Original Articles

Community-based Nutrition Education for Improving Infant Growth in Rural Karnataka

Kilaru A., Griffiths P.L.*, Ganapathy S. and Ghosh Shanti**

From Belaku Trust, 697 15th Cross Road, J.P. Nagar Phase II, Bangalore 560 078.
**Department of Human Sciences, Loughborough University, UK;*
***Pediatrician and MCH Consultant, New Delhi, India.*

Correspondence to: Kilaru A., Belaku Trust, 697 15th Cross Road, J. P. Nagar II Phase, Bangalore 560 078, Karnataka, India.
E-mail: belaku@vsnl.com

Objective: *To evaluate a nutrition education intervention designed to improve infant growth and feeding practices.* ***Design:*** *An intervention study using monthly nutrition education delivered by locally trained counsellors targeted at caregivers of infants aged 5-11 months. Comparison of outcomes for 2 groups - one non-intervention group of infants enrolled in 1997 that did not receive the intervention in the first year of life, and an intervention group of infants enrolled 1998-1999 that received the nutrition education.* ***Setting:*** *11 randomly selected and 2 purposively selected villages of south Karnataka.* ***Subjects:*** *138 Infants (n = 69 intervention) aged 5 -11 months.* ***Methods:*** *Families were administered a monthly questionnaire on feeding and child care behavior, and study infants were weighed at this time, using the SECA solar scales, developed for UNICEF. Logistic regression was used to examine differences between intervention and non- intervention infants in infant feeding behavior outcomes.* ***Results:*** *Statistically significant improvement was found in weight velocity for female infants in the intervention group. These infants were also more likely to exhibit at least four positive feeding behaviors – intervention infants had a higher mean daily feeding frequency (more likely to be fed solids at least four times a day (OR = 4.35, 95% CI =1.96, 10.00), higher dietary diversity (more likely to receive a more diverse diet OR = 3.23, 95% CI = 1.28, 7.69), and were more likely to be fed foods suggested by the counsellors such as bananas (OR = 10.00, 95% = 2.78, 33.3) compared to non-intervention infants.* ***Conclusion:*** *Nutrition education and counselling was significantly associated with increased weight velocity among girls and improved feeding behavior among both boys and girls. These results provide further evidence that community-based nutrition programs that emphasise appropriate feeding and care behavior can be used to prevent and address early childhood malnutrition in poor households.*

Key words: *India, Infants, Intervention, Nutrition education.*

CHILDHOOD malnutrition is a significant health problem in developing countries and one of the main causes of infant and child morbidity and mortality(1-4). Over half of the underweight children in the world live in India, where approximately 47% children under the age of three are underweight and 46% are stunted(5). Growth faltering normally begins around six months of age, the time when a diet based predominantly on breast milk begins to include complementary foods, which when delivered inappropriately results in growth faltering(6). Infants in Karnataka display this pattern of malnutrition, with those aged less than six months having a low prevalence of

underweight (6%), compared to a much higher prevalence of underweight (39%) aged 6-11 months(5).

A lack of food is not the sole cause of malnutrition. Lack of awareness and knowledge about feeding amount, frequency, type of food, *etc.*, contributes significantly to poor nutritional status among children even in families where adults meet their daily requirements(7). Interventions have shown that it is possible to improve infant growth and feeding practices through action-oriented messages(8). Probably the most comprehensive Indian studies of infant-focused nutrition education interventions have been conducted by Bhandari and colleagues(9,10). The findings from these studies suggest that nutrition education messages can result in a longer duration of exclusive breastfeeding, decreased diarrheal morbidity, and increased energy intake.

The objective of the current study was to gain an understanding of infant feeding practices in the period when infants are vulnerable to growth faltering and evaluate the effect of a nutrition education intervention on these practices between 7-11 months of age in rural Karnataka. This paper builds on an earlier report where it was shown that the nutrition education intervention had a positive impact on the growth of female infants but not males(11).

