PD-ABK-840

Best available copy -- pages 217 & 223 missing

PD-ABK-840
964041

Final Report

Vitamin A Child Survival Project

The University of Michigan
School of Public Health

Department of Population Planning and International Health

The Influence of Alternative Vitamin A Deficiency Control Strategies on Xerophthalmia Risk and Nutritional Status among Nepalese Children, 1988-1992

Vitamin A Child Survival Project
Nepal Netra Jyoti Sangh
Kathmandu Eye Hospital
Kathmandu, Nepal

March 4, 1993

Department of Population Planning and International Health
The University of Michigan
School of Public Health
Ann Arbor, Michigan
USA

Executive Summary: Nepal Vitamin A Child Survival Project

Background

Prior to 1981, very little information existed about the risk of xerophthalmia in Nepal. It was suspected to have similar risk to India along their mutual boarder, and cases were also reportedly seen in the hill areas. In 1981, two studies were started that documented that Nepal had a sufficient risk of xerophthalmia for it to be considered as a country with a significant public health vitamin A deficiency problem.[1] [2] Interest in addressing the problem of vitamin A deficiency in Nepal developed over the early eighties, and by 1986 small local vitamin A activities had already been started in several districts. During 1986, a proposal to implement and evaluate a vitamin A child survival intervention study in high risk areas of Nepal was developed. After several years of discussion, securing funding and planning, it was implemented in 1988.

Introduction

The Vitamin A Child Survival Project was a 4 and 1/2 year project designed to look at the feasibility and cost of alternative approaches to control vitamin A deficiency while utilizing the existing rural community health care system of Nepal. The project had two basic components. One component of the project was to develop and identify three alternative community health approaches to control vitamin A deficiency in Nepal. The other component was to evaluate and compare these approaches, based on the impact of these approaches on coverage rates, cost and the health status of children participating.

Three basic approaches were developed to control vitamin A deficiency in Nepal. Existing Village Health Workers and Community Health Volunteers that were part of the district Health Office were used for these activities which included:

1) Semi-annual distribution of 200,000 IU mega-dose **Capsules** (CAP) to children at least twice a year.

2) **Primary Health Care** (PHC) activities including deworming, oral rehydration promotion, treatment for ARI, immunization along with the semi-annual distribution of capsules.

3) **Nutrition Education Activities** (NutEd) with the promotion of six messages, along with the PHC activities, but with no mega-dose capsule. A maternal literacy program was added to this activity, in about 50% of the sites.

In addition, one cohort of children, received mass screening and symptomatic treatment of children with eye signs. This cohort was used as a positive **control**. Each

cohort of children contained approximately 16,000 children of whom 13,500 were examined at baseline, and 12 and 24 month after baseline.

Twenty-five sites for each intervention cohort was randomly selected from 7 districts in the Terai (low-land area) and mid-hills of Central and Western Nepal (see map 1). Teams were selected and trained to census, question, and exam the children in these sites, which contained as few as one village, and as many as nine. Information on program participation, nutritional status, health status and Bitot's spots was collected from each site three times, by the same field team: once before the intervention started, once at 12 months after the baseline, and once again 24 months after baseline. From a selected sub-sample serum vitamin A, and worm egg count information was collected. A detailed symptomology was taken of children that were ill on the day of exam, and at the 12 month and 24 month exam a verbal autopsy was taken concerning children that had been censused and report to have died since the previous exam.

Records were kept of all expenditures, and then attributed to specific interventions and to different activity categories. Estimates of the resources required to replicate the different activities on district wide levels have been generated.

* *Total number of Districts in Nepal 75*

Results:

Risk for xerophthalmia was not evenly distributed in Nepal. Risk for xerophthalmia occurred only in certain specific sites. Most of these sites continued to have risk through the activity, despite intensive interventions to supplement the diet with vitamin A, and control risk factors associated with vitamin A deficiency.

Table 1
Clustering of Vitamin A Deficiency Related Symptoms

Vitamin A Health Measure	Baseline		12 months		24 months	
	nu.	Percent	nu.	Percent	nu.	Percent
Sites with no X1B	173	43.8 %	225	57.0 %	253	65.5 %
Sites with X1B › 0.5% ‹ 2%	94	23.8 %	67	17.0 %	64	16.6 %
Sites with X1B › 2%	108	27.3 %	87	22.0 %	55	14.2 %
Sites with no X2, X3A or X3B	352	89.1 %	369	93.4 %	358	92.7%
Sites with X2-X3B › 1%	22	5.6 %	11	2.8 %	13	3.4 %
Sites with no X1B at baseline 12 and 24 months					148	38.3 %
Sites where X1B had gone down 12 through 24 months					178	46.1 %
Sites with no deaths in censused children			168	42.5	205	53.1 %
Sites with no deaths in censused children at 12 and 24 months					100	25.9 %

At baseline the 100 sites that had been randomly selected contained 395 wards or villages. Of these 395 villages, 173 (48.3%) did not have Bitot's spots at baseline, and 148 (38.3%) of them never had any cases of observed Bitot's spots (see table 1). Although at baseline only 20% of the sites had no nightblindness or Bitot's spots. In the areas where the risk for xerophthalmia was endemic xerophthalmia, the risk went down, but generally did not disappear. However; in 40 villages the risk for xerophthalmia increased, and while some of these were control sites some were intervention sites active in their participation of their intervention. Corneal eye signs were even more limited and found in specific villages within the broader risk areas defined by Bitot's spot prevalence. In most sites however, high rates of program participation were associated with higher levels of risk reduction.

At the third (24 month) examination new cases often were found in the same house, or a neighboring house where new cases had been found the preceding year and

at baseline In high-risk villages most of the children remained free of Bitot's spots or corneal xerophthalmia, with risk concentrated in several neighborhoods of the village.

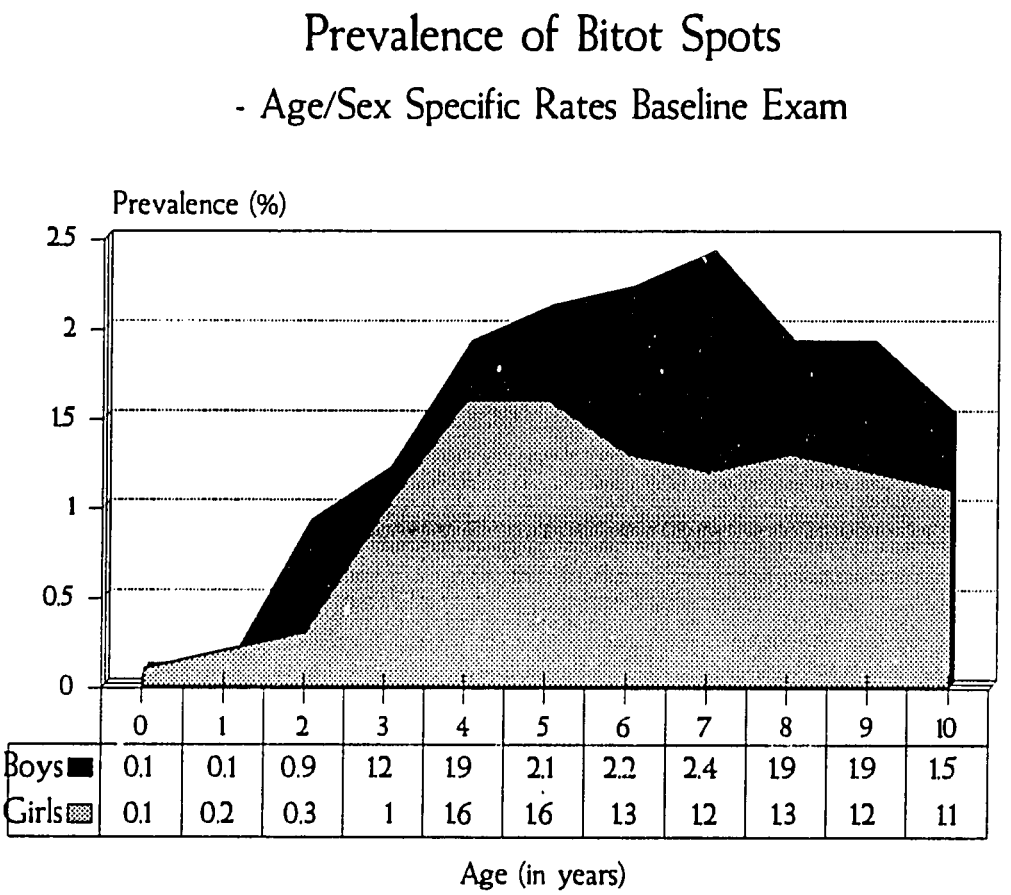
It should also be noted that risk of reported mortality of children censused in the survey also tends to cluster in specific sites. It is noteworthy that 100 villages had no child mortality at either the 12 month or 24 month exam.

A logistic regression performed on village characteristics tended to suggest that risk for xerophthalmia was associated with specific village agricultural patterns, which in effect reduced household food security, which was compounded by the lack of employment opportunities for household members and resulted in high levels of wasting in village children. These villages tended to be isolated villages depending on only one staple food. Within these particular villages, those with low levels of maternal literacy or with poor village sanitation and those villages with high levels of wasting among its children were at the highest risk for xerophthalmia.

The different interventions did reduced risk for some of the children in some of the sites. The interventions, however, did little to change the basic determinants of risk within a site (except for the targeted maternal literacy activities), and hence a number of sites continued to be at risk regardless of the presence of active intervention programs.

This study enrolled children between 6 months and 120 months. The risk of xerophthalmia was not evenly spread at baseline. More new Bitot's spots were seen in children over 60 months than below 60 months. The older children had a larger reduction of risk for xerophthalmia and mortality associated with participation in any of the interventions than did the younger children. Many Bitot's spots found at baseline were diagnosed again in subsequent examinations. These children were not counted as new Bitot's spots at the baseline in subsequent analysis. Only those children responsive to vitamin A therapy were considered new cases of Bitot's spots at baseline.

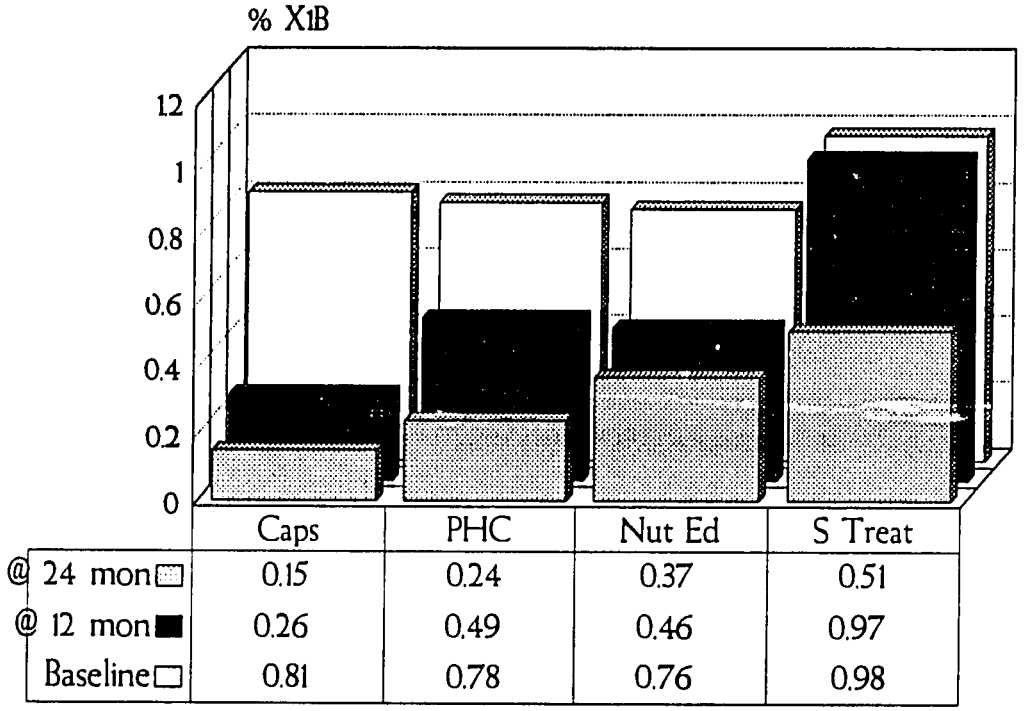
Figure 1
Prevalence of Responsive and Non-Responsive Bitot's Spots by Age and Sex at Baseline



	0	1	2	3	4	5	6	7	8	9	10
Boys	0.1	0.1	0.9	1.2	1.9	2.1	2.2	2.4	1.9	1.9	1.5
Girls	0.1	0.2	0.3	1	1.6	1.6	1.3	1.2	1.3	1.2	1.1

When looking at Bitot's spots time trends by interventions to attribute health impact of the activity (Figure 2), the risk for Bitot's spots is approximately the same between interventions at baseline. The greatest reduction in risk was seen in the capsule intervention cohort at 12 and 24 month exams. It is also noteworthy that while staying stable between baseline and the 12 month exam, the risk for Bitot's spots is also reduced among the control population during the 24 month exam.

