Effect of an integrated nutrition program on child morbidity due to respiratory infection and diarrhea in northern Viet Nam*

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Abstract

*Infectious disease and poor diet are the two proximal causes of malnutrition in children. During the 1990s, integrated nutrition programs implemented by Save the Children (SC) in Vietnam reduced severe child malnutrition, but it has not been clear if this impact was due primarily to improved diet or reduced disease. The aim of this study was to determine whether a community-based, integrated nutrition program in Vietnam reduced child morbidity due to diarrhea or acute respiratory infections. Children 5 to 25 months old were randomly selected from randomly assigned intervention and comparison communes. Caregivers of children from the intervention and comparison groups (*n *= 119 per group) were interviewed about their child's morbidity at program baseline and at study months 2, 4, 6, and 12. Multiple logistic regression and general estimating equations (GEE) were used to evaluate the effect of the intervention on the occurrence of any diarrhea and respiratory illness in the preceding two weeks. Respiratory illness, mainly upper respiratory illness, was more common than diarrheal disease at baseline (54% vs. 6%, respectively). During follow-up, children in the intervention communes had approximately half the respiratory illness experienced by those in comparison communes (AOR = 0.5;* p *= .001). Diarrheal disease was also lower in the intervention group, although differences were not statistically significant. We conclude that SC's integrated nutrition program was associated with reduced upper respiratory illness, perhaps due to improved hygiene practices and/or improved micronutrient intakes.*

Key words: child nutrition, morbidity, ARI, positive deviance, Viet Nam

Introduction

As reflected in the UNICEF conceptual framework, poor diet and high rates of infectious disease are the two proximal causes of poor childhood growth [1]. Programs that aim to prevent or reverse childhood malnutrition can thus do so by either improving dietary intakes, reducing the burden of infectious disease, or both [2]. Both improving dietary intakes and reducing illness are likely to have a synergistic impact on better anthropometric outcomes [3]. In a programmatic setting, however, understanding why an intervention improves growth is complicated by the fact that poor diet and increased disease are themselves interrelated [4, 5].

In Viet Nam, an estimated 40% of children under five years of age are underweight [6]. Although overall morbidity due to infectious diseases in Viet Nam has declined in the past decade, diarrhea and acute respiratory infections remain among the leading child morbidities in the country [6].

Since the early 1990s, Save the Children (SC) imple-

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* The ViSION (Viet Nam study to improve outcomes in nutrition) project evaluated the implementation and impact of an integrated nutrition program on the nutritional status, morbidity, diet of, and care for children 5 to 25 months old at baseline in rural Viet Nam, through a partnership among Save the Children/US (Hanoi and Westport, Conn., USA), the USAID-funded LINKAGES Project (Washington, D.C.), Emory University's Rollins School of Public Health (Atlanta, Ga., USA), and the Research and Training Center for Community Development (Hanoi).

mented community-based, integrated nutrition programs to reduce childhood malnutrition in Viet Nam. These programs, informed by the “positive deviance approach” were found to significantly improve the nutritional status of participating children within a year of implementation [7], with children maintaining their improved status up to two years after program completion [8]. Even more strikingly, the younger siblings of these children, who had never been directly exposed to the SC intervention, grew better than counterparts whose parents had never participated in the program. While these effects were exciting, it remained unclear whether these significant, sustained effects on childhood growth were due to improvements in dietary intakes, reductions in the burden of infectious disease, or some combination of both.

With the overall objective of teasing apart and quantifying the mechanisms responsible for the program’s effects on childhood growth, we undertook a large-scale, randomized trial in northern Vietnam. This trial is referred to as the Viet Nam study to improve outcomes in nutrition (ViSION) project. We have examined the effects of the intervention on growth [9] and dietary intakes within the ViSION project elsewhere [10]. This paper reports on the effects of this program on child morbidity due to diarrhea or acute respiratory.