Subjects and Methods

Sample

Infants aged less than six months were enrolled on an on-going basis between 1997-1999 from 13 villages, 11 randomly selected and two purposively selected to cover a range of settings; one, a small village with a tribal community and the other, a large village with a mix of public, private and traditional health care providers. All infants and recent births identified in each of the 13 villages by fieldworkers through a combination of house visits, the snowball technique, and by the Auxilary Nurse Midwife (ANM)) during the study period were enrolled. As many of the respondents were illiterate, verbal consent was obtained. Information collection started with a baseline questionnaire including socio-demographic characteristics of the household. Monthly questionnaires were used to document feeding practices, including a 24-hour recall of foods and fluids consumed, weight of the infants and morbidity experiences in the previous month; height was measured every three months. The study team visited infants until 24 months of age. Over the three years in which the study was conducted, 468 infants were recruited.

A year into the study, data revealed that levels of malnutrition were high and knowledge of appropriate infant feeding practices was very low. The Belaku Trust's ethical advisory group decided not to conduct a randomised control study of the effect of nutrition education and instead start the intervention nutrition education for all families in the study. However, infants enrolled in the study in early 1997 were already a year old by then and had experienced their first year of life without the nutrition education. This group was considered a non-intervention comparison group (NI) (n = 69) for the first year of life for the analysis and other infants who were not older than 5 months of age when the counselling began (n = 173) were considered an intervention group (I). Hence, the sub-sample of infants for this analysis is 242 (173 + 69). Although we are comparing data from different calendar years (because infants were recruited at different times), there were no significant events that influenced food supply in the area during 1997-1999 and there were no significant changes in public health services offered,

therefore we consider the data to be comparable. The remaining infants in the study were exposed to the intervention sometime between 5 and 11 months of age and are excluded for this analysis. Dropout from the study prior to 12 months of age was very low and thus we do not expect it to have a bearing on the results.

The sixty-nine non-intervention infants (NI) (of whom 34 are females) did not receive the intervention in 1997 but were exposed to the normal standard of care available in that time period in the villages, provided by the anganwadi workers (AWW) and auxiliary nurse midwives (ANM). The 173 intervention infants (I), of which 83 are females, were recruited into the study during 1998 and 1999 and were exposed to the standard care available plus monthly nutrition counselling from 5 months of age or earlier.

Intervention

The field research staff (high school or college educated fieldworkers who live in close proximity to the study villages) also provided the nutrition education. They were trained by Belaku Trust and external MCH consultants (a pediatrician and a nutritionist)(12).

After administering the monthly questionnaire, the field staff would discuss reported feeding practices with the primary caregiver. The total time for the questionnaire and counselling was about 1½ hours. Field staff would review dietary information from the questionnaires and talk about ways of improving the quality and quantity of the diet through questions and probes asked in a friendly manner. The field staff would often provide personal examples of how to overcome challenges in feeding young children, including the kind of communication skills needed to coax young children to eat. The weight trajectory (using a growth chart), episodes of illness, and developmental milestones were also discussed. The tone of the counselling was empathy and concern for the child and family's well-being. Senior staff reviewed all questionnaires and were often present for the sessions. The counsellors were trained to be mindful of household constraints especially in terms of available household food, limited financial resources, decision-making capacity and privilege within the family structure. The key counselling messages included in the study for infants aged 5-11 months focussed on:

- use of developmentally appropriate local foods and preparation of these foods;
- appropriate feeding frequency;
- gradually increasing food diversity;
- complementary feeding followed by breastfeeding;
- avoidance of feeding bottles.

Statistical Analysis

Analysis was done using SPSS(13). Logistic regression (to control for background differences such as economic status) was used to examine differences between intervention and non-intervention infants between 7-11 months of age in outcomes related to the key counselling messages. The analysis for the effect of the intervention is examined from 7 months of age to allow time for changes in feeding practices and changes in the child's weight to be captured.

In addition to feeding behaviors, a linear regression was performed with frequency of breastfeeding in 24 hours at 11 months of age as the outcome variable. This was to assess whether any increase in the frequency or variety of complementary foods was offset by a decrease in the number of times an infant was breastfed.

Since there were a larger number of intervention infants (173), than non-intervention (69) we wished to allow for any statistical effect caused by these different numbers of infants in each group. A random sample of 69 intervention infants was selected to test the analysis. A sample size of 69 in each experimental group will detect differences in the outcome variables studied of between 18-24% between the intervention and non-intervention group (with $P = 0.05$ and 80% power) in a bivariate analysis depending on the outcome being examined.

