. 18% in the Control group) reported initiating breast feeding within 1 h of giving birth, the Control group mothers reported starting to breast-feed significantly (P < 0.031) longer after birth, with 35% of the Control group mothers and only 23% of the Education group mothers waiting 24 h or longer to initiate breast feeding. The most common reasons for initiating breast feeding so late did not differ in the two groups; these were that the mothers had no milk, reported by 38% of the mothers in both groups; the infant didn't want it/wouldn't eat, as reported by 17%; and others told the mother not to do so, as reported by 9% of the mothers in both groups together. The giving of colostrum, already common in this population, was significantly more prevalent (P < 0.004) in the Education group, with 91% reporting having fed colostrum in the Education group and 80% reporting this practice in the Control group.

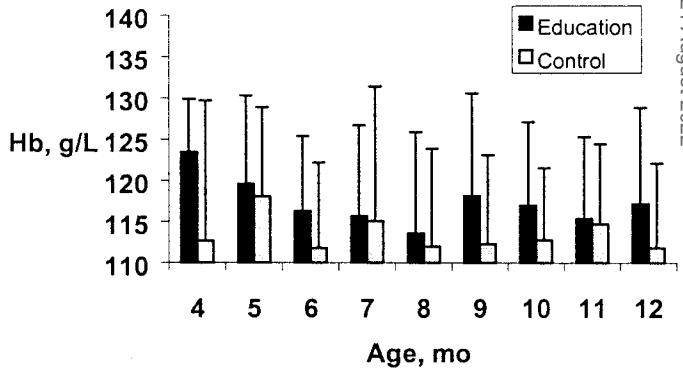

FIGURE 4 Mean hemoglobin (Hb) concentration (g/L) and SD at each month of age in Education (n = 250) and Control (n = 245) groups. Points represent the means at each month of age. Infants in the Education group received intervention (see the Materials and Methods section) from birth. No significant difference in hemoglobin level between Education and Control groups was found at any age, but overall mean hemoglobin level was significantly (P = 0.001) greater in the Education group (116.9 ± 10.8 g/L) than in the Control group (113.4 ± 11.7 g/L).

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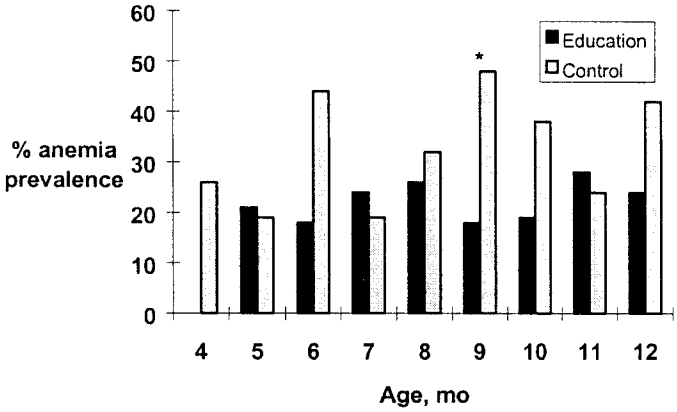

FIGURE 5 Anemia prevalence at each month of age in Education (n = 250) and Control (n = 245) groups. Bars represent the prevalence at each month of age. Infants in the Education group received intervention (see the Materials and Methods section) from birth. Asterisk (*) indicates significant (P = 0.022) difference at 9 mo only. The overall prevalence in the Education group (22%) was significantly (P = 0.008) lower than that in the Control group (32%).

The overall rate of current breast feeding was significantly higher in the Education group than in the Control group (83% vs. 75%; P = 0.034). As expected, the breast-feeding rates in the older infants were lower than in the younger infants (See **Fig. 6**). Rates did not differ in the 4–6-mo-old Education (93%) and Control (94%) group infants, or in the 7–10-mo-old groups (76% in Control group vs. 87% in Education group; P = 0.07), but they were significantly higher in the 10–12-mo-old Education group infants than in the corresponding Control group infants (75 vs. 62%; P = 0.048). Also, a significantly higher percentage of Education vs. Control group mothers (58 vs. 47%; P = 0.017) stated that their infant had been exclusively breast-fed (with no added sugar water, milk, etc.) for the first 4, 5 or 6 mo.