Methods

Study design and population

This longitudinal, prospective cohort study was conducted in rural Phu Tho Province northwest of Hanoi, beginning in December 1999. Details of the methods of this study are presented elsewhere [11]. In brief, the intervention was based on the positive deviant approach, in which foods and caregiver behaviors of better-nourished children from resource poor settings were identified and incorporated into the nutritional intervention program. Investigators identified 12 communes with the highest proportion of malnourished children (i.e., weight-for-age Z score less than –2) and group-matched them for common confounders. One of the resulting matched groups of three communes in each of two districts was randomly assigned to have comparison subjects, the other intervention.

Children age 5 to 25 months old were randomly selected from intervention and control communes to participate in the study, and caregivers of children from each group (n = 119 per group) were interviewed by trained field workers about child morbidity at program baseline and at months 2, 4, 6, and 12. During the same visit, field workers also collected data on anthropometry, caregiver health-seeking behaviors, hygiene, dietary intake, and socioeconomic status (SES). A SES composite variable was created using factor analysis taking into account the caregiver’s self-reported standard of living, electricity access, house construction material, and interviewer’s assessment of the family’s socioeconomic status.

Outcome and case definitions

The outcomes for child diarrhea and acute respiratory infection were defined as a caregiver report of at least one day of diarrhea episode or respiratory illness in the 14 days preceding the interview during each study month. A diarrhea episode was defined as passing three or more liquid or semi-liquid stools in a 24-hour period. Acute respiratory infection was defined as one or more of the following signs, symptoms, or self-reported syndromes for upper respiratory infection (cough, runny/stuffy nose, sore throat/throat infection) or for lower respiratory infection (rapid/difficult breathing, chest indrawing, bronchitis, or bronchopneumonia).

Data analysis

Dichotomous and categorical baseline characteristics of each study group were compared using chi-square tests. Some continuous variables were initially categorized into quartiles, and if the frequencies within each category did not differ between study groups, these variables were dichotomized at the median. The generalized estimating equation (GEE) approach for multiple logistic regression was used for univariate and multivariate analyses to account for within-subject correlations resulting from repeated measures taken for each individual over time [12]. This accounts for correlations that may exist within individuals for time-dependent variables such as weight-for-age Z score (WAZ). If a variable was found to be significant in the univariate analysis, it was then included in a multivariate model. The significance of an interaction term (study group by study month) was tested to assess whether the time of year affected the association between intervention and morbidity outcome measures. A p value less than 0.05 was used to determine statistical significance.

All analyses were carried out using the SAS statistical software (SAS Institute Inc., Cary, N.C., USA).

Results

Baseline characteristics

Half (53%) of the 238 children eligible for analysis were males, 56% lived in high-/midland (vs. lowland) areas, and 33% were malnourished (weight-for-age Z score less than –2) (table 1). Children and mothers were young (median age 15 months and 26 years, respectively). About half of mothers and fathers were

