Effect of nutrition improvement project on morbidity from infectious diseases in preschool children in Vietnam: comparison with control commune

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Abstract

Objective: To evaluate the effect of a nutrition improvement project based on home garden production and nutrition education on morbidity from acute respiratory infection and diarrhoeal disease in preschool children.
Design: The morbidity survey comprised five data collections undertaken by trained interviewers to ascertain the incidence and severity of respiratory infections and the incidence of diarrhoeal disease in children in two communes.
Setting: A project commune and a control commune in Vietnam.
Subjects: Preschool children to 6 years of age living in the project commune Khai Xuan (average 469 children) and the control commune Ching Cong (average 251 children).
Main outcome measures: Differences between the two communes over time in the incidence and severity of respiratory infections and the incidence of diarrhoeal disease.
Results: In Khai Xuan there was a significant reduction ($P < 0.0001$) in the incidence of respiratory infections (from 49.5% to 11.2%) and diarrhoeal infections (18.3% to 5.1%); the incidence of pneumonia and severe pneumonia was also significantly reduced ($P < 0.0001$). In Ching Cong there was no significant change in the incidence and severity of respiratory disease nor in the incidence of diarrhoeal disease.
Conclusions: These findings emphasise the successful health outcome of a nutrition project based on household food production and nutrition education and the value of evaluating nutrition projects by reference to measurable health outcomes.

Introduction

In a well nourished host the body's immune defence systems protecting against colonisation and tissue invasion of infectious agents are remarkably effective.[1] Improving nutrition is regarded as a strategy for control of infectious disease as deficiencies of protein energy and several micronutrients (particularly vitamins A and C, iron, and zinc) compromise the immune system and, in many cases, the integrity of epithelial tissues, which lowers defences to pathogenic invasion.[2] We undertook a morbidity survey to measure the functional effect on the incidence of infectious diseases of a nutrition improvement project with special reference to vitamin A deficiency through increased production and consumption of appropriate foods.[3]

Generally the effects of nutrition programmes for children have been evaluated by using anthropometric and growth measures as indicators of nutrition and health status. Several reviews of evaluated nutrition programmes, including food supplementation and food aid programmes, have shown that many have little or no impact because of problems encountered in their implementation or in the design of the programmes themselves.[4,5] As noted by Ghassemi, what is strikingly missing in most reports of nutrition programmes is information on morbidity and food intake, simply because the world database on those aspects is so small.[5] A decrease in morbidity from diarrhoeal disease and its effects, however, has been shown to be a characteristic related to the benefit associated with the impact of supplementary feeding in Bogata, Columbia, and in the Institute of Nutrition of Central America and Panama's study in Guatemala, and with high energy intake in a study of infants in poor urban families in Peru.[6]

In recent years there has been much interest in the effect of vitamin A supplementation on morbidity and mortality from infectious diseases, with conclusive evidence that improving the vitamin A status of young children reduces mortality by about 23% but with conflicting evidence in regard to morbidity.[7]

As it is accepted that malnourished children are subject to more frequent and more severe infections,[1] we measured morbidity from respiratory and diarrhoeal infections in young children in a project and a control commune in Vietnam as an evaluation of a functional outcome of a nutrition project.

Methods

The nutrition improvement project (number GCP/VIE/013/AUL), funded by the Australian government, was implemented in Vietnam from 1991 to the end of 1993 in four communes, which included Khai Xuan in Vinh Phu province.[3] The major components of this project were increased garden production, particularly of carotene rich fruits and vegetables, nutrition education of mothers of preschool children, and baseline and follow up monitoring of vitamin A status, household garden production, food intake, and growth of preschool children. The project offered a unique opportunity to monitor the effect of the nutrition improvement project on child morbidity from respiratory and diarrhoeal infections. These two infectious diseases are the main cause of mortality in infants and young children in Vietnam[8] and in other developing countries.

Morbidity survey

The morbidity survey monitored the incidence of infection in Khai Xuan, one of the four project communes, and in a control commune, Ching Cong, both located in the same district of Vinh Phu province. The design for the morbidity survey followed the protocol developed by the World Health Organisation for measuring the incidence of acute respiratory infections

and diarrhoeal disease.[9] The detailed development of methods and the training of interviewers for the survey were undertaken by the National Institute of Nutrition, the National Institute of Hygiene and Epidemiology, and the National Institute of Tuberculosis and Respiratory Diseases. Trained village workers visited mothers or other carers every three months to determine the incidence of infection in all eligible preschool children during the previous two weeks. A diarrhoeal condition was defined as the passing of four or more stools a day and respiratory infection by the presence of cough and fever. The severity of respiratory infection was investigated by including questions on rapid breathing (pneumonia) and chest indrawing (severe pneumonia). The training programme for the village workers was conducted over three days. Each of the five data collections in both communes was monitored by two medical nutritionists from the National Institute of Nutrition.