Complementary feeding practices and awareness. More of the Education than Control group mothers (65 vs. 21%; P < 0.001) could tell us that the first food to be fed to the infant should be egg yolk, as was promoted at that time nationwide, and that this food should be added at 4 mo (49 vs. 20%; P < 0.001). (Seventy-eight percent of the Control group and 88% of the Education group households reported producing eggs.) From the food frequency data (See **Table 3**), the Education group mothers reported feeding significantly more fruit daily after 4 mo, eggs daily from 4 to 9 mo, and significantly more daily rice porridge, lard, meat and fish/meat broth, after 6 mo, significantly more daily wheat after 10 mo and significantly less corn and rice flour in the 7–10-mo-old group only than did Control group mothers. The 24-h recall data showed similar trends, with significantly (P < 0.05) more of the Education group 4–6-mo-olds receiving egg yolks (16 vs. 1%) on the day of the survey, the Education group 7–10-mo-olds receiving more breast milk (85 vs. 71%), rice porridge (41 vs. 22%), egg yolks (13 vs. 3%) and whole egg (31 vs. 17%), and the Education group 10–12-mo-olds receiving less rice (74 vs. 88%) but more rice porridge (44 vs. 19%), fruit (53 vs. 39%), meat (32 vs. 18%), egg yolk (5 vs. 0%) and sesame paste (8 vs. 2%) than the corresponding Control group infants. However, the feeding of vegetable oil and vegetables was no higher in the Education group than the Control group and did not reach 100% by 12 mo.

When the mothers of the 4–6-mo-old infants who were not getting egg yolks were asked why they were not feeding this recommended food yet, they replied mainly that the "baby didn't like it" or that "baby is too small and can't digest it." Similarly, when the mothers of the 7–10-mo-old infants were asked why their infants were not getting rice porridge, they said the "baby doesn't like it." Finally, when the mothers of the 10–12-mo-old infants were asked why their infants weren't getting any meat, they replied that "baby is too small and can't digest it." When asked how many times per day their infant ate adult food, the mothers of the 7–9-mo-olds in the Education group reported significantly (P = 0.015) more times than the mothers of the Control group infants (1.6 ± 1.3 times vs. 1.3 ± 1.1 times). When asked how many times per day they added extra oil to the food, t tests revealed significantly higher responses in the Education group than the Control group at 10–12 mo (2.1 ± 1.3 times vs. 1.7 ± 1.2 times; P = 0.018).

The mothers were also asked what foods would help their infants grow well and what foods were not good for their infants. Significant differences also appeared in the responses of the mothers in the two groups. First of all, significantly more mothers in the Education group than in the Control group reported answers to these two questions. Only 23% in the Education group vs. 47% in the Control group had no answer to the first question and only 40% in the Education group vs. 51% in the Control group had no answer to the second question. As for foods that would help the children grow well, significantly (P < 0.05) more Education than Control group mothers reported rice, rice porridge, vegetables, fruit, meat, fish, eggs and egg yolk. As for foods that would not help the infant grow well, more Education than Control group mothers replied sugar and "hard foods." When asked if supplements/tonics were good for a child's growth, a significantly higher proportion (60% vs. 51%; P = 0.020) of the Education group responded "not necessarily."

Hygiene practices were also reportedly better in the Education group than in the Control group, with 75% of the former reporting scalding their infants' eating utensils vs. only 55% of the in the Control group reporting this practice. Also related to hygiene, the Education group mothers were also using significantly (P < 0.005) fewer bottles (28 vs. 36%) for feeding and more bowls with spoons (55 vs. 39%).