TABLE 1. Baseline characteristics by study group

Characteristic	Total children n (%)	Study group: Intervention n (column %)	Study group: Control n (column %)	Chi-square p value
Total	238	119	119	
Sex				
Male	127 (53.4)	67 (56.3)	60 (50.4)	.364
Female	111 (46.6)	52 (43.7)	59 (49.6)	
Age (mo)				
≤15	107 (45.0)	55 (46.2)	52 (43.7)	.697
>15	131 (55.0)	64 (53.8)	67 (56.3)	
Socioeconomic status composite index (0 = average)				
<0	72 (30.3)	38 (31.9)	34 (28.6)	.573
≥0	166 (69.7)	81 (68.1)	85 (71.4)	
Ecology				
Lowland	105 (44.1)	31 (26.1)	74 (62.2)	**<.0001**
Midland	9 (3.8)	9 (7.6)	0	
Highland	124 (52.1)	79 (66.4)	45 (37.8)	
Maternal age at baseline (yr)				
≤26	145 (60.9)	72 (60.5)	73 (61.3)	.895
>26	93 (39.1)	47 (39.5)	46 (38.7)	
Maternal education				
Primary school or less	124 (52.1)	56 (47.1)	68 (57.1)	.12
Junior high school or higher	114 (47.9)	63 (52.9)	51 (42.9)	
Paternal education				
Primary school or less	106 (44.5)	50 (42.0)	56 (47.1)	.435
Junior high school or higher	132 (55.5)	69 (58.0)	63 (52.9)	
No. of live births				
0–1	98 (41.2)	55 (46.2)	43 (36.1)	.115
≥2	140 (58.8)	64 (53.8)	76 (63.9)	
No. of children under five years of age				
0 or 1	158 (66.4)	83 (69.8)	75 (63.0)	.273
≥2	80 (33.6)	36 (30.2)	44 (37.0)	
Maternal BMI at baseline				
≤20	172 (72.3)	84 (70.6)	88 (74.0)	.563
>20	66 (27.7)	35 (29.4)	31 (26.0)	
Child WAZ at baseline				
<–2	78 (32.8)	36 (30.3)	42 (35.3)	.408
≥–2	160 (67.2)	83 (69.8)	77 (64.7)	

educated through junior high school or higher (48% and 56%, respectively). About one-third of caregivers reported having two or more living children five years of age or younger. Intervention and comparison groups were similar in demographics except that intervention subjects were more likely to reside in high-/midland areas than comparison subjects (74% and 38%, respectively; $p = .0001$) (table 1).

Diarrhea in the preceding two weeks was relatively uncommon at baseline (6%). Less educated mothers were more likely to have children with diarrhea (OR = 3.6, 95% CI 1.0–13.3; $p = .04$).

Acute respiratory infection (ARI) was nine times more common at baseline than diarrhea (54 vs. 6%). Almost all ARIs (at baseline, 88.4%, 114 of 129) were upper respiratory infections typically characterized by cough (80.7%, 92 of 114] and/or runny nose (71.1%, 81 of 114). Less educated fathers were more likely to have children with respiratory illness (OR = 1.8, 95% CI 1.1–3.0; $p = .03$). Intervention and comparison children reportedly had nearly identical levels of ARI (53.8 vs. 54.6%, respectively) (table 2).

TABLE 2. Baseline prevalence of diarrhea or respiratory illness in the past 14 days

Variable	Total children n (%)	At baseline (month 0)			
		Any diarrhea (past 14 days)		Any respiratory illness (past 14 days)	
		Yes n (row %)	Chi-square p value	Yes n (row %)	Chi-square p value
Total	238	14 (5.9)		129 (54.2)	
Study group					
Intervention	119 (50.0)	6 (5.0)	.58	64 (53.8)	.897
Control	119 (50.0)	8 (6.7)		65 (54.6)	
Sex					
Male	127 (53.4)	8 (6.3)	.77	75 (59.1)	.109
Female	111 (46.6)	6 (5.4)		54 (48.7)	
Age (mo)					
≤15	107 (45.0)	7 (6.5)	.70	57 (53.3)	.795
>15	131 (55.0)	7 (5.3)		72 (55.0)	
Socioeconomic status composite index (0 = average)					
–2 or –1	72 (30.3)	5 (6.9)	.65	41 (56.9)	.577
0, 1, or 2	166 (69.7)	9 (5.4)		88 (47.0)	
Ecology					
Lowland	105 (44.1)	6 (5.7)	.97	58 (55.2)	.860
Midland	9 (3.8)	1 (7.1)		4 (44.4)	
Highland	124 (52.1)	7 (5.7)		67 (54.0)	
Maternal age at baseline (yr)					
≤26	145 (60.9)	9 (6.2)	.79	78 (53.8)	.875
>26	93 (39.1)	5 (5.4)		51 (54.8)	
Maternal education					
Primary school or less	124 (52.1)	11 (8.9)	**.04**	69 (55.7)	.642
Junior high school or higher	114 (47.9)	3 (2.6)		60 (52.6)	
Paternal education					
Primary school or less	106 (44.5)	5 (4.7)	.49	66 (62.3)	**.026**
Junior high school or higher	132 (55.5)	9 (6.8)		63 (52.3)	
No. of live births					
0–1	98 (41.2)	6 (6.1)	.90	52 (53.1)	.768
≥2	140 (58.8)	8 (5.7)		77 (55.0)	
No. of children under five years of age					
0 or 1	158 (66.4)	11 (7.0)	.32	81 (51.3)	.202
≥2	80 (33.6)	3 (3.8)		48 (60.0)	
Maternal BMI at baseline					
≤20	172 (72.3)	9 (5.2)	.49	98 (57.0)	.166
>20	66 (27.7)	5 (7.6)		31 (47.0)	
Child WAZ at baseline					
<–2	78 (32.8)	5 (6.4)	.81	39 (50.0)	.365
≥–2	160 (67.2)	9 (5.6)		90 (56.3)	