At each data collection for the morbidity survey, the mean number of participating children was 469 (range 452-497) in the project commune and 251 (237-279) in the control commune. The differences in numbers between collections were mainly explained by the movement of families in and out of the commune or failure to contact the mother or carer.

Statistical methods

The morbidity data were examined for significant associations by a χ^2 test. These data were analysed in terms of trends in the five data collections every three months (March, June, September, and December 1992 and April 1993). We analysed the age and sex distribution to determine age and sex patterns in the incidence of infection, with the age groups covering 0-12, 13-24, 25-36, 37-48, 49-60, and 61-78 months, and used logistic regression to test for differences between the project and control communes over time. The model included commune, time period (treated as an ordinal variable), and the interaction of commune and time period. The hypothesis that the average change over time in the two communes was the same was tested by examining the significance of the interaction term in the model.

Results

The analysis of the five data collections showed significant differences in incidence trends of respiratory infections between the two communes (table 1). The incidence of acute respiratory infection was lower in Khai Xuan than in Ching Cong throughout the study, but the difference was greatest in period 5. Table 1 also illustrates differences in severity of respiratory infection between the two communes. There was a significant decrease in severity in the project commune ($P<0.0001$) but no statistical differences in the control commune. Rapid breathing was significantly less common in Khai Xuan by periods 3, 4, and 5, and chest indrawing was significantly less common by periods 4 and 5.

The incidence of diarrhoeal disease was significantly higher in Khai Xuan than in Ching Cong in periods 1 and 2, but by period 5 the incidence was lower in Khai Xuan, though not significantly so (table 2). Diarrhoeal disease was less prevalent in the fifth compared with first data collection in Khai Xuan.

Table 1 Incidence of acute respiratory infection and severity as indicated by rapid breathing and chest indrawing in children in previous two weeks in Khai Xuan (project commune) and Ching Cong (control commune) by data collection period

Collection period	Proportion (%) of cases in Khai Xuan	Proportion (%) of cases in Ching Cong	Difference between Khai Xuan and Ching Cong (95% CI)
Acute respiratory infection*			
1	246/497 (49.5)	169/279 (60.6)	–11.1 (–18.3 to –3.9)
2	124/452 (27.4)	138/251 (55.0)	–27.5 (–34.9 to –20.1)
3	192/474 (40.5)	128/245 (52.2)	–11.7 (–19.4 to –4.1)
4	74/466 (15.9)	128/237 (54.0)	–38.1 (–45.3 to –31.0)
5	51/455 (11.2)	148/241 (61.4)	–50.2 (–57.0 to –43.4)
Rapid breathing*			
1	77/497 (15.5)	31/279 (11.1)	4.4 (–0.5 to 9.3)
2	39/452 (8.6)	33/251 (13.2)	–4.5 (–9.4 to 0.4)
3	17/474 (3.6)	18/245 (7.4)	–3.8 (–7.4 to –0.1)
4	9/466 (1.9)	37/237 (15.6)	–13.7 (–18.5 to –8.9)
5	4/455 (0.9)	23/241 (9.5)	–8.7 (–12.5 to –4.9)
Chest indrawing*			
1	26/497 (5.2)	7/279 (2.5)	2.7 (0.04 to 5.4)
2	2/452 (0.4)	3/251 (1.2)	–0.8 (–2.2 to 0.7)
3	23/474 (4.9)	5/245 (2.0)	1.9 (–1.0 to 4.8)
4	3/466 (0.6)	7/237 (3.0)	–2.3 (–4.6 to –0.04)
5	1/455 (0.2)	9/241 (3.7)	–3.5 (–6.0 to –1.1)

* χ^2 test for trend: $P<0.0001$ for Khai Xuan but not significant for Ching Cong.