Intervention activities evaluation. When the mothers in both groups were asked from where they wanted to learn their infant-feeding knowledge, almost half (48%) of the Education group mothers said that they would like to learn it from a book as compared to only one-third (33%) (P < 0.001) giving this

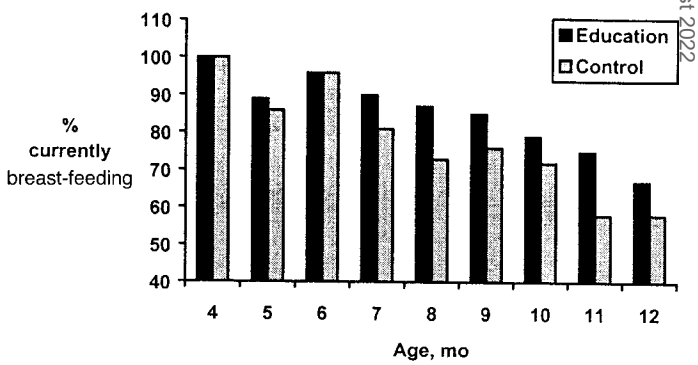

FIGURE 6 Percentage currently breast-feeding at each month of age in Education (n = 250) and Control (n = 245) groups. Bars represent the rate at each month of age. Infants in the Education group received intervention (see the Materials and Methods section) since birth. The overall prevalence in the Education group (83%) was significantly (P = 0.034) higher than that in the Control group (75%).

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TABLE 3

Percentage of infants fed foods daily in Control and Education groups at 4–6, 7–9 and 10–12 mo according to food frequency inquiry

	Age group					
	4–6 mo		7–9 mo		10–12 mo	
	Control	Education	Control	Education	Control	Education
n	69	57	76	85	100	108
			%			
Food item						
Eggs	16	37**	41	66**	62	66
Rice porridge	22	30	42	73***	42	64**
Rice	39	40	67	75	91	82
Rice flour	23	16	28	12*	16	13
Wheat products	3	4	4	9	5	15*
Corn flour	10	7	25	7**	22	19
Vegetable broth	28	28	54	75**	74	83
Vegetables	32	35	65	79*	89	89
Fruit	10	26*	42	68**	52	79***
Lard	4	9	9	31**	28	46**
Vegetable oil	29	32	58	65	82	82
Fish/meat broth	0	4	1	9*	3	13**
Meat	0	4	8	19*	9	23**
Fish	0	2	0	1	1	3
Poultry	0	2	0	1	1	0
Liver, blood	0	0	0	1	2	4
Soy products	7	5	16	9	6	9
Peanuts	1	5	7	15	21	31
Powdered milk	26	18	21	32	25	32
Biscuits	3	4	7	12	13	16
Candy	1	0	1	7	8	8
Sugar	42	49	53	54	59	52

* Indicates *P*-value of <0.05 from χ^2-test between Education and Control groups. ** indicates *P*-value of <0.01 from χ^2-test between Education and Control groups. *** indicates *P*-value of <0.001 from χ^2-test between Education and Control groups.

response in the Control group. As an evaluation of the intervention, the mothers were asked now that they had learned some good child-feeding methods that require them to cook more than once a day, did they do it? And if not, why not? Seventy-one percent of the mothers said that they had done it, and in the 10–12-mo-old group only, those that said they had done it had infants with a significantly higher WHZ (-0.06 ± 0.8 vs. -0.46 ± 1; $P = 0.026$) than those who said they had not done so. When those who did not follow that suggestion were asked why not, 56% of them said they did not have enough time, and 29% said it was too troublesome. Sixty percent said that they were visited once per month by the nutrition educator, and 64% said her visits were helpful, 18% said very helpful, and 10% said "a little" helpful. Eighty-three percent said they received the guidebook, and 25% said the book was "very helpful" and 60% said it was "helpful." Most of the mothers who had not received the guidebook were those with the youngest infants.

The mothers in both groups were asked how many times since birth their infants had been weighed. At each month of age, the difference was significant, with only one Education group infant never having been weighed, as opposed to 14% of the Control group infants. Most Education group infants were weighed at least five times, while most Control group infants were weighed only about twice. The number of times that each infant was weighed was examined as an independent variable controlling for child age. From these partial correlations, the number of times weighed was found to be significantly ($P < 0.05$) associated with HAZ, WAZ and WHZ in the Control group and HAZ and WAZ only in the Education group.