Figure 2
New X1B at Baseline, 12- and 24-Month Exams by Intervention and Year



All Baseline Bitot's spots seen @ 12 and 24 month exam excluded from baseline

Table 2 shows the level of program participation among the different intervention cohorts. Except for the capsule cohort, the interventions usually prescribed multiple activities and/ or promote different knowledge, attitudes and practice for the mothers to improve their children's health, and to reduce risk for xerophthalmia.

Table 2 Participation in different activities of the Vitamin A Child Survival Project Among the assigned cohorts.

Activities	Time period	Capsules	Primary Health Care& Capsules	Nutrition Education	Symptomatic Treatment
Capsules					
	@12 months	75.1	72.3	3.0	1.2
	@24 months	80.2	80.9	2.8	2.8
Primary Health Care					
Deworming	@12 months	10.2	77.1	71.4	11.5
	@24 months	10.1	80.2	75.9	10.5
Oral Rehydration Therapy	@12 months	54.4	73.9	74.1	46.4
	@24 months	68.4	69.9	74.0	46.1
Co-trimoxazole therapy for ARI	@12 months	12.2	27.8	36.4	0.1
	@24 months	26.4	38.4	40.1	13.2
Fully Immunized DPT	@12 months	79.6	84.9	85.3	78.1
	@24 months	75.2	80.3	80.7	71.7
Fully Immunized Polio	@12 months	80.8	84.9	85.7	78.5
	@24 months	76.3	80.6	80.7	69.3
Fully Immunized Measles	@12 months	68.2	72.7	72.4	65.9
	@24 months	69.1	79.2	81.6	66.2
Nutrition Education					
Knows foods with Vitamin A	@12 months	10.9	6.8	14.9	1.8
	@24 months	13.7	12.7	16.0	8.4
Know DGLVs Best, Cheapest Vitamin A	@12 months	4.8	22.7	29.3	3.7
	@24 months	20.1	54.6	60.2	41.8
mother feeds food with Vitamin A	@12 months	20.1	22.7	28.2	3.7
	@24 months	49.3	55.7	61.4	45.3
mother feeds wild greens	@12 months	58.7	59.3	56	52.7
	@24 months	65.1	69.5	73.6	62.8
mother feeds colostrum	@12 months	69.1	65.8	66.8	58.9
	@24 months	76.4	79.4	76.9	66.1
Monthly Weighing	@12 months	6.3	8.6	17.1	2.9
	@24 months	2.6	3.7	16.4	6.4
Mothers literate	@12 months	16.8	12.3	13.8	6.4
	@24 months	18.4	15.3	16.8	8.3
Mothers attend Literacy class	@12 months	0.6	0.2	12.6	0.1
	@24 months	2.4	2.8	8.9	1.3

While the distribution of mega-dose capsules and deworming medicine was fairly well contained within those sites where they were programmed to be utilized, the ideas within the nutrition education intervention tended to "contaminate" both the control population and the CAP and PHC cohorts. The demand for female literacy programs was also something that could not be "contained" by the project, and during the 2nd year of the evaluation, local development officers responded to requests from the mothers and started classes in villages that were not part of the NutEd cohort including the control population.

Coverage was high for all the activities. Capsule receipt was reported to be over 70% at 12 months and over 80% at 24 months in the two interventions (CAP and PHC) where it was utilized. Deworming was programmed for two intervention cohorts (PHC and NutEd). It was popular with the mothers so that it had almost the same coverage as the capsule program (> 70% in both interventions at both points in time). Immunization and oral rehydration therapy were widely accepted prior to the implementation of the program and coverage remained high in all interventions through out the study. Co-trimoxazole therapy for severe ARI gained in popularity during the study, but coverage never exceeded 40% of the cases in the scheduled intervention cohorts (PHC and NutEd).

Nutrition education focused on 6 messages, which in turn were designed to increase the mothers understanding and recognition of xerophthalmia They also suggested how to increase the child's dietary intake, throughout the year, but especially in the seasons of highest risk (April-June), when sources of beta-carotene in the diet are limited because of climatic conditions. Different rates of knowledge and practice were achieved for different aspects of the mothers' understanding of vitamin A deficiency and her management of risk factors related to vitamin A deficiency. The highest rates of understanding about vitamin A deficiency occurred among the nutrition education cohort, but improvements about understanding and dietary practices was found throughout all cohorts in the ladder part of the study.

Table 3 Risk of Bitot's spots by participating in Activities of the Vitamin A Child Survival Project

Activities	Time Period	XIB Participate	XIB Not Participate	Relative Risk	(95% CI)	Chi Square P-value
Capsules						
	@12 months	0.30	0.67	0.45	(0.33, 0.60)	****
	@24 months	0.23	0.39	0.59	(0.41, 0.84)	***
Primary Health Care						
Deworming	@12 months	0.47	9.56	0.85	(0.66, 1.10)	N.S.
	@24 months	0.30	0.33	0.89	(0.64, 1.25	N.S.
Oral Rehydration	@12 months	0.65	0.84	0.77	(0.54, 1.10)	N.S.
	@24 months	0.35	0.45	0.77	0.44 1.34)	N.S.
Co-trimoxazole	@12 months	0.44	0.62	0.72	(0.40, 1.30)	N.S.
	@24 months	0.54	0.37	1.44	(0.79, 2.64)	N.S.
Immunization	@12 months	0.13	0.25	0.54	(0.10, 2.90)	N.S.
	@24 months	0.15	0.16	0.99	(0.18, 7.70	N.S.
Nutrition Education						
Mother Knows Vit A important	@12 months	0.29	1.45	0.20	(0.07, 0.67)	****
	@24 months	0.26	0.39	0.66	(0.46, 0.95)	**
Mother Knows Vit A Foods	@12 months	0.12	0.56	0.21	(0.08, 0.57)	****
	@24 months	0.10	0.42	0.22	(0.07 0.51)	**
Mother Knows Wild Greens	@12 months	0.31	1.01	0.31	(0.28, 0.40)	****
	@24 months	0.22	0.62	0.35	(0.24, 0.50)	****
Mother Literate	@12 months	0.14	0.56	0.25	(0.11, 0.57	****
	@24 months	0.02	0.35	0.06	(0.01, 0.42)	****

* < .1 ** < .05 *** < .01 **** < .001

The dynamics of vitamin A deficiency within the village seemed to suggest that changes in the risk for Bitot's spots were affected not only by underlying socio-economic factors and the level of program participation (coverage), but also by the "biological efficacy" of the intervention. The reduction of risk for Bitot's spots in a site is described below

Risk after Intervention for X1B =

Risk at Baseline * (100% - Coverage) * (100% - Biological Efficacy)

Where **Biological efficacy** is related to:

A) Household food security and wasting of children
B) Sanitation of Household or risk of diarrhea
C) Dosage of Vitamin A.

Table 4 Risk of corneal Xerophthalmia by participating in Activities of the Vitamin A Child Survival Project

Activities	Time Period	X2-3B Participate	X2-3B Not Participate	Relative Risk	(95% CI)	Chi Square P-value
Capsules						
	@12 months	0.057	0.064	.89	(0.42, 1.89)	N.S.
	@24 months	0.08	0.062	1.29	(0.64, 2.61)	N.S.
Primary Health Care						
Deworming	@12 months	0.035	0.082	0.43	(0.19, 0.99)	**
	@24 months	0.085	0.055	1.54	(0.75, 3.17)	N.S.
Oral Rehydration	@12 months	0.043	0.069	0.63	(0.15 2.47)	N.S.
	@24 months	0.049	0.097	0.51	(0.12, 2.01)	N.S.
Co-trimoxazole	@12 months	0.068	0.073	0.93	(0.13, 4.00)	N.S.
	@24 months	0.067	0.104	0.64	(0.14 2.96)	N.S.
Immunization	@12 months	0.034	0.062	0.54	(0.01 2.12)	N.S.
	@24 months	0.000	0.000	-	- -	N.S.
Nutrition Education						
Mother Knows Vit A important	@12 months	0.012	0.000	-	(0.07, -	NS
	@24 months	0.043	0.104	0.42	(0.19, 0.94)	**
Mother Knows Vit A Foods	@12 months	0.000	0.052	0.00	(0.02 8.25)	N.S.
	@24 months	0.070	0.070	1.00	(0.35, 2.89)	N.S.
Mother Knows Wild Greens	@12 months	0.036	0.083	0.43	(0.18, 1.04)	*
	@24 months	0.060	0.107	0.56	(0.25, 1.26)	N.S.
Mother Literate	@12 months	0.024	0.051	0.47	(0.06, 3.52)	N.S.
	@24 months	0.000	0.081	0.00	(0.00, .983	**

* < .1 ** < .05 *** < .01 **** < .001

High levels of coverage were easier to achieve for the capsule and deworming components of the project, where twice a year a mother would participate in a

community campaign. The defusion of ideas had lower levels of coverage but had much higher levels of biological impact because of higher efficacy. Where two capsules had a biological efficacy of 55% (see table 3)[3], a mother knowing which of seven foods had vitamin A had a biological efficacy of 80%. The biological efficacy of the capsule and primary health care intervention was quite limited against corneal eye signs. At the 24 month exam when corneal eye signs had increased in magnitude from the 12 month exam (see table 1), very few project promoted activities were associated with reduced risk of corneal eye signs. As can be seen in Table 4, a mother being literate and knowing vitamin A is important is associated with reduced risk of corneal eye signs at the 24 month exam.

The study was designed to look at three different measures of health status in the children that were participating in the different interventions. The measures of health status and program impact that the study was designed to measure are: 1) Bitot's spots rates, 2) Rates of Nutritional Status, and 3) Serum Vitamin A levels. In addition because of the census frame at baseline, some children have been reported as dying during the survey, and estimates of mortality rate by intervention cohort have been generated.

Table 5
Mean Serum Vitamin A Levels at Baseline, 12 and 24 month exam by Intervention
(micro-grams per deci-liter)

Intervention	Baseline exam	12 month exam	24 month exam	Number
Vitamin A Capsule Distribution	21.3	25.2***	25.6***	70
Primary Health Care	21.8	29.7***	27.6***	83
Nutrition Education	19.3	22.4**	24.9***	66

* < .1 ** < .05 *** < .01 **** < .001

Table 6
Wasting by participation in project activities.

Activities	Time Period	Wasting Participate	Wasting Not Participate	Relative Risk	(95% CI)	Chi Square P-value
Capsules						
	@12 months	12.13	14.42	0.84	(0.80, 0.88)	****
	@24 months	11.12	12.5	0.89	(0.85, 0.94)	****
Primary Health Care						
Deworming	@12 months	13.66	13.25	1.03	(0.98, 1.08)	N.S.
	@24 months	12.10	11.64	1.04	(0.99, 1.09)	N.S.
Oral Rehydration	@12 months	14.36	13.83	1.04	(0.96, 1.12)	N.S.
	@24 months	13.60	12.17	1.12	(1.02, 1.23)	**
Co-trimoxazole	@12 months	12.24	14.61	0.84	(0.75, 0.93)	***
	@24 months	16.67	12.50	1.33	(1.21, 1.47)	****
Immunization	@12 months	18.59	19.71	0.94	(0.83, 1.07)	N.S.
	@24 months	19.21	19.94	0.96	(0.84, 1.10)	N.S.
Nutrition Education						
Mother Knows Vit A important	@12 months	11.49	17.36	0.66	(0.51, 0.87)	***
	@24 months	11.78	12.29	0.96	(0.91, 1.01)	N.S.
Mother Knows Vit A Foods	@12 months	9.52	13.80	0.69	(0.62, 0.77)	****
	@24 months	11.74	12.02	0.98	(0.9 1.06)	N.S.
Mother Knows Wild Greens	@12 months	11.24	18.58	0.61	(0.57, 0.63)	****
	@24 months	10.82	16.13	0.67	(0.63, 0.71)	****
Mother Literate	@12 months	10.88	13.73	0.79	(0.72, 0.87)	****
	@24 months	9.89	12.28	0.80	(0.74, 0.88)	****

* < .1 ** < .05 *** < .01 **** < .001

The rates of Bitot's spots was reduced during the study among all the children, but the largest reduction was seen among children in the capsule cohort, and the lowest

reduction was seen in the control group. However, in terms of increases of serum vitamin A levels the largest increase was seen in the Primary Health Care cohort and Nutrition Education Cohort (Table 5). In terms of nutritional status improvement (reduction of wasting is presented), and there appeared to be a biological efficacy of 10-15% for capsules on wasting, and no inconsistent impact on wasting risk associated with utilizing the primary health care activities. The nutrition education activities showed a much strong biological efficacy than the capsules despite its lower coverage rates (Table 6).