Table 2 Incidence of diarrhoeal disease in children in previous two weeks in Khai Xuan (project commune) and Ching Cong (control commune) by data collection period

Collection period	Proportion (%) of cases in Khai Xuan*	Proportion (%) of cases in Ching Cong†	Difference between Khai Xuan and Ching Cong (95% CI)
1	91/497 (18.3)	33/279 (11.8)	6.5 (1.4 to 11.6)
2	63/452 (13.9)	16/251 (6.4)	7.6 (3.2 to 12.0)
3	26/474 (5.5)	10/245 (4.1)	1.4 (–1.8 to 4.6)
4	16/466 (3.4)	15/237 (6.3)	–2.9 (–6.4 to 0.6)
5	23/455 (5.1)	22/241 (9.1)	–4.1 (–8.2 to 0.1)

* χ^2 test for trend: $P<0.0001$.† χ^2 test for trend was not significant.

Age and sex differences and seasonal pattern

Significant age patterns were identified when we analysed the results of the two communes both together and separately. Table 3 shows that for the analysis of respiratory infections there was an increase in incidence from the first to the second year of life then a decrease through the remaining years. A significant but different age-incidence pattern was identified for diarrhoeal disease (table 4). The highest incidence was in infants, with a significant and linear decrease through the older age groups, both when the datasets from the two communes were analysed together ($P<0.0001$) and when the data from the control commune were analysed separately ($P<0.0001$). In Khai Xuan incidence did not decrease until the third year of life and then followed the same linear trend ($P<0.0001$).

No significant differences were identified between boys and girls either for the incidence or severity of respiratory infections or the incidence of diarrhoeal disease. A clear seasonal pattern was observed only for the incidence of respiratory infections, with this rate peaking in spring and autumn.

Discussion

Morbidity trends

The analysis of the incidence and severity of acute respiratory infections clearly shows that in Khai Xuan (the project commune) both the incidence of infection and

Table 3 Age trends in incidence of acute respiratory disease in past two weeks in Khai Xuan (project) and Ching Cong (control) communes during survey period (five data collections). Values are numbers of cases of acute respiratory disease/total number of interviews (percentages)

	Age (months)						
Commune	0-12	13-24	25-36	37-48	49-60	> 60	P value*
Both	262/659 (39.8)	305/653 (46.7)	336/820 (41.0)	266/746 (35.7)	219/660 (33.2)	10/59 (17.0)	<0.0001
Khai Xuan	121/412 (29.4)	171/439 (39.0)	156/517 (30.2)	131/512 (25.6)	101/411 (24.6)	7/53 (13.2)	<0.0001
Ching Cong	141/247 (57.1)	134/214 (62.6)	180/303 (59.4)	135/234 (57.7)	118/249 (47.4)	3/6 (50.0)	0.02

* χ^2 test for trend.

Table 4 Age trends in incidence of diarrhoeal disease in past two weeks in Khai Xuan (project) and Ching Cong (control) communes during survey period (five data collections).Values are numbers of cases of diarrhoea/total number of interviews (percentages)

	Age (months)						
Commune	0-12	13-24	25-36	37-48	49-60	> 60	P value*
Both	81/659 (12.3)	75/653 (11.5)	62/820 (7.6)	54/746 (7.2)	42/660 (6.4)	1/59 (1.7)	<0.0001
Khai Xuan	50/412 (12.1)	55/439 (12.5)	43/517 (8.3)	41/512 (8.0)	29/411 (7.1)	1/53 (1.9)	<0.0001
Ching Cong	31/247 (12.6)	20/214 (9.4)	19/303 (6.3)	13/234 (5.6)	13/249 (5.2)	0/6	<0.0001

*χ^2 test for trend.

its complications of pneumonia (rapid breathing) and severe pneumonia (chest indrawing) significantly decreased after the implementation of the nutrition project. Furthermore, the trends in incidence for respiratory infections and pneumonia were significantly different in the two communes. There was no evidence of a difference in trends between the two communes for severe pneumonia, probably owing to the increased incidence of severe pneumonia in Khai Xuan during the third data collection.

Though there were fewer reported episodes of diarrhoeal disease than respiratory infections, the decrease in the incidence of diarrhoea was significant only in Khai Xuan. There is no evidence that the change in diarrhoeal disease over time, however, was different to that in Ching Cong. For both respiratory and diarrhoeal infections the similar rates in the two communes in the earliest periods of data collection are at variance with the differences identified towards the end of the data collection period. To explain this trend it is reasonable to accept that there would be a considerable time period after the nutrition project started before changes occurred in home garden production, nutrition education programmes were implemented in the commune, and food intakes were affected and had an impact on immune function.