Prospective findings

The level of reported childhood diarrhea remained low across all study months, peaking at 12% during study month two (fig. 1). Statistical significance was nearly reached at month six when comparison subjects were three times as likely (8% vs. 3%, respectively) as their counterparts to experience diarrhea. However, no significant differences were shown in diarrhea prevalence between comparison and intervention groups during any of the study months. Although the overall prevalence of diarrhea declined from baseline to month 12 in both intervention and comparison groups, repeated measures analyses show the difference between study groups to be statistically significant ($p = .001$).

Intervention children had less respiratory illness than the comparison children for study months 2, 4, 6, and 12 (fig. 2), reaching statistical significance at month two (OR=0.4, 95% CI 0.3-0.7; $p = .002$) and month four (OR=0.5, 95% CI 0.3-0.9; $p = .01$). A greater reduction in respiratory infection prevalence from month 0 to month 12 was observed for the intervention group than for the comparison group (54% to 45% vs. 55% to 54%, respectively). Repeated measures analyses show the difference between study groups to be statistically significant ($p = .001$).

Upper respiratory infections consistently accounted for most respiratory illness in both the intervention and comparison children (table 3). We found no significant association between study group and reported lower respiratory infection (LRI) (data not shown).

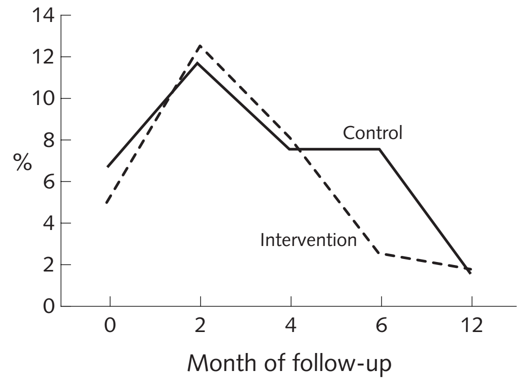

FIG. 1. Percent of mothers reporting their children had diarrhea in past 14 days by study group and month of follow-up

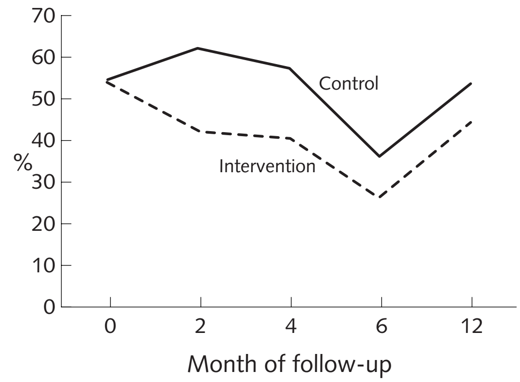

FIG. 2. Percent of mothers reporting their child had one or more symptoms of respiratory illness in past 14 days by study group and month of follow-up

TABLE 3. Acute respiratory infection signs, symptoms, and reported syndromes[a] by study month