Table 7
Mortality Risk among Intervention Cohorts

Intervention Group	age group	at 12 month exam			at 24 month exam		
		Dead	Exam	Rate 10,000	Dead	Exam	Rate 10,000
Capsules Cohort	all ages	80	12,674	63.1	63	12,323	51.1****
	0-1 year	16	1,140	140.4	16	1,147	130.8**
	1-2 year	24	1,274	188.4	16	1,138	140.6
	2-5 year	23	3,995	58.2	25	3,854	64.9
	5-10 years	17	6,305	27.0	7	6,184	11.3**
Primary Health Care Cohort	all ages	102	13,287	76.8	89	13,119	67.8**
	0-1 year	21	1,215	172.8	16	1,223	130.8**
	1-2 year	29	1,444	200.8	27	1,256	215.0
	2-5 year	29	4,297	67.5	35	4,186	83.6
	5-10 years	23	6,333	36.3	11	6,454	17.0
Nutrition Education Cohort	all ages	90	13,593	66.2	75	13,038	57.5***
	0-1 year	21	1,266	165.9	16	1,249	128.1
	1-2 year	25	1,398	178.8	22	1,243	177
	2-5 year	27	4,254	63.5	28	4,138	67.7
	5-10 years	17	6,675	25.5	9	6,408	14.0**
Symptomatic Treatment (control)	all ages	106	12,813	82.7	115	12,817	89.7
	0-1 year	30	1,325	226.4	29	1,194	242.9
	1-2 year	27	1,360	198.5	26	1,310	198.5
	2-5 year	28	4,134	67.7	41	4,174	98.2
	5-10 years	21	5,994	35.0	19	6,139	30.9

* < .1 ** < .05 *** < .01 **** < .001

The risk for mortality at the 12 month exam was lower in the intervention cohorts than among children in the control group (table 7), but the difference was not significant. By the 24 month exam, the risk for mortality had increased among children in the control cohort, but had continued going down for children enrolled in the different intervention cohorts. By the twenty-four month exam risk reduction was

significant between the capsule cohort and the control group, but the other interventions also had significant risk reduction, and among the children who had been in the nutrition education cohort, the reduction of mortality risk was almost as great as it had been among the capsule cohort. The most significant reduction of risk was seen among children that were 0-12 months on the preceding exam, and among children that had been over 60 months at the preceding exam.

TABLE 8
COSTS OF STARTING AND OPERATING ALTERNATIVE VITAMIN A INTERVENTIONS IN A TERAI OR HILL COUNTRY DISTRICT
(in U.S. dollars)

Intervention	Initial Investment	Annual Operating Cost	Total 5-year cost
Capsules 2 x yr.	10,000	15,000	83,000
Primary health care and capsules 2x yr	18,000	40,000	218,000
Nutrition Education and primary health care with Adult Literacy	33,000	82,000	435,000

The interventions all were reasonably priced, and when estimating the cost of running any of the programs for a district for five years, it would appear that the capsules are the cheapest alternative (table 8). Not only are the capsules the cheapest, but they are also the most effective in promoting health in children, both old (60-120 months) and young (6-60 months). The limitation to the capsule program is while it can reduce risk for children, it does little to eliminate the site level risk, which as stated earlier is a result of socio-economic and agricultural patterns. The nutrition education activity impacts on the pattern of risk, and while it has a very high level of biological efficacy, it is more difficult to achieve coverage with ideas than activities. This is compounded in Nepal with the low rates of maternal literacy, and high rates of wasting among children. When literacy rates improve, the cost of delivering Nutrition Education messages should decrease, however, at the present time it is costly enough that unless massive amounts of resources are made available Nutrition Education Interventions should be focused primarily on areas of highest risk.

Programs with capsule can be wide spread in districts where little information exists about the distribution of risk among villages or within villages. If the same patterns are observed in other parts of the country that were seen in the study area, then about 50% of the villages will benefit from this activity. When villages with excessive risk are located within the district then more expensive activities, with the highest level of biological efficacy, could be added to the capsule distribution activities in those specific villages.

Discussion

All the programs were successful and well received by the village mothers. Participation rates remained high throughout the study. The level of understanding of the mothers in the nutrition education cohort improved throughout the study. By the end of the study almost 97% of the mothers in the cohort had learned something about vitamin A during the study, and almost 16 % of them could correctly identify which foods contained vitamin A.

The improvement in health status was dramatic for the capsule group and the nutrition education group, but also noticeable in the Primary Health Care & capsules cohort. The reduction of risk for xerophthalmia and mortality was the greatest in the capsule group, and for mortality the reduction of risk was almost as great in the nutrition education group. The children receiving Primary Health Care with capsules, along with Nutrition Education had the largest improvement in serum vitamin A levels, but the Primary Health Care cohort did not have the same level of risk reduction for Bitot's spots or mortality as did the capsule. Risk for mortality increased in the control group between the 12 month and 24 month exam, while it was reduced in the intervention cohorts. Reduction for risk of wasting was seen across all intervention cohorts.

The cost of the capsules is the lowest and the cost of the nutrition education activities are the most expensive. However, all of the programs are relatively inexpensive given the level of improvement in health status and reduction of mortality risk as seen in those areas where vitamin A deficiency is endemic.

It appears however, that the level of risk varies greatly across geographical areas of Nepal, as does the capacity of the health care system. The more costly approach of nutrition education is probably most suitable for areas where the risk is moderate or high, and the capacity of the health care system is great enough to support the responsibility of implementing and supervising the program. Capsules however are cheaper, and therefore more cost-effective and could be widely spread on those areas where some risk occurs but is more defuse.

The real root of vitamin A deficiency in Nepal appears to be found in rural areas with high rates of wasting. This problem is socio-economic in nature, and is a household food security issue which is based on agricultural practices, local markets and job availability. Until caloric adequacy for children can be ensured, until employment opportunities for rural households are developed, until a critical mass of rural mothers in Nepal becomes literate, Vitamin A deficiency will remain endemic in Nepal. While the alternatives identified and developed in this project are cost-effective ways of preventing excessive risk for specific children within Nepal, the risk for the communities within which these children live, can only be reduced through directed social development planning in the agricultural and educational sector.

Conclusion

The Vitamin A Child Survival Project demonstrated that the vitamin A deficiency control activities tested were affordable, and were associated with varying degrees of improved health status among children aged 6 months to 120 months. Two activities in particular appear to hold much promise for the control of vitamin A deficiency in Nepal: (1) the capsule distribution program, because it is cheap and relatively effective, and (2) nutrition education/maternal literacy program because of the profound effect it makes on reducing risk for corneal xerophthalmia, wasting malnutrition, and mortality among the children of mothers that participate

The impact of public health activities on xerophthalmia and wasting appears to be influenced by caloric availability. Caloric insufficiency appears to limit the impact of such public health activities on xerophthalmia, wasting and mortality. Acute caloric insufficiency which causes wasting appears to be one of the major risk factors for xerophthalmia in Nepal. It would appear that job availability to heads of households would be very useful in reducing the risk of xerophthalmia in communities.

The areas of highest risk in Nepal boarder India, and this region generally has fertile soil. This region experiences times of agricultural surplus, but in any year demand from India absorbs a portion of the staple crop market. This in turn depletes any storage of crop surplus. Because of the cyclic rainfall patterns there are often periods when production is reduced, the price of grains increases, and the poorer elements of society have increased risk of wasting and xerophthalmia.

This study was designed without a maternal literacy component. It was added when the low levels of literacy were documented at baseline. Subsequently, using training materials that were saturated with health and nutrition information, it appeared that maternal literacy was one of the most effective interventions in the reduction of xerophthalmia, wasting and mortality. It appears that the Ministry of Health would be wise to involve other sectors, such as agriculture and education, to create a unified approach for the prevention vitamin A deficiency in Nepal.

Several findings of this study extend beyond Nepal in their significance.

1) Nutrition education and maternal literacy were more effective in reducing risk for nutritional blindness, Bitot's spots, mortality and wasting among participants than was the capsule distribution program. The capsule distribution program had higher levels of participation than did the nutrition education program.
2) The vitamin A deficiency control activities reduce risk of mortality, wasting and Bitot's spot more among the cohort of children aged 60-120 months than among preschool aged children.
3) The reductions seen in Bitot's spots, wasting and mortality attributed to a vitamin A intervention among a population is greater than the reduction of nutritional blindness seen in that same population.

4) Dietary supplementation with vitamin A can reduce risk for xerophthalmia wasting and mortality even in the most severe conditions. However, it can do little to effect the ecological and economic dynamics that create vitamin A deficiency.

---

1 Seva Foundation; "The Epidemiology of Blindness in Nepal". Chelsea, Michigan 1988.

2 Upadaya, M., Gurung, B., Pillai, K., Nepal, B (1985). "Xerophthalmia among Nepalese Children." American Journal of Epidemiology. 121:71-77

3 In table three Relative risk are given. Biological Efficacy is defined as the reduction associated with participating with an intervention and is therefore defined as 1 - relative risk. A .45 relative risk is the same as a 55% biological efficacy.

Acknowledgments

Many acknowledgments are due for work in this project. In sum, acknowledgment should go to the donors that developed and supported this project; to the agencies that executed it, and to the many individuals that worked as project team members. Some team members were employed full time; others part time, some worked for Nepal's Ministry of Health or related ministries, and there were many indispensable volunteers.

The project really belonged to rural mothers in the seven districts, and is being perpetuated by enthusiastic village health workers and community health volunteers throughout the study area. Therefore, complete acknowledgment to all those playing crucial roles is impossible. Additionally, enumerating the people who demonstrated good will, or specific people in the organizations that assisted or worked with the project, while desirable, would add several pages to this acknowledgment. We could take the manager's approach, and list only those individuals contributing financial support from the project, but many people have been drawn to this project and volunteered their time because of interest in the subject, or the country. We are appreciative, though, of all assistance received, and acknowledge that this is not an exhaustive list of institutions and people who have assisted with this project.

Funds that supported this project, though traveling through often convoluted pipelines, came from two basic sources: the *Government of the United States of America,* and the *Italian Government.* The United States funds were part of a congressional allotment to Vitamin A work, which was managed by the *Asia Bureau of the Agency for International Development* and sub-contracted to the *Office of International Health* within the *Public Health Service, Department of Health and Human Services.* The Italian funds were part of the global *Joint Nutrition Support Programme* allotment, which was jointly managed by *WHO and UNICEF.* UNICEF, which managed the Italian funds, also allotted money from other sources to maintain the continuity of the project. Hoffman-La Roche of Basel, Switzerland, provided the vitamin A capsules used in the project. The University of Michigan also supplied limited support of materials and in-kind donations during the project.

Field salaries and expenses were covered through UNICEF by the Italian grant, while the technical support was delivered through the University of Michigan by the U.S. funding. This division of financial responsibility was generally followed during the life of the project.

The field program was run under the auspices of the Nepal Netra Jyoti Sangh, the keystone organization of blindness prevention in Nepal. They lobbied intensively for the development of vitamin A programs, which they considered a significant health problem in Nepal, during their 1980 national blindness prevalence survey.

The University of Michigan Department of Population Planning and

International Health held the banner for program development, implementation and evaluation. Its role has been to provide technical support and advice to the project, and to give an objective evaluation regarding the suitability of various intervention activities for the control of vitamin A deficiency in Nepal. The Michigan team and the field activities were separated by half a world, so while some people from the Michigan team did visit the project, most working on the project in Michigan did not. Fewer people yet came from Nepal to work in Michigan, so many people at the field level in Nepal were not entirely aware of where or what the University of Michigan was.

Project staff from the University of Michigan include:

Principal Investigator:
Robert Tilden

Faculty Advisors:

Jim Lepkowski	Institute for Social Research
Robert Grosse	Population Planning and International Health
George Simmons	Population Planning and International Health
Arnold Monto	Epidemiology
Mary Fran Sowers	Epidemiology
Peter Fajans	Population Planning and International Health
Anthony Schork	Biostatistics
Frances Larkin	Human Nutrition
Gene Higashi	Epidemiology
Frank Andrews	Population Planning and International Health/ Institute for Social Research
Alan Sugar	Kellog Eye Center

Human Subjects Committee:
Dr. Hafner
Jim Koopman

Support Staff:

Filippo Curtale	Project Manager
Susan Campbell	Administrator
Suzinne Pak	Secretary, Consultant, Acting Project Manager, Sampling, Analyst
Jonathan Gorstein	Anthropometrics, information-management systems
Jim Lepkowski	Statistican, Sampling
Mary Bannister	Pre-survey, nutrition education module development
Norman Starr	Form development, data structure development
Anna Schmitz-Erpelding	Nutrition Education materials development
Sandy Richards	Secretarial

Donna Hadley	Secretarial
A.E. Doyle	Secretarial
Imam Sumarno	Workstudy/Morbidity Analysis
Sandjaja	Workstudy/Mortality Analysis
Peter Rycus	Workstudy/Ward level Analysis
Pradip Patel	Workstudy/Participation and Nutrition
Ya-Ching Lin	Workstudy/Seasonality
Jon Fryzyk	Workstudy/Cost/Maternal Literacy
Kate Colson	Workstudy/Body Mass
Debbie Humphries	Student Researcher/Adiposity
Claudia Gras	Student Researcher/Participation
Paula Tavrow	Student Researcher/Cost Effectivenss
Scott Grosse	Editorial Review

Consultants:

Barbara Underwood	Technical Reviewer {NEI-NIH}
Muhilal	Biochemistry {sponsored by UNICEF/JNSP}
Atmarita	Statistical analysis, graphics
Berlian Siagian	Data management, machine maintenance, and staff training
Joycelin Jenkins	Acting Project Manager
Bill Hawks	Opthalmic Materials Consultant, Training Advisor
Susan Schreiber	Logistics system development

The University of Michigan contribution has been a team effort. The project was designed to have the role of the University diminish over the life of the project and to stimulate local support networks for the activities, so that the project would facilitate the process of implementing a national program, rather than displace it.