The observed changes in the incidence of respiratory and diarrhoeal infections are important for health planning and programming in Vietnam, where respiratory and diarrhoeal infections are reported as the major causes of morbidity and death in children.[8]

Data collections from the nutrition improvement project

The baseline and follow up data for the nutrition project measured in a random sample of commune families the changes in household garden production of fruit, vegetables, fish, eggs, and livestock; the food and dietary intakes of the household and young children; the nutritional knowledge of the mothers; and the anthropometric data of all the children. The same data collections were undertaken in the control commune. The analysis of these data at the National Institute of Nutrition[10] and by Waters and Bennett at the Australian Institute of Health and Welfare showed an increased garden production of vegetables, fruit, fish, and eggs, with a significant improvement in the mothers' knowledge, attitude, and behaviour in regard to nutritional care of their children in the project compared with the control commune. These changes were reflected in significantly higher intakes of vegetables, fruit, energy, protein, vitamin A, and iron by the project children compared with the control children at follow up. In his analysis of trends in food and nutrient intake from baseline to follow up Tilden reported a highly significant increase in the project children's intake of vegetables, fruit, energy, protein, vitamins A and C, and iron compared with a significant decrease in the control children's intake of vegetables, fruit, energy, protein, and iron.[10]

Further evidence of improvement came from growth monitoring of the project children, which showed a significant improvement in their nutritional status at follow up compared with no change in the control children. The results from Khai Xuan showed a decrease in stunting together with an increase in the proportion of children with acceptable heights and weights, which is consistent with the findings of other successful nutrition programmes for children, in which stunting is the primary nutritional status indicator favourably affected.[2]

In explaining the highly significant results of the morbidity study the issue of the chance of systematic error should be raised, particularly in relation to selection of the control commune and measurement bias. Ching Cong was selected as the control as it is in the same district as the project commune, it had not then been included in the national vitamin A capsule programme,[11] and it is 20 km from Khai Xuan, with limited contact between the two communes because of poor roads and other transport difficulties. All the families available in their homes on the survey day willingly participated in the survey so bias would not have been introduced through non-response. Because of their location within the same district both communes experienced the same health services and sanitation programmes and systems, were in the same weather region, and had similar garden areas allocated to the homes for food production. We do not think measurement bias in the collection of the morbidity data occurred. Any bias to report more favourable results for the project commune would probably have

indicated a lower incidence of overall morbidity from the beginning of the survey.

Positive factors that supported the successful conduct of the nutrition improvement project (1991-3) include the system of government, the social and economic situation in Vietnam, and the availability of professionally educated nutritionists at the National Nutrition Institute who were responsible for implementation and the training component of both projects under the guidance of an expatriate technical adviser.

We thank the officers at the National Institute of Nutrition Hanoi, particularly Professor Ha Huy Khoi for his planning advice and support for the morbidity survey; Dr Le Danh Tuyen and Dr Bui Dai Thu for their help in the planning of, training for, and monitoring of the morbidity data collections; and Mr Le Thanh Do for the initial analysis of the morbidity data. We thank Dr Nguyen Hoang Long (National Institute of Tuberculosis and Respiratory Diseases) and Dr Nguyen Anh Dung (National Institute of Hygiene and Epidemiology) for helping with the planning and training for the morbidity survey; Dr Franz Simmersbach (FAO Food and Nutrition Division, Rome) for his professional advice and supervision of the FAO Project; Ms Sian Fitzgerald, nutritionist (FAO Office Hanoi), for her valuable help and advice on identification and analysis of the morbidity data; Dr Robert Tilden, FAO consultant, for preparing the comprehensive report on the impact of the FAO nutrition improvement project; and Dr P Anderson, Dr I Gajanake (Australian Institute of Health and Welfare, Canberra) and Mr C Stevenson (National Centre for Epidemiology and Population Health, Australian National University, Canberra) for statistical advice. We also thank the mothers and children in Khai Xuan and Ching Cong communes who participated in the survey, the officials of the Peoples' Committees for their support, and the local interviewers, who so diligently collected the morbidity data for the survey.

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Conflict of interest: None.