	Study month				
Symptom, sign, or reported syndrome	0	2	4	6	12
Total children (*N*)	238	238	235	232	227
Any ARI	129	124	115	73	111
URI (% of total)					
Cough	38.6	39.9	41.7	27.2	42.7
Severe cough	1.7	0.4	0.9	0.9	0.4
Runny nose	35.3	31.9	31.9	16.8	37.4
Throat infection/sore throat	1.3	0.4	3.0	2.6	0
Any URI	47.9	48.7	47.7	29.7	46.2
LRI (% of total)					
Bronchitis	2.1	2.5	0.9	0.9	0
Broncho-pneumonia	1.3	0.8	0	0.4	0
Rapid/difficult breathing with cough	2.9	0.4	0.9	0.4	2.6
Chest indrawing	0	0	0	0	0
Any LRI	6.3	3.4	1.3	1.7	2.6

a. Children may have more than one sign/symptom/syndrome.
URI, upper respiratory infection. LRI, lower respiratory infection.

TABLE 4. Multivariate GEE model for having any diarrhea in the past 14 days for study months 2, 4, and 6

Characteristic	Adjusted odds ratio (95% CI)	*p* value
Intervention	0.61 (0.35, 1.06)	.08
Age > 15 mo	0.47 (0.27, 0.81)	.01
Female	1.11 (0.66, 1.88)	.68
Reside in High-/midlands	2.82 (1.53, 5.23)	.001

Reference groups: Comparison study group; baseline child age ≤ 15 mo; male; reside in lowlands
GEE, generalized estimating equation.

TABLE 5. Multivariate GEE model for having any respiratory illness in the past 14 days for study months 2, 4, and 6

Characteristic	Adjusted odds ratio (95% CI)	*p* value
Intervention	0.51 (0.36, 0.72)	0.001
Age > 15 mo	0.94 (0.68, 1.30)	0.71
Female	0.73 (0.53, 1.01)	0.06
Reside in High-/midlands	1.05 (0.75, 1.48)	0.76

Reference groups: Comparison study group; baseline child age ≤ 15 mo; male; reside in lowlands.
GEE, generalized estimating equation.

Multivariate analyses

Multivariate GEE models for the outcome of any diarrhea showed that the intervention was not independently associated with a decrease in diarrhea. Factors that were independently associated with a lower prevalence of diarrhea were older than 15 months of age at baseline and residing in highlands (table 4).

The intervention was significantly independently associated with less respiratory illness (AOR = 0.5, 95% CI 0.4–0.7; $p < .0001$), controlling for age at baseline, gender, ecology of residence, and taking within-subject correlations over time into account. Female children were less likely to have ARI than males, though this association was not quite significant. No other factor was independently associated with the respiratory illness outcome (table 5).

Interaction terms of study group by study month, as well as study group by gender and by age were assessed in both models. The interactions did not significantly contribute to either model and were subsequently dropped from further analysis.

Discussion

In this randomized trial of a multifaceted, community-based nutrition intervention, we found that children living in intervention communes had significantly lower levels of acute respiratory infections than children in comparison communes. No differences between the two groups were found for diarrheal disease.

The significant reductions in the prevalence of respiratory illness among the children in the intervention communes were due primarily to lower rates of upper, but not lower, respiratory illness. We do not fully understand why the intervention had such significant effects on upper respiratory infection (URI). These results may be due to improved hygiene, such as increased hand washing, and/or improved diet, including breastfeeding and micronutrient intake [13]. In an analysis of the quality of the implementation of the intervention we found that caretakers successfully practiced hand washing upon arrival at the nutrition education rehabilitation program (NERP) [14]. The intervention did not incorporate educational messages or other inputs that specifically targeted either upper or lower respiratory infections. In fact, it would be reasonable to think that the increased exposure to other children during the NERP sessions could have increased the rates of respiratory infections. The large magnitude (50% reduction) and consistency of our results from month to month, however, indicate that these results are real.