The field program that the University of Michigan helped develop and later provided technical support for was based in two localities in Nepal. There was a office in the capital of Kathmandu where data entry, health education, training materials development, and materials procurement took place. In addition, there was also a hospital in Bharatpur where the field evaluation teams and program facilitators worked, providing a link to District health offices. Field evaluation teams and vehicles were also based in this center, and the training for field evaluation teams also took place there. To begin our acknowledgment of contributors in Nepal, we should start by reviewing the Ministry of Health staff who have assisted in the delivery of the program.

National Nutritional Planning Coordination Committee:

Upendra M. Malla/Bal G. Baidya	-Chairman
Shashi Maya Shrestha/Tirtha Rana	-Member secretary
S. Bhattarai/M. Joshi/M. Chettri	-Min. of Health
Tika B Karki/Yogesh Vaidya	-Min. of Agriculture
Ishowari Bhattarai	-Min. of Education and Culture
Shanti Basnyat/Uma Pradhan	-Min. of Local Development

Central Food Research Laboratory

Kundan Shrestha	Analysist

Regional Directors of Health:

Dr Prakash Aryal / Dr. Kokila Vaidya	Central
Dr. Badri Lal Shrestha / Dr. Benu Bahadur Karki	Western

District Health Officers: Ministry of Health:

Shree Hari Sharma	Chitwan
Hansa Pd Malla / Krishna M. Srivastav	Parsa
Dhan Man Shrestha / Rajkishor Singh	Bara
Jit Man Sing Basnet / Chdetra Bhandur K.C.	Tanahu
Madan Raj Thapa	Nawalparasi
Shilendra Kr. Sainjhu / Puspa Raj Shakya	Palpa
Jyoti Raj Sheratha / Tulsi Pd. Acharya	Makwanpur

Training Coordinators: District Public Health Offices, Ministry of Health:

Bharat Raj Bista	Chitwan
Chakra Bd Shakya	Parsa
Ram Chandra Shinhe	Bara
Rammadhr Tiwari	Tanahu
Moti Lal Kanu	Nawalparasi
Khil Nath Adhikari	Palpa
Ambika Baral	Makwanpur

Ministry of Health:

Dr. Suniti Acharya	Planning Division
Dr. Savitri Pahari	Public Health Division

Central Government:

Principal Investigator:
Ram Prasad Pokhrel

Ophthalmic Support Staff

Gopal Prasad Pokharel,	Evaluation Director
Chet Raj Pant,	Community Health Activity Director
M.R. Bajracharya	
B.P. Nepal	

In Kathmandu, the project maintained an office with the following staff:

S. Raja Ranjit	Administration Officer
Sushila Dahal	Data-entry supervisor
Usha Pant	Data Clerk
Rita Joshi	Data Clerk
Bidya Risal	Data Clerk
Madhab Karki	Data Clerk
Rup Kumar Rai	Bilingual Secretary
Bharat Pokharel	Assistant Administrative Officer
Prakesh Kuinkel	Audio-Visual Technician
Pradeep Rajbhandari	Graphic Artist
Shiva Lal Gautan	Assistant
Ganesh Bdr. Thakuri	Night Gaurd
Dipak Rimal	Night Guard
Laxmi R. Bajrachary	Internal Auditor
Mukunda Raj Paudel	Procurement Officer
Ram Saran Thapa	External Auditor
Mani Rai	Graphic Artist
Sunita Paudel	Data Entry
Sunita	Data Entry

King Mahendra Eye Hospital in Bharatpur served as the central location for field activities. The hospital is a well-constructed and staffed eye care facility which was established by a Pakistani Donor. The team leaders were all ophthalmic assistants who worked in the outpatient, and surgical sections of the hospital. Stores for the field teams were managed separately from the hospital stores, but many of the hospital staff also worked in the project. The project had five field teams, and eight different

ophthalmic assistants shared the jobs of team leaders. The *Ophthalmic Assistant Team Leaders* were:

Bhola Siwakoti
Binod Bista
Keehab Sharma
Bhawani Pant
Hari Ghimire
Harka Bdr. Thapa
Bhogendra Limbu
Gyan Bdr. Bhujel

In any one year, about 45 people worked on the field census/enumeration teams. By the end of the project, a well-disciplined, self-motivated field team emerged, which continues to help in expanding the program by district level assessments in new districts. Over the three census periods approximately 60 people worked as *Field Team Members,* including:

Prabhakar Thapa
Ambika Ghimire
Nil Bdr. Thapa
Bisheswor Pd. Pandy
Shalik Ram Battarai
Chhaya Shrestha
Shree Kanta Adhikari
Akela Shrestha
Man Bdr. Humal
Remant Khadka
Babu Ram Dahal
Purshottam Sigdel
Indra Pd. Bagale
Awad Raj Yanday
Mahesh Pd. Adhikari
Naba Raj Paudel
Saroj Dhakal
Purna Chandra Kandel
Ranjeeh Shrestha
Sohan Chaudhari
Deepak Raj Dharel
Kedhar Nath Dhital
Ram Raj Luitel
Madav Chimire
Kalapana Adhikari
Hari Bal Chaudhari
Ganesh Pd. Khanal
Shree Dhar Pokharel
Uma Nath Neupane
Dinesh Kumar Sharma
Dina Nath Paudel
Meera Pant
Rajendra Maharjan
Keshab Sing Thakuri
Sada Chhetri
Madan Pd. Chaudhari
Dirdha Nath Grungana
Ani Rudra Lameshane
Kumar Mainali
Bala Shrestha
Anjuna Thapa
Piyas Dahal
Ishor Giri
Dhan Bdr. Air
Karna Gurung
Bharat Gurung
Laxman Gautam
Narayan Datta Chapagai
Dinesh Pradhan
Nar Bahadur Rana
Raju Rijal
Bishnu Bhattarai

Ram Naresh Yadav
Ram Krichna Pokharel
Sanu Kaji Pant
Ashi Ram Chaudhari
Ganesh Pd. Khanal
Madhav Pokhrarel
Megha Nath Paudel
Babu Ram Neupan

The field teams were supplied, fed, paid, and transported to the different sites by the King Mahendra support staff. Public health nurses were trained for community outreach and a store-keeper and helper were constantly busy delivering urgently needed supplies, forms and salaries to teams in the field. Project vehicles were maintained and driven by a hard-working crew of drivers, whose efforts paid off in the safety of the project staff under treacherous driving conditions. A guest house facility was used by project staff and government officials alike during the project, and staff there developed some of the first demonstration gardens. The staff at the hospital included:

Ram Chandra Adhkkari
Surya Raj Paudel
Narendra Raj Paudel
Rajendra maharjan
Lokendra Kafle
Bhawani Adhikari
Chaya Shrestha
Shanta Sharama
Bal Ram Sharma
Indra Bdr. Thapa
Bimal Darai
Ganga Rayamajhi
Ganga L. Shrestha
Pravin Man Shrestha
Mohan Nepali
Deelip Chuadhari
Ganesh Lal Joshi
Ram Sundar Joshi
Parta Bdr. Gurung
Dil Bdr. Magar
Ambar Bdr. Nepali
Lekha Bdr. Khadka
Bhim Bdr. Chhetri
Shiva Karki
Indra Bdr. Thapa
Thola Tamang
Basanti Kumel
Prasanta Ghimire
suku Maya Shrestha
Lalu Maya Thapa
Dibu Bamal

However, the real project took place in the wards scattered throughout the seven districts. Acknowledgment is due to the nutrition workers at the health posts and the community health workers who so effectively delivered services to mothers and children in project areas.

Moreover, acknowledgment is due for the willingness of the Nepalese health establishment to begin this program, and utilize the information that it generated to help in the identification of appropriate national strategies. The Nepalese health care workers should be commended for their great conviction, as demonstrated by the success of their immunization and primary eye health care programs.

Table of Contents

Executive Summary: Nepal Vitamin A Child Survival Project i
Acknowledgments xix
Table of Contents xxvi
Chapter 1 Background Information: Vitamin A Deficiency and Health Status 1
1.1. Summary of established relationships 1
1.2. Interventions Designed To Mitigate Vitamin A Deficiency. 3
1.3. Historical context and specific aims of the project. 5
1.4. The Primary Health Care Structure in Nepal and the Intervention Interface 7
1.5 Experimental Design 9
Special design issues 9
Sample size considerations 12
Selection of study subjects 13
1.6. Survey Topics and Measurements: Baseline and 12 & 24 Months 14
Post-Intervention 14
1.7 Supervision and Monitoring of the Project 18
1.8 Data Collection and Data Management 19
Data collection 21
Data entry 21
Data editing/cleaning 22
Data linking 22
1.9 Data Preparation for Analysis of Health Effects 23
Weighting of the data set for study design bias 24
CHAPTER 2 Program Participation 28
2.1 Capsule Distribution Program 29
District-level differences in participation/ capsule distribution 30
Ward-level differences in participation/ capsule distribution 32
Determinants of participation/ capsule distribution 33
2.2 Primary Health Care Activities 34
Deworming 35
District-level differences in participation/ deworming 36
Ward-level differences in participation/ deworming 37
Determinants of participation/ summary -- deworming 38
Oral Rehydration Therapy 38
District-level differences in participation/ ORT 40
Ward-level differences in participation/ ORT 41
Acute Respiratory Infection Therapy 41
District-level differences in participation/ARI therapy 43
Ward-level differences in participation/ ARI therapy 43
Childhood Immunization for Diphtheria, Polio and Measles 44
District-level differences in participation/ immunization 45
2.3 Nutrition Education Activities 46
Knowledge of vitamin A 48
Attitudes about vitamin A 50

Practice and feeding habits related to vitamin A 51
Mothers feeding vitamin A-rich food 51
Mothers feeding wild sources of vitamin A-rich food 52
Feeding colostrum to newborns 53
Monthly weighing 54
Literacy 54
2.4 Summary of community, household, and individual factors influencing participation 58
Chapter 3 The Effect of Program Activities on Health Status 60
3.1 Factors that influence the distribution, measurement and/or risk of Xerophthalmia 60
Overview of the Nutritional Status of the Study Population 61
Stunting and wasting within study area 64
Skin fold and mid-upper arm circumference 65
Wasting and risk for xerophthalmia 66
Effect of location on nutritional status 68
Effect of education on nutritional status 69
Clustering by district and site 70
Seasonality 72
Age/Sex 74
Attrition at follow-up exams 75
Non-responsive Bitot's Spots 76
3.2 Program Impact on Specific Health Status Indicators 80
Capsule Distribution 83
Risk of Bitot's spots and Corneal Xerophthalmia by receipt of Capsule 83
Risk of Wasting and Stunting by receipt of capsule 85
Primary Health Care 87
Risk of Bitot's Spots and Corneal Xerophthalmia / 88
PHC Deworming 88
Risk of Wasting and Stunting / PHC -- Deworming 91
Risk for Bitot's spots and Corneal Xerophthalmia / PHC - - ORT 92
Risk of Wasting and Stunting / PHC -- ORT 93
Risk for Bitot's spots and Corneal Xerophthalmia / PHC - ARI Treatment 93
Risk of Wasting and Stunting/ PHC -- ARI Treatment 95
Risk of Bitot's Spots and Corneal Xerophthalmia/ PHC -- Immunization 95
Risk of Wasting and Stunting/PHC -- Immunization 96
Nutrition Education 96
Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: 97
Mothers Know Importance of Vitamin A 97
Risk for Wasting and Stunting/Nutrition Education: 98

Mothers Know Importance of Vitamin A 98
Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: 98
Mothers Know Foods with Vitamin A.....98
Risk of Wasting and Stunting/ Nutrition Education: 100
Mother Knows Foods with Vitamin A.....100
Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: 100
Mother Knows the Importance of Wild Greens 100
Risk of Wasting and Stunting/ Nutrition Education: 102
Mother Knows the Importance of Wild Greens 102
Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: 103
Maternal Literacy.....103
Risk of Wasting and Stunting/ Nutrition Education: 103
Maternal Literacy.....103
Risk of Wasting and Stunting/ Growth Monitoring.....105
Impact on Serum Vitamin A 105
Impact on Mortality 109
Worm Loads.....111
Chapter 4 Cost of Establishing a National Program 113
4.1 Background for Program Cost Determination 113
Sources of Funds 113
Cost Categories 114
Cost Comparisons 114
Sequencing Cost Analysis Activities.....114
4.2 Projected Budgets for Possible National Program Implementation.....115
Administrative Costs 116
Central Costs 117
District costs.....118
Assessment and Monitoring Costs.....119
Technical Assistance 121
Intervention Costs 121
Capsule Distribution (Once per year).....123
Semi-Annual Capsule Distribution 124
Capsule Distribution (3 times per year) 124
Primary Health Care 124
Nutrition Education.....125
Intervention Cost Summary 126
Other National Programs.....127
Expanded Program of Immunization (EPI) 127
Oral Rehydration Therapy.....128
4.3 Summary.....128
CHAPTER 5 Discussion and Conclusions.....130
Confirmation of Study Hypotheses 130

Program Participation and Bitot's Spot Reduction 130
Increased Program Participation in Combined Intervention Sites 132
Effective Nutrition Education is the Most Beneficial Intervention 134
Cost Effectiveness Analysis 135
Conclusions: Project Organization and Delivery 139
LITERATURE CITED 144
Appendix A: Background Determinants for Health Status in the Study Area 149
Groups of Independent Variables 149
Bitot's Spots 153
Corneal Xerophthalmia 155
Communities at Risk for Low-Weight Children 158
Stunting (Height for Age) 160
Wasting (Weight for Height) 163
Mortality 166
Appendix B: Distribution of Anthropometric Indicators by Age, Sex and Intervention 171
Appendix C: Relative Risk Tables from Chapter 3 178
Appendix D: Tables from Chapter 4 226

Chapter 1 Background Information: Vitamin A Deficiency and Health Status

1.1. Summary of established relationships

The identification and treatment of ocular symptoms of vitamin A deficiency was known to the ancient Greek civilization.[4] However, it was not until the beginning of the twentieth century that vitamin A was isolated, and in the last thirty years that serious observations and studies concerning the relationship of vitamin A deficiency and health status manifested. While early animal studies suggested the importance of Vitamin A to the maintenance of the epithelium of the cornea, it has only been recently that the overall importance of the control of vitamin A deficiency in children has been recognized as a cost-effective component of primary health care.