No differences were observed in the outcomes, suggesting that the disparity in numbers does not affect our findings - hence our final results presented are for the entire group of 173 (I) group infants and 69 (NI) group infants. In addition, because the children had not been randomly allocated to the intervention and non-intervention groups, potentially confounding factors were controlled for in the regression models. These included sex, village of residence, caste, mother's education, economic level, and the mother's age at the child's birth. Since higher weight velocity was observed only in intervention girls in bivariate results, a sex-intervention interaction term was included in the regression models. To account for baseline weight, weight at 6 months of age was also controlled for in the models.

Results

Most background characteristics were not statistically different between the intervention and non-intervention groups of infants (*Table I*), except for variable called village group. This was constructed by classifying the villages in which the families live according to the level of health services available (facility

TABLE I–*Characteristics of the Intervention and Non-Intervention Infants.*

	Intervention infants (n = 173) (%)	Non-intervention (n = 69)(%)
Female	54	46
Scheduled caste/ tribe	14	15
Mother no education	48	42
Village group 1*	61	51
Village group 2	13	30
Village group 3	26	19
Low standard of living[+]	36	33
Mother aged < 20 at birth	33	43
Mean weight for age Z-score 6 months (SD)	–1.08	–0.81
	(1.00)	(1.04)

* Villages were grouped according to geographic region and the type of health care available. Group 1 has poor access generally to health facilities and no active health workers. Group 2 has moderate access to a primary health sub-centre, and has an active Auxiliary Nurse Midwife (ANM) who is involved in outreach. Group 3 contains one large village which has access to a mix of services, private providers, a missionary hospital and a government clinic, but no active outreach worker.

[+] Composite index of ownership of household consumer goods, based on the local value of goods. Low standard of living refers to the bottom tertile value of the owned household goods.

type and extent of outreach services). Because of this, village group was controlled for in the regression model.

Females enrolled in the intervention had a weight velocity that was 77 g per month greater than non- intervention girls between 6-10 months of age(11) (*Fig. 1*, bivariate results). This was also tested using linear regression controlling for socio-demographic factors that either varied between the I and NI groups, or because they have been shown in the literature to be predictors of nutritional status. Including a sex-intervention interaction term in the regression model revealed that female infants in the intervention group had greater weight velocities relative to the other groups (NI and I boys, and NI girls).

Descriptive statistics for the feeding behavior outcomes are displayed in *Table II*. Significant differences were observed in the feeding of bananas, with intervention infants being more likely to eat these (33%) compared

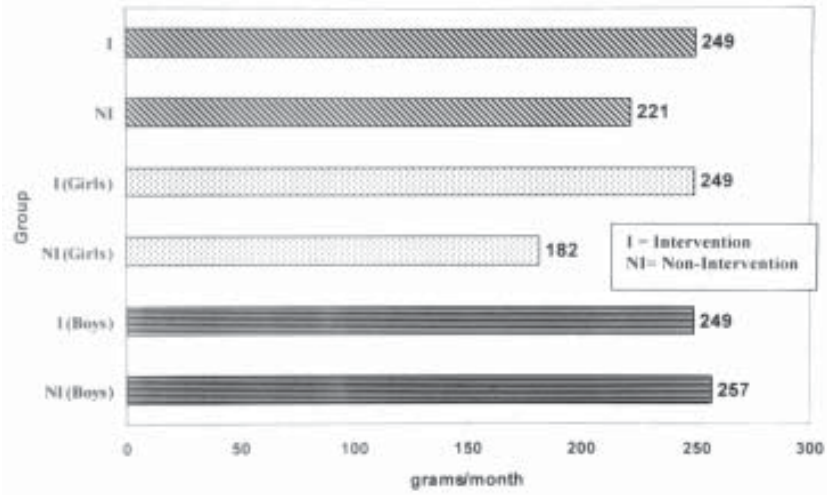

Fig. 1. Average weight velocity, stratified by intervention group.

TABLE II–*Percentage of Infants Displaying Positive Feeding Behavior by Intervention Group.*

	Intervention (%)	Non-intervention (%)	P-value
Not feeding animal milk ages 7-11 months	41	29	0.15
Not using a bottle ages 7-11 months	85	72	0.06
Feeding appropriate semi-solid foods ages 7-11 months	32	26	0.45
Feeding bananas ages 7-11 months	33	4	< 0.001
Feeding at least 4 times in 24 hours in addition to breast milk ages 7-11 months	78	51	< 0.001
Feeding at least 5 different food groups* age 11 months	42	19	0.01
Displays at least 4 positive feeding behaviors†	65	49	0.06

* Food groups examined were dairy, cereal, protein, fruit, vegetables, oil and fat, sugar and savory snacks.
† Out of the six positive behaviors shown in the table above.

to non-intervention infants (4%). Intervention infants were also significantly more likely to be fed at least four times in 24 hours in addition to breast milk (78% versus 51%) and to receive foods from at least five different food groups (42% versus 19%) in comparison to non intervention infants.