DISCUSSION

In this 1-y pilot nutrition education intervention, we tried to improve infant growth by improving feeding practices in two rural Chinese townships. The intervention was successful in improving the mothers' infant feeding knowledge and some reported infant feeding practices, maintaining higher breastfeeding rates, decreasing anemia rates, and improving infant growth at 12 mo of age in the Education group, relative to the Control group. Additionally, after 10 or 11 mo in the Education group only, the infants' Z-scores began showing an upward trend. Some of these growth, health, knowledge and practice differences were small, but all were in the desired direction.

There are few diet and growth studies of infants and children in China. We know of no other study in China that has attempted such work and reported similar results. One study among infants up to 18 mo of age conducted in 1992 and 1993 reported similar activities but did not report any health or growth results, although they did find improvement in nutrition knowledge and reported feeding practices (Li and Zhai 1997).

A strong point of this intervention was its clear goal and focus. Its goal was to improve growth, and the focus was improvement in feeding practices, particularly with respect to

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raising the low energy intake and inadequate complementary feeding during the second 6 mo of life. We stressed individual behavior change and not information dissemination, and we had a behavior-based earlier needs assessment from the same county on which to base all our activities and messages. We also emphasized to the health workers and mothers about the needs of an infant that grows well and healthily if fed the recommended complementary foods daily, and did not mention the existence of rural-urban growth differences or detailed nutrition knowledge about infant feeding.

After the intervention, the Education group mothers could at least cite some better feeding practices, but they were not always putting their new knowledge into practice. Although some better breast-feeding practices were observed and decreased use of bottles was found, the feeding of complementary foods only showed improvements in some areas.

The complementary feeding messages promoted in this intervention faced resistance and were often ignored, in part due to time limitation of the agriculturally involved mothers and in part due to the influence of widespread beliefs about infants being too small to digest the recommended foods. These beliefs have their roots in traditional infant and child feeding practices in which extended breast feeding and overdependence on breast milk after 6 mo of age were common. A review of the medical texts and family records in imperial China (Hsiung 1995) found that breast feeding was the predominant method of feeding infants, and it extended well into the second and third year of life or even into the fifth year. That review also found that feeding guidelines emphasized feeding only small amounts of soft, delicate foods to avoid overfeeding and to promote the development of the infant's digestion and absorption, prevent illness and also to "minimize crying and uncooperativeness." It was common for our mothers to refuse our feeding suggestions because they felt the baby was too small and could not digest the foods promoted.

In this intervention, we put little emphasis on food quantities in an attempt to emphasize the daily or more-than-once daily feeding of these foods. This may have resulted in feedings that were too small to meet the infants' physiological needs. Also, the study was short—further interventions of this nature should continue for at least 18 mo or even 3 y in order to more strongly reinforce better feeding practices and follow the growth for a longer time period to better understand the impact of the intervention. In this intervention, it is not clear whether the differences in growth seen at 12 mo were due to their having been in the intervention longer or to their older age.

We believe that another channel, perhaps television, could be added to the intervention, as our evaluation showed that 90% of the local households had a television, and 80% of mothers reported viewing television daily. In Gansu, television is already being reported to be exposing rural adults in that province to various new ideas about child feeding (Jing 2000). If well-designed, and broadcasting timed according to the viewing habits of the caregivers, television spots or programs could potentially add a lively, modern, colorful and otherwise attractive channel for the messages to reach the families. However, the face-to-face contact of village educators and the complementary feeding guidebook are still recommended as additional effective communication channels, as these were welcomed by most of the households.

Another strong point of this intervention was its low cost, which can facilitate its further development and dissemination to other areas later. Although we relied on outside funding to introduce the intervention, the intervention tapped as much local expertise and involvement as possible during its implementation in order to succeed amid the socioeconomic constraints. The training and employment of the Village Doctors and Women's Affairs Officials was a step toward the utilization of village-based education with more community participation and eventual utilization of rural mothers and more development of maternal self-reliance for managing this health problem. Earlier education-oriented needs assessments (Guldan et al. 1990 and 1993) had revealed that the women and households in this environment preferred face-to-face home visits. However, during this intervention, we also learned that in villages that were less scattered, the women were willing to gather together for infant weighing and meeting the educators and socializing when weather and seasonal agricultural work permitted. We suggest that in future interventions of this type, both possibilities for weighing and counseling are arranged, keeping in mind that the more isolated families must still be reached, but taking advantage of the clustering of other families for joint weighing and counseling sessions.