Based on clinical and observational studies, it is well established that severe vitamin A deficiency is associated with 1) increased risk for blindness, 2) increased risk for death, 3) elevated levels of morbidity, 4) high levels of wasting malnutrition and 5) decreased linear growth. These indications are pronounced in children with xerophthalmia. In the last 30 years, with the emergence of replicable and well-documented community intervention studies, it has been established that improvement in community vitamin A nutrition has as an outcome a decrease in some of the related health problems associated with xerophthalmia in clinical settings.

Risk at a community level for xerophthalmia is associated with insufficient dietary intake, compounded by increased levels of childhood morbidity, as well as insufficient information available within communities identify and appropriately treat the problem. High-risk communities are usually relatively poor, with high levels of maternal illiteracy, and poor household food security causing inadequate caloric and protein intake and anemia. Fathers are often unemployed or under-employed. There is often a lack of health care programs and facilities. Communities particularly in Asia, Africa, and South America are chronically plagued by vitamin A deficiency, both in established populations and refugee situations. During the 1970's several studies were carried out in India [5] and Indonesia [6] that demonstrated the effect of community vitamin A supplementation programs on non-blinding forms of xerophthalmia. It was not until the mid-1980's that the effect of community dietary supplementation on the risk for blinding xerophthalmia was demonstrated in India .[7]

A 1983 study on the effect of community supplementation on blinding xerophthalmia implied a startling and controversial result; viz, the reduction of childhood mortality rates.[8] Indeed, a 35% reduction in risk for mortality associated with implementation of a program that cost about $ 0.25 per year for child covered seemed impossible to some researchers.[9,10] However, several subsequent studies in Indonesia[11], India [12], Nepal [13,14] have shown similar (if not more striking) results. At the same time, contrary observations in India and Sudan, which showed little or no

difference in mortality risk between children receiving supplementation and those not receiving supplementation,[15] have resulted in extending the controversy.

A relatively clear picture of the distribution of risk for vitamin A deficiency has emerged in recent years. However, indications are that the factors that generate significant risk of vitamin A deficiency are not always the same and do not always interact in similar fashions. Further, patterns of risk may differ from year to year or from season to season. In some communities the problem is consistently endemic, while in other populations it tends to occur only after some large-scale disruption of food supplies and consumption of beta-carotene rich foods (such as green leafy vegetables or fruits).

Xerophthalmia, on the other hand, tends to cluster both in time[16] and geographically.[17] In some areas where xerophthalmia is endemic a majority of the cases tend to occur in a small proportion of the villages.[18] This may be due to the convergence of risk factors in certain locations which, coupled with the general widespread problem of low vitamin A status, creates neighborhoods or locations with high risk of xerophthalmia.

Risk factors at the individual level include beta-carotene dietary deficiencies that put the child at risk, as well as other nutritional deficiencies that exacerbate the underlying shortage of protein bound retinal in the body. Maternal breast-feeding habits significantly impact offspring's susceptibility to vitamin A deficiency. Age and sex are also significant correlates of the disease.

A variety of dietary deficits can influence risk for vitamin A deficiency. Lipids, protein and other nutrients are essential for the metabolism of pre-vitamin A into the bio-active holo-retinal binding protein (holo-RBP). Anemic children that are treated with iron usually also show marked improvements in serum vitamin A levels.[19] Protein is an essential nutrient for the development and transport of the bio-active form of vitamin A to the different receptor sites in the body. In Indonesian studies (1978), the relative risk of corneal disease among individuals with serum albumin above or below 3.5 g/100 ml was 49 to 1 as determined by paired analysis.[20] The relative risk of xerophthalmia in children with low serum vitamin A or low serum albumin is similar, but in some children only the albumin status is depressed, in others the serum vitamin A and holo-RBP levels are depressed, and in some both albumin and serum vitamin A levels are depressed.

Poor nutritional status, as measured by anthropometric parameters, is a significant risk factor for xerophthalmia in children. Indonesian children exhibiting active corneal xerophthalmia[21] were more often stunted (chronically malnourished) and wasted (acute malnutrition) than their matched controls. However, this finding presents only part of the picture; forty percent of the total cases of corneal xerophthalmia in that study were malnourished.

Children with vitamin A deficiency severe enough to cause ocular symptoms may also exhibit decreased efficiency of the immune system.[22] Children suffering from protein calorie malnutrition and vitamin A deficiency have an increased risk for inadequate immune response to challenges from bacteria and viral agents responsible for common childhood diarrhea and respiratory infections. Children who suffer from vitamin A deficiency appear to have more episodes of disease.[23] It is not known however if this is due to the vitamin A deficiency itself, to generalized malnutrition among children with eye signs, or simply a covariate to other factors. Certainly, however, it merits observing that the problem is circular in that many disease patterns, particularly those correlated with episodes of diarrhea, directly contribute to the depletion of vitamin A stores.

The prevalence of xerophthalmia in a cohort is related to the age of the cohort. The different ocular manifestations have peak occurrences in different age groups in different areas. In Indonesia, prevalence of the more severe corneal xerophthalmia occurs predominantly among children between 12 and 36 months, while the peak prevalence of Bitot's spots is in children ages 6 to 8 years, and the peak age for night blindness is 7 to 10 years.[24]

Findings from many different studies have shown that the prevalence of Bitot's spots is almost universally higher among males. The difference in Indonesia between male and female preschoolers was 1.7 to 1.[25] In Nepal, the same gap was found, but it was noted that the male-female ratio varied for specific age groups.[26] Cohen observed an excessive frequency of Bitot's spots among males in Bangladesh.[27] He speculated that the difference was due to food preparation practices favoring females. Given the metabolic requirements for fat to ensure the transport and utilization of vitamin A, it remains clear that a deficit in fat intake would inhibit the bio-availability of vitamin A even when it is consumed in adequate quantities. Consequentely, one can hypothesize that individual lipid stores may be higher for females and therefore yield protection from deficiency. At the same time it should be noted that a gender difference in risk for the more severe blinding forms of vitamin A deficiency has not been demonstrated.

The educational level of the mother influences the types of risk to which an offspring is exposed. Xerophthalmia is not exclusively associated with poverty. In Nepal, most cases occur in poor, lower caste villages that are densely populated.[28] In Indonesia, on the other hand, xerophthalmia is found among middle-class children who are indulged in their feeding habits and choose to consume most of their calories in the form of rice.

1.2. Interventions Designed To Mitigate Vitamin A Deficiency.

One of the objectives of this project was to study the effectiveness of several promising interventions, and an appropriate mix of them, for the control of risk for childhood vitamin A deficiency. These interventions and others, in similar or different

settings, have been more or less previously investigated. We review them here.

An adequately nourished and healthy human body is able to store enough vitamin A to meet cellular demand for about a month. This fact, coupled with the low cost of synthetic vitamin A, has led to the development of a mega-dose capsule that can satisfy physiological demands for up to four months. Capsules of greater strength have been formulated, but these higher potency versions are associated with toxic reactions in some children. Capsule distribution programs have been institutionalized in many community primary health programs, and in some areas as vertical programs. Several decades of experience with capsule distribution have shown benefits to participating children, but rates of participation decline over time unless expensive monitoring, staff retraining and intense supervision of activities are implemented.

Dietary improvement through nutrition education is often viewed as a long-term solution to community vitamin A deficiency problems. Nutrition education, is often delivered through primary health care workers, as well as school health and maternal and child health programs. The effectiveness of such delivery systems has not been adequately documented. However, the importance of maternal literacy to the overall health status of the children has been well documented.[29]

Fortification is used extensively in industrialized countries for dietary supplementation. It has also been experimented with in developing countries. Inadequate capital investment, technical deficiencies and lack of private sector involvement have often kept effective pilot projects from being expanded into national programs.

Finally, since in certain areas such as Nepal where worms, diarrhea, measles, acute respiratory infections and other childhood diseases have a major impact on children's health status, management and prevention programs, combined with other vitamin A interventions, can be undertaken. Such combined programs have not previously been evaluated.

It was the hope of this work that the development of effective programs for controlling vitamin A deficiency in children would result in a reduction of risk for xerophthalmia, decreased mortality and improved growth. We studied programs with the particular objectives of determining the extent of community participation, assessing costs, and measuring resulting changes in health status. Control programs have different costs and levels of effectiveness depending on the environment and cultures into which they are introduced. The approach and the intensity of the vitamin A deficiency control program is influenced by the magnitude of the vitamin A deficiency problem, its associated risk factors, and the cost of implementing the control program within a particular area. Therefore the most appropriate mix of activities will vary from area to area. The current project interventions have been designed to accommodate the specific mix of risk factors that appear to be responsible for xerophthalmia in the specified districts of Nepal.

1.3. Historical context and specific aims of the project.

Vitamin A deficiency in Nepal was first documented in the early 1980's in a blindness prevention study[30] and a vitamin A deficiency study.[31] The deficiency had been known to occur in neighboring India for some time. After malaria was controlled in the mid 1960's the terai flatlands of Nepal was developed as an agricultural area and by the 1980 census one third of the Nepalese population was living in the terai bordering India. Even though the risk is highest in the terai area, it also has been demonstrated to be a significant health problem in some parts of the hills and mountains of the country. It was not until the mid-1980's that vitamin A deficiency control was attempted in the Rupundi district. This program was under the direction of Dr. C.R. Pant and was a screening and treatment initiative. In 1987 UNICEF imported its first stock of mega-dose capsules. The capsules were distributed through the Joint Nutrition Support Program (JNSP) in high risk terai areas. By 1987, the Nepal Blindness Prevention Association (Nepal Netra Jyoti Sangh, NNJS) was receiving several hundred thousand capsules annually as donations.

In the late 1980's the Vitamin A Child Survival Project was formulated to address some key policy questions relating to the development of a national program in the context of the available infrastructure and control strategies appropriate to the country. Several approaches were developed and tested to calculate costs, participation rates, and health status impact on participating children. Through discussion with Nepalese Ministry of Health Officials, Nepal Netra Jyoti Sangh and donor organizations, an outline of aims and objectives for the Vitamin A Child Survival Project was developed. An original work plan was reviewed by a peer committee called by the National Eye Institute of the National Institute of Health, USA, and has been the basic plan for the project since its implementation in 1988.

The research was carried out in collaboration with Nepal Netra Jyoti Sangh and the Nutrition Unit of His Majesty's Government of Nepal. The study goal was to identify the most cost-effective strategies at varying resource levels for the control of vitamin A deficiency in Nepal, while enhancing existing indigenous skills and resources available to develop, implement, and evaluate nutrition and other health programs. To achieve these goals a field investigation of alternative interventions designed to attain vitamin A sufficiency was conducted between 1988 to 1992.

> The specific aims of this research program were as follows: *1) devise efficient methods of control in context of Nepal's ecology of childhood vitamin A deficiency; 2) determine the program attributes with high sustained coverage in Nepal; 3) document the evidence of vitamin A deficiency, identify risk factors and assess Bitot's Spot prevalence; 4) determine the reasons some families refuse program participation and identify effective incentives to participation; 5) determine the cost of achieving different levels of vitamin A-deficiency reduction; 6) develop a cadre of trained vitamin A investigators capable of independent vitamin*

A deficiency research; 7) strengthen existing indigenous capabilities for carrying out large-scale intervention programs; 8) improve childhood growth in the study districts; and 9) identify potential vehicles suitable for vitamin A fortification.

Nepal Netra Jyoti Sangh and the nutrition units of the seven district health offices field-tested intervention programs in a sample of children aged six months through ten years old. To summarize, three modes of vitamin A deficiency control appear effective for endemic areas of Nepal.