Our results are consistent with the findings of a similar study conducted in Viet Nam, which looked at the effects of a nutrition improvement project on child morbidity [15]. English et al., found that children enrolled in their nutrition improvement project had significantly fewer acute respiratory infections than their counterparts in control communes. In addition, they found that rapid breathing and chest indrawing were significantly less in the project communes.

The role of acute respiratory infections on nutritional status and growth of children has not been well documented as compared to diarrheal diseases [13]. In a small cohort of Gambian children, however, acute lower respiratory infections were associated with loss of 14.7 g of weight per day of illness, greater than the reduction observed with diarrheal diseases [16].

Although upper respiratory infections are generally not life threatening, they may lead to more serious complications in children, such as sinusitis or otitis media [17, 18]. In addition, Broor et al., found that significant predictors of child acute lower respiratory infection included upper respiratory infection among siblings, suggesting that preventing URIs in children may help prevent more serious respiratory diseases in children with whom they frequently come into contact [19].

The relatively low occurrence of diarrhea in all communes was unexpected. Low rates of childhood diarrhea have been reported in other studies conducted in Viet Nam [20, 21] so we do not believe that these low rates were an artifact or due to the presence of fieldworkers in the communities (i.e., the Hawthorne effect). The study by English et al. [15], conducted in Vietnam, similarly found no significant differences in diarrheal incidence between project and control communes over time.

Limitations of the study

One limitation of the study is the non-continuity of the morbidity data, which are based on two-week recalls every two months, until study month six, and then once more at study month 12. A limitation of the analysis presented in this paper is that the duration and severity of illness were not included in the analyses.

Relevance of findings to the larger ViSION project

An overall aim of the ViSION project was to determine whether the improvements in growth seen with the SC community empowerment and nutrition program (CENP) interventions were primarily due to improvements in diet and/or reductions in morbidity [11]. In this implementation of the CENP, it appears that reductions in morbidity were not likely responsible for any improvements in growth [9]. Although we found an improvement in URI with the intervention, other research does not indicate that URI is a major contributor to poor growth [13]. On the other hand, diarrheal disease is a well-established cause of malnutrition [22]. However, we found relatively low levels of diarrheal disease, and only mild, non-statistically significant reductions in diarrheal disease in the intervention communities.

Future research

The impact of predominantly diet and nutritional interventions on upper-respiratory infections found in this and other studies in Viet Nam [15] should be confirmed in other settings. In subsequent analyses, we will examine whether the duration and severity of illnesses varied between the intervention and comparison groups.

Programmatic implications

While URIs (including conjunctivitis, rhinitis, stomatitis, pharyngitis, otitis, sinusitis, and laryngitis, among others, singly and in combination) are rarely associated with death, they can cause irritability, lassitude, temporary loss of appetite with decreased dietary intake, and tissue catabolism with concommitant fever. Affected children need extra care and generate often inappropriate and costly use of health services. Policy makers, donors, and programmers wisely promote interventions that save lives and reduce serious morbidity and disability. Reducing URIs makes only a small contribution to this calculus.

On the other hand, in the presence of other demonstrable benefits, such as improved growth [9] this added effect of a CENP-type program should interest providers and beneficiaries alike. Indeed, community members might perceive childhood URIs, which they commonly see, as a greater health threat than childhood malnutrition, which they rarely recognize. The prospect of reducing this nuisance might prove a powerful stimulus to community mobilization.

Summary and conclusion

In conclusion, this analysis found that an integrated nutrition program in northern Vietnam reduced the burden of URI, but not diarrheal disease. The mechanisms behind these large, nearly 50% reductions in URI, are unclear and thus require further investigation. In regards to the larger ViSION project, the intervention was effective at improving growth by increasing dietary intakes, which resulted in both direct improvements in nutrition and, possibly, better micronutrient intakes, this in turn, may lead to reductions in URI burden documented in this paper.

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