Also in line with keeping costs low, this intervention sought to depend on home-based complementary foods for feeding. In this county, there is widespread year-round availability of foods that can be used to make up an adequate diet—eggs, vegetables, rice, oil on a daily basis and even meat, fruit, noodles and soy products, although somewhat less often. In such a situation, technological solutions or overdependence on food fortification are less likely to be successful than interventions such as these that are targeted to the families' specific household food circumstances (Engle et al. 1997). However, perhaps more study should be made of the women's agricultural and other time commitments so as to devise more readily adaptable feeding messages.

Although hemoglobin levels were significantly higher and anemia rates were significantly lower in the Education group compared to the Control group, anemia was still prevalent at an overall rate or 22% in the Education group. A recent review of complementary feeding concluded that unfortified complementary foods may not be able to meet infant iron needs (WHO 1998). Subsequent interventions of this nature should consider some form of iron supplementation, fortification of complementary foods or medicinal iron drops; research is needed to identify an appropriate solution to this problem in rural China where animal foods are not readily available.

Among the shortcomings of this project was the weak supervision of the township and village educators. Unfortunately, at the beginning of the project we placed too much responsibility for supervision and funding management into the hands of the county level MCH personnel, who had little control over the township and village level health workers. In the future, we suggest more direct contact and support to the township and village level workers so that the desired work can be initiated and mobilized more effectively. Training and supervising village level personnel are crucial to the improvement of infant feeding in the village households in order to effectively reach mothers with services of message delivery and adequate support and counseling to enable them to understand and adapt the new behaviors. In this situation, with strong political support lacking, the county was unable to provide the infrastructure support for service delivery required for the intervention to be more successful. Since this intervention was conducted, rural infant growth failure has been highlighted as a priority for action in China's national nutrition and child development policies (All-China Women's Federation, 1991b, Chen 1997, General Office of the State Council 1997). Therefore, it is hoped that future interventions aimed at improving rural infant feeding will benefit from stronger national commitment and will receive more support at all levels, including the county level. We also recommend hiring special

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MCH complementary feeding specialists at the township level to supervise and support the village educators until the feeding practices improve more widely. This is because the county MCH staff do not have the resources to deploy one of their staff specifically to conduct the regular, frequent supervision and training visits to the more rural townships and villages.

A problem arising from our lack of adequate supervision was that the counseling was often too didactic and did not stimulate the mothers' initiative as much as was originally planned. We had hoped for less emphasis on compliance and the medical model and more effort put into empowerment of the women, developing their self-reliance. In the future, we recommend that one of the stated objectives also be to replace the mothers' passivity with a more action-oriented attitude showing more initiative, with the ultimate goal being to recruit some of the mothers who have been through the intervention with their infant to become village educators.

Another weakness was that we had no immediate baseline due to the difficulties and expense of conducting a survey, a very large and difficult undertaking for these workers for whom it was a new and very demanding experience. In the planning of this intervention, we relied heavily on the results of our work from 4 y earlier in the same area. We did find that that earlier needs assessment was extremely valuable in helping us understand some of the household level causes of the growth faltering and pre-existing practices in order to plan this intervention. The present intervention could not have been undertaken without it.

Because of the successful outcomes, we conclude that this pilot intervention has potential for further adaptation and development to other rural areas in the province or other areas in China. However, we recommend strengthening the training and incentives for the township and village nutrition educators to include more emphasis on counseling techniques, as well as stronger supervision of their work from the county and township level maternal and child health centers. We suggest that this be accomplished by the training of a complementary feeding specialist in each township, with the ultimate goal of eventually empowering the local mothers to perform this work.

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