(a) *Capsule Distribution* consisting of dietary supplementation through mass mega-dose vitamin A capsule distribution semi-annually or tri-annually;

(b) *Primary Health Care with Capsule Distribution* consisting of mega-dose vitamin A capsule distribution with additional activities such as control of childhood infections (including diarrhea, acute respiratory infection, worms, and measles) in order to 1) determine the effectiveness of the combined activities among participating children and 2) to gain community support for vitamin A activity as part of a perceived effort to improve health resources generally, and thereby to increase rates of coverage; and

(c) *Nutrition Education and Primary Health Care* consisting of improving dietary intake through maternal nutrition education and education of children; capsule distribution is not included (except as treatment for children exhibiting ocular signs).

Three hypothesis were formulated to guide the development of the experimental design. They are as follows:

1) *Children of all ages participating in any of the three vitamin A deficiency control programs will have a significant reduction in the prevalence of Bitot's spots;*

2) *villages with children participating in the intervention combining capsule distribution and infection control will sustain a greater level of community participation than those where only capsules are delivered; and*

3) *children participating in the nutrition education intervention whose mothers have understood the nutrition messages (and who subsequently altered their child's feeding behavior) will have a significant reduction in Bitot's spots, and sustain a greater improvement in nutritional status than those mothers who have not changed their child's feeding behavior.*

1.4. The Primary Health Care Structure in Nepal and the Intervention Interface

Nepal is divided into 75 administrative units or *districts*. Seven districs were chosen for the study. In each district, a district public health office is operating. These offices report to the Ministry of Health and are responsible for the budget and personnel of all the health activities in the district, except that government hospitals (located in urban areas) fall under different jurisdiction. Subordinate to the district public health office in the hierarchy are health posts, usually nine per district, headed by a paramedic health assistant, two nurse midwifes, two health assistants and nine *village health workers* (VHWs). The village health workers are based in the village development committee, which includes nine wards. VHWs have a variety of responsibilities, ranging from administering immunization to community family planning activities. They supervise and support the *community health volunteers* (CHVs) in village development committees. Each CHV attends to one ward covering an average of 500 people.

In the past, primary health care programs were implemented vertically. Such programs consisted of family planning, the extended program of immunization (EPI), oral rehydration therapy (ORT), malaria, leprosy and tuberculosis control programs. Each program had its own equipment and personnel at the district and health-post level. During the last few years the structure has been changed. There is now no separation among different programs; and the primary health care staff integrates all activities to integrate them at the village level.

The Vitamin A Child Survival Project was designed to operate within framework of this infrastructure and to deliver the three Vitamin A deficiency control programs as an integral part of the overall activities of the Ministry of Health. The three program interventions were specifically designed to be implemented through the rural model primary health care system utilizing VHW's and CHV's. This approach was followed with the objective of developing a national model that could be replicated in every district requiring assistance.

It is worth noting that although the study was principally directed at rural populations seven urban sites, one in each district, were included with the objective of obtaining a representative sample. Unfortunately for the purposes of the study, since district hospitals do not fall under the primary health care system, the population living in urban areas where a hospital is generally operating is not included in the same primary health care delivery model as the remaining rural part of the district. More specifically, the rural delivery model including VHW's and CHV's characterized above is replaced by a hospital based delivery system operated by hospital staff. The intervention activities for urban areas were therefore delivered by project staff, and consequentely the interventions cannot be replicated on a larger scale in the form they have been designed. On the basis of the experience accumulated during the study it

will be desirable to develop different approaches for urban areas. Indeed, the urban populations in the study area were less receptive to the project activities than their rural counterparts.

To reach the outlier populations, CHV's were used to deliver services. Voluntary staff were already selected and trained in at least four of the seven study districts. In those districts only additional training and materials were provided. In each village the same person was selected by the district public health office, without creating a duplicate cadre. In the three study districts where the community health volunteer program was not yet implemented at the time the project operations started, the selection of volunteers was done by Project staff in consultation with the district public health office following criteria suggested by the Ministry of Health; viz., a literate female, possibly married, and a resident in the village.

A major limitation of the primary health care system in Nepal is the high turnover of the district public health office staff and the great number of vacancies in the *health posts* (HPs) including the VHW positions. The continual transfer of district public health office staff disrupts activities and slows implementation. At a lower level, personnel are more stable and most of them are resident in the area, but many positions are still vacant. Some are real vacancies, meaning that no one has been appointed for the position. Other are false vacancies, in the sense that a person has been appointed but never started working. False vacancies represent a more serious problem because it is not possible to hire replacements.

In addition, due to limited resources available for health services in Nepal, most health posts operate with an insufficient supply of drugs, facing the choice of being without drugs for most of the months during the year, or providing drugs in insufficient dosage. The limited budget also affects training activities and supervision, since daily and travel allowances are usually not covered.

The CHV's also face several problems. Most are non-literate women overburdened with farming and work at home. As volunteers they are not supposed to receive cash compensation and no other incentives of any form are provided. Furthermore, training is inadequate and funds for refresher and replacement training are not available. Like the health post staff, the CHV's are asked to work with an insufficient supply of drugs and education materials and seldom receive supervision or support visits from the paid staff of the Ministry of Health. In this situation most of them simply drop out as soon as their first stock of medicines is distributed.

These problems combined with the low level of awareness about health needs in the communities and the difficult terrain (which necessitates extensive walking for the implementation of any activity), result in a relatively unproductive system; a primary health care structure exists in Nepal and represents significant cost to the government in salary and supplies, but has only a limited impact on the community. Despite these significant limitations inherent in the system, it was the mission of the project to

accomplish its objective within the context of the existing infrastructure and to work out practical solutions to its effectiveness. It is our observation that not only did good participation result around the vitamin A activities but that the general level of primary health care services improved during (and probably related to) the study.

1.5 Experimental Design

Special design issues

Given the multiple objectives of the study special attention was paid to providing an efficient experimental design which was sufficiently large to satisfy all primary study needs. It was essential that the design incorporate a number of complexities unique to the study subject and area, as well as a variety of ethical considerations which arise in such interventions.

Seven issues were of importance to the study design: (1) the length of interventions; (2) treatment of all children discovered with eye signs of nutritional deficiency; (3) the seasonality of vitamin A deficiency; (4) background prevalence rates of vitamin A deficiency signs; (5) measurement bias; (6) assuring impartiality among investigators between treatments; and (7) intervention checks and monitoring. These factors are discussed in order below:

1) The study was designed to observe changes in community vitamin A status over time. While it is desirable to validate the effects of direct clinical interventions (such as mega-dose supplementation with and without infection control) which tend to produce results quickly, it was essential to allow sufficient time for diet modification to be established, reinforced, accepted and adopted by communities, and to gradually demonstrate effects in terms of improved health status. The investigators believed two years represented an adequate time reference to satisfy the aforementioned needs.

2) It was essential that the experimental design incorporate investigator concerns that every child within the study population who showed any signs of illness during the course of the study (vitamin A related or not), received some type of appropriate medical intervention or referral. Equally, every child in the study (however healthy) should have the benefit of receiving a preventive intervention. Thus, each child in the study population received an intervention intended to control vitamin A deficiency (or improve sufficiency) together with symptomatic treatment of minor illness, or referral to an appropriate medical facility for treatment of more serious illness. Accordingly, it was unfeasible for the design to provide for a true control population of cohort matches. Nevertheless, the experimental design does provide for estimating (and

therefore adjusting for) systematic bias, so that the children in the study population serve as their own internal controls.

Thus the design does reflect a balance between the need to provide sufficient control to allow for statistically valid inference, the need to improve the health status of all of the study population (not only as a prospective result of the study, but as its direct consequence) and the need to make sure that the intervention activities developed were replicable on a national scale.

3) Evidence existed at the beginning of the study that levels of vitamin A deficiency, (as indicated by the prevalence of eye signs), were seasonal in nature. Indeed, review of the results of two major studies of vitamin A deficiency[32 33] as well as hospital records from Nepal, strongly supported the hypothesis that vitamin A deficiency exhibits a marked annual periodicity in the areas of Nepal where it is endemic. Moreover, the months from May until the onset of monsoons in July represented the peak periods of Bitot's spot prevalence.[34]

4) Bitot's spot prevalence based on a national survey was estimated to be only between 4.3/1000 and 6.4/1000 among children less than six years old.[35] If this level were reflected in the study population, then inference based on Bitot's spots prevalence concerning intervention effects, and particularly effectiveness comparisons among interventions, would require very large samples to detect even relatively large differences.

The investigators expected that the prevalence of Bitot's spots in the study population would be considerably larger than the rate observed nationally during the non-peak seasons. This expectation was based on the following observations:

a) Estimates of Bitot's spots prevalence for the cohort of children under age six from the same survey in the terai region are 12/1000, and in the Narayani zone, part of the current study area, 22/1000.[36] This study consists of seven districts, mostly in the terai, including four in the Narayani zone.

b) Investigator's belief that the estimates cited above are conservative since thaey are based on mid-winter observations (the season of least Bitot's spots prevalence in Nepal.[34]

Sample sizes were chosen to achieve all of the principal design objectives, provided that the prevalence of Bitot's spots in the study population is approximately 8/1000, (a conservative value). Moreover, since the study is longitudinal, opportunity existed both to estimate and

compare intervention effects separately with respect to expected decrease in prevalence at the end of one and two years of intervention.

5) The study was designed to be longitudinal with two post-intervention measurements on the initial cohort at one-year intervals. Because of the length of measurement intervals, the design included consideration of the possibility of systematic bias of two types; measurement, and temporal changes, which may effect the treatment outcomes.

   Certain sources of such possible bias may be controllable and/or estimable directly by the investigators. For example, among measurement errors, anthropometric measurements of skin fold and mid-arm circumference tended to have systematically smaller standard deviations over time as a result of improving measurement capability with increasing experience of field staff. Of greater concern were the temporal changes such as seasons of abnormal shortage of foodstuffs, disease epidemics, and disasters which were beyond investigators' control.

   Design features were incorporated to provide information with which to construct reliable measures and, if necessary, adjustments for these biases.

6) No attempt was made to blind either the data collectors or the participants in the study to the purpose of the study or the interventions in which they are participating. Indeed, the University of Michigan School of Public Health Human Subjects Committee required informed verbal consent from all the participants in the study population. While double blinding is a desirable feature, it is easiest to accomplish in a clinical setting. It is more difficult in an operations research evaluation of an intervention program, and indeed double blinding would have limited the ability of the project to generate sustainable community-based programs.

7) Periodic intervention checks were necessary to assess whether the interventions were being delivered as designed. These included checks in coverage rates after capsule distribution, as well as checks to determine if those exposed to the nutrition education program understood and responded to the messages. Activities within all experimental groups were periodically checked for compliance to initial program design.

Sample size considerations

Sample size for the Vitamin A Child Survival Project involved a consideration of compromise across conflicting sample size requirements. After extensive review of requirements a sample size was chosen which was suitable for comparing treatment (intervention) effects with adequate power. A sample of 13,500 subjects (in 25 sites) assigned to each intervention was necessary to these meet minimum power requirements.

Demonstrating an improvement in the vitamin A status of the children in a given treatment group dominated all other study objectives. Vitamin A status can be measured directly, e.g., serum vitamin A levels, or indirectly, through the prevalence of a variety of clinical signs and symptoms associated with vitamin A deficiency e.g., the presence of Bitot's spots. Growth rates of the children were also used to demonstrate the differences between interventions. Since the prevalence of clinical signs is so low, large samples are required to detect differences in estimates of treatment effects with adequate precision.

To assess differences between intervention and control groups, a relatively small sample size was required. The sample needed to detect differences between the interventions was much larger. It was postulated that Bitot's spot prevalence would be at least 0.8% at the beginning of the study in both treatment and control groups, and it was desired to be reasonably certain that if there were at least a 40% difference in Bitot's spot prevalence between treatment groups the study would detect it. To be specific, the power of the test was predetemined to be 0.80 at the Type I rate of alpha = 0.05. Finally, it was assumed that there would inevitably be losses in an initial sample cohort, both due to initial non-response to the study and to the inability to follow some members of the initial cohort. We assumed that an initial 10% of the children in a sample of villages would not cooperate, and that after one year of program intervention another 10% would be lost before follow-up. Thus, the initial sample of children was increased by a factor of 1/(1-0.1-0.1)=1.25 or 25% to account for these losses.

One additional design feature was considered in the sample size determination: the effect of clustered data collection on the precision of estimated rates. It was operationally impossible to select a simple random sample of children from the study area. A large amount of clustering was required, and to the extent that children within the same cluster (for example, a village unit) were similar in their response to an intervention the precision estimates of treatment effects would be diminished.

Under the above set of postulates, each intervention group and the control group were assigned 13,500 children aged 6 months to 10 years. Thus, the total sample consisted of 54,000 children. This initial sample size was operationally feasible, and it provided more than adequate levels of precision for most other survey

objectives.

Selection of study subjects

The sample design was a two-stage area probability sample of 100 area units (clusters of wards, which resemble a rural village or community) in seven districts in two economic development zones.

The seven districts contain 457 panchayats or sub districts; in 438 rural and 19 town locales. Each panchayat is further divided into wards which contain approximately 90 households, of an average 5.5 persons each, thus, comprising approximately 500 persons in each ward. Approximately 30% of the population are children less than 11 years of age. About 150 children were expected in each ward, 1,350 children in each panchayat. At each stage of selection care was taken to assure that probability selection principles were observed such that each one of the children would have the same chance of being registered as an initial or second stage study cohort.