Odds ratios with 95% confidence intervals were examined from the logistic regression models for feeding behavior. Non-intervention infants were observed to be significantly less likely to be fed bananas (adjusted OR = 10.00, CI 2.78, 33.33), to be fed solids at least four times in 24 hours (adjusted OR = 4.35, CI 1.96, 10.00); and to be fed from at least five different food groups (adjusted OR = 3.23, CI 1.28, 7.69) compared to intervention infants.

In addition, we constructed a composite score of 6 positive feeding behaviors and compared intervention and non-intervention groups. Intervention females were more likely to report at least 4 of the 6 positive behaviors than non-intervention females (adjusted OR = 2.78, CI 1.02, 7.69). No significant differences were observed for male intervention or non-intervention infants.

Discussion

One of the most significant findings is the increase in weight velocity among the intervention girls compared to NI girls. Although the increase is small, it suggests that nutrition education can improve growth in poor households, and may be especially effective in regions where females are socially discriminated against. It is difficult to say why this effect was seen only in girls; boys tend to have faster rates of gain relative to girls and as such are considered more sensitive to the environment(14); we therefore may have expected more effect in boys in response to improved feeding practices. However, a study in Zaire found that girls showed catch-up growth more quickly than boys(15) and what we see here may be a demonstration of this. It is also possible that the fieldworkers paid greater attention to families with girls, although they were not instructed to do so, because of an expectation of higher risk of poor growth for girls due to a culture of female discrimination.

Girls in the intervention group were more likely to have at least 4 positive feeding behaviors compared to NI girls. This suggests that changes in a combined set of feeding behaviors may account for the improved weight gain observed in intervention girls even though no single feeding practice appears significantly different for the girls. Further analyses will use observed feeding behavior in weight velocity regressions to see if the increase can be explained by these positive behavior changes.

The study limitations include the non-randomised allocation of the intervention and non-intervention groups, which, as explained above, was done for ethical reasons. However, there is increasing recognition of the importance and value of evaluation research to public health policy and practice, especially when it is unethical to conduct randomised control trials because the intervention being withheld has a strong potential for benefit(16). In addition, information on exact portion sizes would have been useful in assessing the impact of the intervention to see if there was a direct effect on growth; these data were collected, but were unreliable, due to the well-known difficulties of collecting such data in the field.

These findings support other evidence that there is significant scope for improving feeding behavior and growth through counselling and education (9,10,17-19). We

Key Messages

- Nutrition education and counselling lead to significant increase in weight velocity among girls.
- Counseling women and their families in appropriate feeding and core behavior could reduce the incidence of malnutrition.

have observed significant positive differences in weight velocity, feeding frequency, dietary diversity, and in the use of specific recommended and locally available foods(20). Ideally, it would be better to counsel women and their families much earlier in the infant's life, or even to begin during antenatal care. Addressing groups of families through the anganwadi, rather than individuals, would be a way of using existing programs and reducing the cost of nutrition education interventions. Current recruitment requires AWWs to have at least a 10th standard education, so training them to fulfil their role as community nutrition advisors is indeed possible. Although macro-level strategies to reduce food insecurity are needed, in many poor households there is usually some food available that can be modified and fed to young children with appropriate frequency. Teaching families to increase feeding frequency, increase dietary diversity, modify household food as well as raising awareness on existing food taboos for young children (*e.g.*, bananas and eggs), could reduce the incidence of growth faltering and subsequent malnutrition.

Acknowledgements

We wish to thank UNICEF, New Delhi, for supporting this study. The authors would like to thank the field staff Shobha Prakash, Jyothi, Mallika, Mani, Tejaswini, C.K. Shoba and Anila, who delivered the intervention, and Gopal; ANM Jayanti for her dedication to her work and assistance to the study. We also thank the other members of the research team: Dr. Jayashree Ramakrishna, Dr. Usha Abraham, Shanti Mahendra, Srilakshmi Divakar and Dr. Thilaka Baskaran; we also thank Jahnavi Vasudevan for critical comments.