Key messages

- Deficiencies of protein energy and a number of micronutrients compromise the immune system and, in many cases, the integrity of epithelial tissues, which lowers defences to pathogenic invasion
- The implementation of a nutrition project, focusing on household food production and nutrition education, significantly reduced the incidence and severity of acute respiratory infections and the incidence of diarrhoeal disease in preschool children in a rural commune in Vietnam
- Nutrition improvement should be widely adopted as a strategy for infectious disease control in international and national development programmes, especially in those countries where respiratory and diarrhoeal infections are the major cause of morbidity and mortality in young children

1 Tomkins A, Watson F. *Malnutrition and infection. A review.* Geneva: ACC/SCN State-of-the-Art, 1989. (Series No 5.)
2 Gillespie S, Mason J. Nutrition and infectious disease control. In: ACC/SCN. *Nutrition relevant actions.* Geneva: ACC/SCN, 1991. (Nutrition Policy Discussion Paper No 10.)
3 Food and Agricultural Organisation. *Nutrition Improvement Project with special reference to vitamin A deficiency through increased production and consumption of appropriate foods.* Rome: FAO, 1990. (GCP/VIE/013/AUL.)
4 Beaton G, Ghassemi H. Supplementary feeding programmes of young children in developing countries. *Am J Clin Nutr* 1982;35(suppl):864-916.
5 Ghassemi H. Supplementary feeding in programmes in developing countries: lessons in the eighties. *Asia Pacific J Clin Nutr* 1992;1:195-206.
6 Rivera J. Effects of supplementary feeding on the growth of children with infection. In ACC/SCN. *Nutritional issues in food aid.* Geneva: ACC/SCN, 1993:55-7. (Nutrition Policy Discussion Paper No 12.)
7 Beaton GH, Martorell R, Aronson KJ, Edmonston B, McCabe G, Ross AC, et al. *Effectiveness of vitamin A supplementation in the control of young child morbidity and mortality in developing countries.* Geneva: ACC/SCN, 1993. (Nutrition Policy Discussion Paper No 13.)
8 Ministry of Health. *Health statistics of Vietnam 1990-1992.* Hanoi: Ministry of Health, 1993.
9 World Health Organisation. *Diarrhoea morbidity, mortality and treatment practices—household survey manual.* Geneva: WHO, 1986. (CDD/SER/86.2.)
10 Tilden R. *Impact of the FAO vitamin A nutritional improvement project in rural Vietnam on: rates of xerophthalmia, nutritional status, maternal attitude and practices, household production and consumption patterns, and children's dietary practices.* Rome: FAO, 1993.
11 Socialist Republic of Vietnam. *National plan of action for nutrition (1995-2000).* Hanoi: Medical Publishing House, 1995.

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New medical needs

The stay ill card

Several of my good friends and colleagues have been diagnosed with chronic illnesses over the past few years. Among other things, their maladies include cancer, heart disease, arthritis, multiple sclerosis, and permanent injury sustained in accidents. As the world's population continues to age and medical science is able to cure acute illnesses and manage chronic diseases, I am likely to be faced with more friends with a condition that is unlikely to be fatal but will never go away completely and which will probably affect that person's future lifestyle and life options.

When I hear about the illness of a friend or colleague, my natural inclination is to want to say something to indicate my personal compassion and support, and sometimes a simple oral expression of concern seems insufficient or awkward. In the case of a friend's acute illness for a specific, well defined medical problem, with a full and relatively speedy recovery expected, the answer has always been easy. I purchase and send a commercial greetings card—usually one in terribly bad taste.

For chronic illnesses, however, the standard get well cards—for example, "Don't worry ... you'll be chasing nurses around before you know it" —do not seem quite appropriate. The patient is not going to get better and perhaps may not even function normally again. The cuteness and gentle teasing that characterise most traditional cards are out of place in trying to console an individual who has recently been told that his or her life, which may last for many more years, will never be the same.

Thus, there is a virtually untouched marketing opportunity for greetings card manufacturers: funny (or, for those stick in the muds who cannot see the humour in chronic disease, mushy) get well cards for those with serious medical problems predicted to be permanent or of indefinite duration. I do not quite know what message these cards would convey; "Hang in there until you die ... it's just another 30 years" or "Don't get any more speeding tickets in your new wheelchair" probably lack the catchiness needed for successful sales campaigns. Surely, though, the advertising geniuses who sell tobacco and liquor to teenagers must be up to the challenge of a changing demographic and healthcare landscape, in which people with chronic conditions deserve to get their own expressions of compassion and care from tongue tied and ill at ease friends like me.

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