The sampling unit is a cluster (block) which incorporates a variable number of wards within a panchayat. The exact number of wards that comprise a cluster depends upon the population size. Each cluster was designed to include about 450 children below the age of 11.

The first stage of the sampling process involved the selection of panchayats in each district. All panchayats in the seven districts were assigned an identification number and the population of each panchayat was listed. From the population of each panchayat, a block number was assigned and written on the list that represented about 500 persons (150 of whom would be children). Because greater population meant more blocks per panchayat, panchayats with high population were assigned larger weights. Then block lists were chosen randomly. This procedure was repeated until 100 panchayats were selected, with each panchayat's probability of being selected proportional to its population size.

A random 'treatment code' was then assigned systematically according to the geographic selection order to each of the 100 selected panchayats. Codes numbered one through four were assigned to each panchayat to designate them as capsule distribution, disease control, health education, or positive control sites. Maps of each district were consulted to ensure that panchayats assigned to a particular treatment group were not contiguous.

The second stage of sampling was conducted in Nepal. For each selected panchayat, the individual wards were listed together with their populations. Wards within each selected panchayat were grouped into as many blocks as had been assigned to the panchayat. Each grouping of wards was to contain approximately the same

population and be contiguous (i.e., have shared boundaries). For example, if a rural panchayat had been assigned a block count of 4, the list of, say, 9 wards in the panchayat was examined. The wards were grouped into 4 blocks of approximately equal population size. The blocks were geographically contiguous; blocks were not allowed to have wards separated from each other by other wards not in the same block. Finally, using random tables and the block number for each block in the panchayat, one block (or cluster of wards) was selected from each selected panchayat.

1.6. Survey Topics and Measurements: Baseline and 12 & 24 Months Post-Intervention

At the beginning of the study an initial cohort of children was selected by methods of probability sampling and registered in the study. Each cohort was observed before intervention (*Baseline Measurement*), assigned an intervention, and then re-observed one year later (*12-Month Post-Intervention Measurement*). The interventions were then continued. After 24 months from baseline the children were re-observed (*24-Month Post-Intervention Measurement*). Once the baseline survey was completed, the principal activity of the program (field testing interventions with children aged six months to eleven years) began.

The study design may be summarized as follows:

1) All children registered in the initial cohorts received an intervention (the "control group" receiving symptomatic treatment only);

2) systematic bias in post-intervention measurements is estimated by comparing the odds ratio of risk between participants and non-participants at 12 and 24 months and subsequentely comparing pre- and post-intervention rates of risk between cohorts; and finally

3) after adjustment for systematic loss to the cohort, each child was weighted to represent an internal control and statistical analysis proceeded as in a longitudinal experimental design.

The baseline survey was conducted at all study sites prior to intervention. The survey included interviews with community leaders (such as political officials or teachers) to obtain data on community social and demographic characteristics, as well as information concerning the existence and scope of other health projects in the study area (Refer to Appendix A for Background Determinants for Health Status in the Study Area). A house-to-house survey was conducted within all households of each selected study cluster. A household is defined as a family unit in which all members eat from a common cooking pot. The baseline household survey first enumerated all persons in

the household. Interviews were conducted with mothers or other responsible adults about the child's health, current illnesses; immunization history, knowledge, attitudes, and practices concerning nutrition, family food expenditure, availability and use of health services, water supply sources, household social and demographic characteristics, and information which may be useful in tracing the household if it moves during the study period.

Baseline measurements were made on all children enumerated in the household. In addition to ophthalmic observations, five anthropometric measures were taken in the field: weight, height, triceps' skin fold thickness (TS), mid-upper arm circumference (MUAC) and the elbow breadth (EB). These measures were taken according to standard protocol as provided by the World Health Organization and United Nations National Household Survey Capability Program. The age of the child was calculated from birth data to the exam date using the Nepali calendar and then converted to the Gregorian calendar. Where birth information was not available, age was estimated using an events calendar, developed in Nepal and appropriate to the area of the study. Ages were then rounded to the nearest whole month. Serum vitamin A, serum pre-albumin, hemocrit and stool samples were obtained and analyzed from a (10%) sub-sample of the study population.

Movement of survey operations from site to site to conduct eye examinations in a spread-out terrain such as the terai of Nepal presented challenging logistical problems. Centralized examination sites, where as many as 90 persons per day could be examined by a trained ophthalmic assistant during a two- or three-day period, were necessary to reduce survey costs. Sites had to be distributed throughout the seven districts proportionately to the population in each district.

Annual training of the enumerators took place before each of the examination cycles. The initial training took place six weeks before the baseline exam and lasted until the beginning of the baseline survey. Classroom lectures and field practicums were managed by project staff. The training for the field team leaders was six months long and involved training and standardization in clinical examination for xerophthalmia as well as training about the epidemiology of xerophthalmia and how to develop community vitamin A programs. The ophthalmic assistants spent a month of their training in Bogor, Indonesia, where Dr. Muhilal arranged an intensive training program. Training for staff performing the HPLC serum determination was also undertaken at Bogor.

Special training was given to the team administrators who were responsible for site mapping. Anthropometrists were given special training on the use of the equipment and standardization at each exam. Special training sessions were also held for other specialized skills used in the project.

Training was given emphasis in the Vitamin A Child Survival Project. Training of VHW's and CHV's was conducted by the district public health office and health

post staff. To make training effective, the Project assisted in the organization of training sessions, production of training materials and development of the training curricula. At the time of enrollment in the program most community health volunteers had already received some form of training from the district public health office. Training provided by the Project focused mainly on nutrition and Vitamin A. During the two years of field implementation the CHV's received their first training at the beginning of the activities (August-September 1989), and a refresher training after one year (September-October 1990). The training was held in the seven district public health offices and run by government staff with the support of the Project personnel and material provided by the Project. No replacement training was provided at the district level, but following the drop-out of some of the CHV's, a short training for new CHV's was provided in the village, or the new people were included in the refresher training program.

Health post staff and community health volunteers' supervisors (village health workers) also attended the training, giving an opportunity to develop stronger links among the different levels of the primary health care provider chain. The government training is usually run by category, one training for health post staff, a different one for village health workers and another one for community health volunteers. Most of the staff do not know who is responsible for their supervision or from whom they can request assistance. The project's combined training method certainly increased the efficacy of the system in the three interventions as compared to the symptomatic treatment, which involved no form of training.

During the first training and the refresher training the participants were divided into three groups with some sessions in common for two groups: distribution of capsules for CD + PHC, primary health care activities for PHC + NE. (See Table 1.) The community health volunteers in the capsule distribution group received the shortest training while the community health volunteers in the nutrition education group had the longest training, both during the first and the refresher training. At the end of the training program, each community health volunteer received one manual, one or more posters and a stock of medicine according to their assigned intervention. The community health volunteers who were selected to implement the Nutrition Education intervention also received educational materials, scales, growth charts to perform growth monitoring and improved seeds for promotion of kitchen-gardening. All participants received a certificate at the end of the training, to enhance the status of the volunteers in the community.

Table 1
Training of Community Health Volunteers
FIRST TRAINING (AUGUST-SEPTEMBER 1989)

Day	Subject	CHV Participants	Subject	CHV Participants
1	Capsule Distribution	CD + PHC	Nutrition Education	NE
2	Capsule Distribution	CD + PHC	Nutrition Education	NE
3	Capsule Distribution	CD + PHC	Nutrition Education	NE
4	CD Practical Session	CD + PHC	NE Practical Session	NE
5	Primary Health Care	PHC + NE		
6	Primary Health Care	PHC + NE		
7	Primary Health Care	PHC + NE		
8	Primary Health Care	PHC + NE		
9	PHC Practical Session	PHC + NE		

REFRESHER TRAINING (SEPTEMBER-OCTOBER 1990)

Day	Subject	CHV Participants
1	Capsule Distribution	CD + PHC
2	Primary Health Care	PHC + NE
3	Primary Health Care	PHC + NE
4	Primary Health Care	PHC + NE
5	Nutrition Education	NE
6	Nutrition Education	NE
7	Nutrition Education	NE

A separate training for Adult Literacy Teachers and supervisors was organized only for the villages included in the Nutrition Education intervention (February 1990). The same criteria adopted by the Ministry of Education for recruitment of teachers (a person with a School Certificate or Grade 10 Pass) was utilized by the Project. Training took place in the seven district headquarters, conducted by staff from the Ministry of Education, with the participation of the district education officer and support from Project staff. The same material produced by the Ministry of Education for the national adult literacy program was utilized.

One year after the first training, a refresher, literacy training and a post-literacy training was organized for all seven districts (January 1991). The adult literacy

teachers also attended the refresher training of community health volunteers in order to understand the objective of the study and their specific role within the Project.

1.7 Supervision and Monitoring of the Project

The Project is designed to have a very strong evaluation component. In practical terms, more than 90% of the Project staff were utilized for the surveys, the data-entry process and administrative tasks. Only the implementation director and seven district supervisors (one for each district, about 8,000 children beneficiaries) work full-time on the implementation of the interventions. Additional supervision of the community health volunteers was very limited and consisted mainly in checking and re-supplying the medicine stock. This arrangement has been worked out giving priority to the replicability of the intervention rather than program coverage.

During the program implementation a monitor made periodic visits to each site to check program coverage and other attributes of the Program process and performance. Monitoring was performed twice during the first year and once in the second year. The information was collected on Process Indicator Forms. Interviews were performed with a sub-sample of mothers (a 10% random sample) to access the community's knowledge and perception of the program. All Village Health Workers (VHWs) and Community Health Volunteers (CHVs) were interviewed to identify and correct any problems they might be having with the community, logistics or support and to access their ability to perform the activities given their varied levels of training and supervision.

Performance indicators were established that included intervention-specific cut-off points. Capsule distribution with coverage lower than 70% in the capsule distribution and PHC sites resulted in an immediate report to the ophthalmic assistant in charge of district supervision and discussions with the VHW or CHV. Likewise, low immunization coverage (less than 60%), or lack of knowledge of appropriate response to diarrhea or acute respiratory infection by more than 40% of the mothers in the PHC sites resulted in corrective action. In the nutrition education sites, a low proportion (less than 40%) of the mothers having exposure to one of the five nutrition education messages resulted in corrective action.

Information from each intervention was analyzed to assess average performance. Those sites with repeated low program performance received special supervision and correction. Those sites with repeated high program performance received positive feedback, special recognition, and the reasons for their success were documented. This process evaluation, while not part of the impact evaluation, was an essential part of the evaluation process, and was critical to achieve the high participation rates that were seen.

1.8 Data Collection and Data Management

The data structure for the study is complex, due to the large sample size and longitudinal nature of the study design, and therefore required an elaborate data entry and data management system. The data was linked across all levels of hierarchy in the data set, i.e., site, ward, household, mother and child, as well as across the three years of the study. To ensure compatibility over time, care was taken to standardize the identification codes used so that records could be easily linked.

Draft forms were developed in English and discussed among different project staff, and with different government officials. The forms were translated into Nepalese and field tested during the training of the enumerators. Questions that were not easily understood by the mothers or enumerators were rephrased or dropped from the questionnaires. The forms were printed locally.

The forms were modified slightly for the second year. Some questions concerning maternal dietary practice and knowledge of vitamin A that was collected as a sub-sample during baseline was asked of all mothers at the 12 month and 24 month exam. Additionally, a verbal autopsy form was developed for the 12 month and 24 month exam of children censused at baseline and reported dead by mothers at the subsequent household census (see Table 2).

Forms were stored by site and year in a large metal case. Data cleaning took place throughout the study, so that all forms were organized by household within the sites, and sequentially placed in the stack of forms. The final disposition of the forms will be in the Kathmandu Eye Hospital.

The data management procedures were refined over the life of the Project, and took into account the fact that a support staff would be available throughout the study. That is, beyond the data entry for each census and examination, it was possible to undertake extensive cleaning and editing of the data to ensure that reliable data would be available. Following the baseline, the Ophthalmic Assistants who were responsible for the data collection become involved with the data cleaning, and gave valuable feedback to the data management staff which enhanced the quality of enumeration in subsequent evaluations.

The procedures to link as many of the children and households as possible over time became an integral component of the data collection. Household census listings, detailing the number of mothers and children in each household, along with key discriminating variables, were useful in capturing demographic characteristics for as many survey participants as possible through the three years of the study. This task was complicated by considerable political and economic unrest during the study period, as well as migration in some study areas. Still, that some 80% of the children were located for follow-up evaluation is an impressive testament to the efforts of the Project staff at all levels.

TABLE 2: Description of the Data Forms

Form name and description		Form Number
Ward level		
BLOCK -	Ward Background form	10
MARKET -	Market description	11
VENDOR -	Market vendor	12
Household level		
HH	Household census/demographics	20

The following forms were provided to a random sub-sample of 10 % of all households included in the study and were only administered at the baseline. Subsequently many questions were incorporated into other forms which allowed for 100 % representation, i.e., into HH, MOM, KID, etc.