Contributors: Ganapathy and Ghosh designed the study; Kilaru and Ganapathy implemented the study. The analysis and draft manuscript was done by Griffiths and Kilaru. All four authors reviewed the manuscript.

Funding: UNICEF, New Delhi.

Competing interests: None stated.

REFERENCES

1. Mosley WH, Cowley P. The challenge of world health. Population Bulletin 1991; 46: 2-33.
2. Gage TB, Zansky SM. Anthropometric indicators of nutritional status and level of mortality. Am J of Human Biol 1995; 7: 679-691.
3. Murray CJ L, Lopez AD, editors. The global burden of disease: A comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020 (Vol 1. Global burden of disease and injury series). Boston: Harvard School of Public Health; 1996.
4. Murray CJ, Lopez AD. Mortality by cause for eight regions of the world: Global burden of disease study. Lancet 1997; 349: 1269-1276.
5. IIPS (International Institute of Population Sciences) and ORC Macro. National Family Health Survey (NFHS 2), India 1998-99. Mumbai: IIPS; 2000.
6. World Health Organization, Department of child and adolescent health and development.

Complementary feeding family foods for breastfed children. WHO/NHD/00.1; Geneva; 2000.

7. National Nutrition Monitoring Bureau. Diet and nutritional status of rural population. Technical report no. 21. National Institute of Nutrition (ICMR), Hyderabad, India; 2001.
8. Caulfield LE, Huffman SL, Piwoz EG. Interventions to improve the complementary food intakes of 6-12 month old infants in developing countries: Impact on growth, prevalence of malnutrition and potential contribution to child survival. Food and Nutrition Bulletin 1999; 20: 183-200.
9. Bhandari N, Bahl R, Nayyar B, Khokhar P, Rohde JE, Bhan MK. Food supplementation with encouragement to feed it to infants from 4 to 12 months of age has a small impact on weight gain. J Nutr 2001; 131: 1879-1880.
10. Bhandari N, Bahl R, Mazumdar S, Martines J, Black RE, Bhan MK. Effect of community-based promotion of exclusive breastfeeding on diarrheal illness and growth: A cluster randomised controlled trial. Lancet 2003; 361: 1418-1423.
11. Ghosh S, Kilaru A, Ganapathy S. Nutrition Education and infant growth in rural Indian infants: narrowing the gender gap. J Indian Med Assoc 2002; 100: 483-490.
12. Ghosh S. The feeding and care of infants and young children. New Delhi: Voluntary Health Association of India; 1985.
13. SPSS. Statistical Package for the Social Sciences. Version 11. SPSS Inc. Chicago, Illinois; 2001.
14. Bielicki T. Physical growth as a measure of the economic well-being of populations: the twentieth century. *In:* F. Falkner, J.M. Tanner editors. Human Growth, vol 3, New York: Plenum Press; 1986.
15. Hauspie RC, Pagezy H. Longitudinal study of growth of African babies: An analysis of seasonal variations in the average growth rate and the effects of infectious diseases on individual and average growth patterns. Acta Pediatr Scand 1989; Suppl. 350: 37-43.
16. Kirkwood B. Making public health interventions more evidence based. BMJ [online WWW]. 2004 April;328:966-967. http://bmj.bmjjournals.com/cgi/content/full/328/7446/966?etoc&eaf [23 April 2004].
17. Cerquieria MT, Olson CM. Nutrition education in developing countries: An examination of recent successful projects. *In:* P. Pinstrup-Andersen, D .Pelletier, H. Alderman editors. Child Growth and Nutrition in Developing Countries. Delhi: Oxford University Press; 1995.
18. Zeitlin MF, Formacion C. Nutrition education, study II. *In:* J. Austin, M.F. Zeitlin editors. Nutrition Intervention in Developing Countries: An Overview. Cambridge, MA: Oelgeschlager, Gunn and Hain; 1981.
19. Hornik R. Nutrition Education: A State of the Art Review. ACC/SCN Nutrition Policy Discussion Paper No 1. Rome: United Nations Food and Agricultural Organization; 1985.
20. Ghosh, S. Nutrition and Child Care; A Practical Guide. 2nd edition. New Delhi: Jaypee Bros; 2004.