WEALTH	Household wealth	30
DIET	Dietary knowledge, attitudes and practices (KAP)	31
DIA	Diarrhea KAP	32
BREAST	Breast feeding KAP	33
MORB	Morbidity/disease KAP	34
EXP	Household expenditure	35
Mother level		
MOM	Mother demographic Knowledge, attitudes and practices (KAP)	21
Individual level		
KID	Child demographic/participation	22
CLINIC	Clinical examination	40
CASE	Case and matched control form	41
WORM	Worms and serum vitamin A	42
MORBID	Child morbidity form	43

The following form was used in the second and third measurements to maintain detailed verbal (written) autopsy records of all children from the original sample who died during the course of the study

MORTAL	Child mortality	44

Data collection

All data was collected by trained field enumerators, and coded on questionnaire forms. These forms were then organized by site and reviewed at the central field management office in Bharatpur. In this first screening of the data, any obvious coding errors in site or ward level information were identified and corrected. If problems could not be remedied, the forms were sent back to the field for clarification and correction. Once finalized, the data forms were sent to the central Project office in Kathmandu where the data were checked a second time before being entered into the computer.

On all forms, identification codes were recorded from the highest to the lowest level. For ward level forms, only the site and ward identification codes were detailed, while for the child level (lowest), the site, ward, household, mother and child identification codes were noted. Because there were multiple forms for some of the data levels, it was critical to record appropriate, identical identification information on all forms.

Prior to data entry, all collection forms were reviewed and organized in numerical order by household identification number. The household form was printed on a heavier stock paper, and was made into a folder to allow for easy organization of the other forms. All lower level files, i.e., mother and child information, were placed into the household folder, and during the final review of the forms, all forms for each household were checked for correct site, ward, and household identification codes. Finally, within each household, the child forms were checked to ensure that all proper identification information was coded, including the coding of each child's mother.

Data entry

The data entry programs incorporated a series of quality control measures, including logic and consistency checks, identification and flagging of outliers, duplicates, and in the case of the last two years, unlinked records. Data was entered for each site and then the forms were stored. As data entry for each site was completed, the data was backed-up onto a Zenith 386 PC computer where sub-directories were established for each of 100 sites. In addition to hard-disk storage, two series of back-up diskettes were maintained, each with hidden codes which prevented any errors in data copying.

A second set of backup diskettes was stored at the University of Michigan on an machine identical to the one used in Kathmandu. From this set of data the initial cleaning procedures were developed.

Data entry programs were developed so that as different levels of the data were entered, the identification data for the higher levels were stored as memory variables

until they were manually changed. It was unnecessary to repeat the keystrokes for data that did not change between records. For example, site level data was usually entered only once and then stored throughout each data entry session, while ward codes changed more often, followed by households, and within these, the mother and child identification codes changed most frequently. Built-in duplicate entry checks automatically evaluated whether information for a specified record had already been entered. Standardized methods were developed to address issues of duplicate codings from the field.

Baseline data-management computer programs were developed using dBASE III and were compiled using CLIPPER software. Updated programming for successive years utilized FoxPro. Prior to each round of data entry, the programs were tested critically to identify any problems, and the database files evaluated to ensure that all data entered was properly appended into the files.

Once data entry was completed, there were sessions of training of the data entry clerks. These included descriptions of the programs and standardization exercises in which forms were entered in duplicate and then analyzed. The level of agreement for each data entry clerk and between the data entry clerks was superlative. Wherever errors were identified during periodic monitoring of the data entry process, supplementary training and supervision was provided to the data entry personnel.

Data editing/cleaning

Following each round of data entry, a series of data cleaning and editing exercises were undertaken to identify and rectify errors, including duplicates, outliers, consistency problems and identification coding. Outliers were identified through univariate analysis in which the frequencies of all variables were listed in association with all valid codes. Lists were prepared detailing all errors which needed to be corrected, and the data entry staff was responsible for consulting the original questionnaire forms in order to correct the data. As data files were corrected, periodic copies were made. With experience, revised data entry programs were developed which eliminated many of the potential problems through the use of appropriate controls built into the programs.

The univariate statistics were examined following the baseline survey and the first evaluation to assess whether any further coding of the data forms was required to gain more detailed responses to the questions.

Data linking

Following the baseline data collection, listings of all household members surveyed in each site were generated and lists to be used by the field teams for the second round of data collection were prepared. These lists included identification information and variables which helped track down the children again. The lists were

maintained in the field, and made it possible to solicit responses from mothers or neighbors about the whereabouts of children who could not be located.

The data used for the linking lists was stored in separate database files and was used in the subsequent rounds of data entry to record the linking status of households, mothers and children. Codes were developed which enabled the Project team to keep track of attrition and its causes. For the final round of data collection, an updated linking list was prepared which included the linking status for the previous two years, and greatly facilitated the follow-up of children in the original sample.

Linking codes were valuable for maintaining a clear record of attrition, and to determine the children who could be included in the different analyses. It was important throughout the study to maintain records of which children were retained in the sample, and in which interventions, in order to estimate the impact of the activities on health status.

1.9 Data Preparation for Analysis of Health Effects

Throughout the study, analysis was undertaken continually to identify problems and to prepare provisional results. Several data sets were created for this analysis. For the individual level assessment of programmatic impact on ocular status and anthropometry, a linked data set was created to assess the dynamic changes which occurred in the population, and facilitated an assessment of the impact that the interventions had on health status.

For the linked data set, the data were combined into a hierarchical format beginning with the individual level data. All records from the KID and CLINIC databases for each of the three years were joined into one long flat file. Thus, data variables for all three years for each child were available for evaluation of program impact. These records were distinguished with each individual identification string consisting of the site, ward, household, mother and child numbers so that each record had a unique identifier. Data for all years was linked, and a field was created to denote the survey years that each child was present for the study, that is, if the child was followed up all three years, or for only some for the evaluations. This variable, called 'YEAR' was classified as follows :

TABLE 3:

CODE	YEAR 1	2	3
1	X		
2		X	
3			X
4	X	X	
5	X		X
6		X	X
7	X	X	X

With this coding scheme, it was possible to determine how records were linked across time. These codes were used to distinguish children who were followed up over differing time intervals of the study, i.e., baseline to first evaluation (first 12 months), baseline to second evaluation (entire 24 months), and between the two evaluations (second 12 months).

Children who were followed up were compared to those who were lost to attrition. A logistic regression model was developed to identify characteristics which best predicted whether or not children remained in the study. Once the most important covariates were identified, a stratified analysis was undertaken in order to compute three sets of weights for all records. The different sets of weights corresponded to the periods of follow-up.

Once the data sets were joined into a single file, the data was then linked with the mother-level information for all three years. This file served as the driver file for all subsequent analysis on attribution of effect on health status, and it allowed for the assessment of information both in terms of the individual cross-sectional analysis, as well as for the dynamic changes of the cohort over the duration of the study.

Weighting of the data set for study design bias

As with any longitudinal study design, there was unavoidable attrition and loss to follow-up. It was critical to evaluate whether the children who were not followed up in the study differed in any way from those children who were retained in the study, to assess non-response bias introduced by the study design. Several steps were followed to identify differences between respondents and non respondents at follow-up. The results of these steps were used to derive weights to compensate for each non-response. Analysis was only undertaken for those children who satisfied the criteria for follow-up (only children who were less than nine years of age were evaluated, since it was only this age group that was expected to be retained into the second year). Similarly, for the

twenty-four month follow-up, only those children less than eight years of age were of interest, since all other children were expected to "age" out of the study.

From the linked data set, it was possible to distinguish between those children who were assessed at baseline and followed up from those children for whom baseline measures were available but were not retained.

The objective was to develop an adjustment factor to provide a better statistical representation of what would have been observed in the original cohort, had there been a complete follow-up of all children throughout the survey. Children who were followed up who have similar qualities and characteristics to those who were not followed up were given weights with higher values, which, when applied to the analysis, will compensate partially or completely for non-responding children.

---

4 Sommer, Alfred; Nutritional Blindness, Oxford Press, New York, 1982.

5 Swaminathan, M.C., et.al. (1970); "Field prophylactic trial with a single annual oral massive dose of vitamin A." American Journal of Clinical Nutrition, 32,119.

6 American Foundation for the Overseas Blind (1975). "An Evaluation of the Vitamin A Deficiency Prevention Pilot Project in Indonesia," American Foundation for the Overseas Blind, New York.

7 Vijayaraghaven, K. et. al., "Impact of massive doses of vitamin A on incidence of Nutritional Blindness." Lancet 84 2 (8395):199-51.

8 Sommers, Tarwotjo et. al. (1986). "Impact of Vitamin A Supplementation on Childhood Mortality." Lancet May 18.

9 Costello, "Vitamin A supplementation and childhood mortality, Lancet, August 16, 1986, 161.

10 Maratnex, Shekar, Latham, Letter to the Editor, Lancet August 24, 1986.

11 Muhilal, et.al., "Vitamin A fortified monosodium glutamate and health, growth, and survival of children: a controlled field trial." Amer Journal of Clinical Nutrition, 48:1271-6.

12 Ramatulah, et.al., "Reduced mortality among children in southern India receiving a small weekly dose of vitamin A." New England Journal of Medicine, 323:929-35.

13 West, K., et.al., "Efficacy of vitamin A in reducing preschool child mortality in Nepal." Lancet 338:67-71.

14 Daulaire, NMP, et.al., "Childhood mortality after a high dose of vitamin A in a high risk population." British Medical Journal 304:207-10.

15 Beaton, et. al., "Effectiveness of vitamin A supplementation in control of young child morbidity and mortality in developing countries. Interm report on mortality effects." Department of Nutritional Sciences, Faculty of Medicine, University of Toronto, Ontario, Canada, March 1992.

16 Oomen,H.A.P.C., (1974). Xerophthalmia in Indonesia. In "Vitamin A deficiency and Blindness Prevention." American Foundation for the Overseas Blind, New York.

17 Sommer, Muhilal and Tarwotjo, (1982). "Protein Deficiency and Treatment of Xerophthalmia." Arch Ophthalmol, 100:785-787.

18 Tarwotjo, et.al., (1986). "Vitamin A Deficiency Control in Indonesia." In the Control of Vitamin A Deficiency. Academic Press Inc.

19 Muhilal, (1984). "Highlight of Current Studies: Considerations for Program Intervention." Preceedings of the Fourth Asian Nutrition Conference: Human Nutrition, Better Nutrition, Better Life. Aksornsmai Press, Bankok, Thailand.

20 Tarwotjo, Sommer and Tilden, (1980). "The Epidemiology of Vitamin A Deficiency and Xerophthalmia in Indonesia" Proceedings of the Meeting of Vitamin A Deficiency and Xerophthalmia in Jakarta.

21 Government of Indonesia, (1980). "Nutritional Blindness Prevention Project: Characterization of Vitamin A Deficiency and Xerophthalmia in the Design of Effective Intervention Programs: Final Report" Jakarta, July.

22 Kutty, Mohanram and Vinodini, (1981). "Humeral Immune Response in Vitamin A Deficient children." Acta Vitaminol Enzymol. 3.231-235.

23 Sommer, Katz and Tarwotjo, (1984). "Increased risk of respiratory disease and diarrhea in children with pre-existing mild vitamin A deficiency." American Journal of Clinical Nutrition, 40:1090-1095.

24 Muhilal, (1984). "Highlight of Current Studies: Considerations for Program Intervention." Preceedings of the Fourth Asian Nutrition Conference: Human Nutrition Better Nutrition Better Life; Aksornsmai Press, Bankok, Thailand.

25 Government of Indonesia, (1980). "Nutritional Blindness Prevention Project: Characterization of Vitamin A Deficiency and Xerophthalmia in the Design of Effective Intervention Programs: Final Report." Jakarta, July.

26 Tilden, et.al., (1985-B). The Ecology of Vitamin A in Nepal. Department of Epidemiology, The University of Michigan in Ann Arbor.

27 Cohen, et.al., (1985). "Prevalence and determinants of nutritional blindness in Bangladesh." World Health Statistical Quarterly, 38:317-329.

28 SEVA Foundation, (1988). The Epidemiology of Blindness in Nepal: Report of the 1981 Nepal Blindness Survey, Edited by G. Brillant.

29 Grosse, Perry, "Correlates of Life expectancy in less developed countries." Health Policy and Education (1982) 275-304.

30 SEVA (1986), The Epidemiology of Blindness in Nepal: Report of the 1981 Nepal Blindness Survey. Edited by G. Brilliant.

31 Upadaya, M. Gurung, B., Pillai, K., Nepal, B. (1985). "Xerophthalmia among Nepalese

Children." American Journal of Epidemiology, 121:71-77.

32 SEVA Foundation, 1988. The Epidemiology of Blindness in Nepal: Report of the 1981 Nepal Blindness Survey. Edited by G. Brilliant.

33 Upadhay, et.al., (1985). "Xerophthalmia among Nepalese Children," American Journal of Epidemiology, 121:71-77.

34 Tilden, 1985-A. "Assignment Report: Vitamin A Deficiency in Southeast Asia, A Regional Strategy for Control through Primary Health Care."

35 SEVA Foundation, (1988). The Epidemiology of Blindness in Nepal: Report of the 1981 Nepal Blindness Survey. Edited by G. Brilliant.

36 SEVA Foundation, (1988). The Epidemiology of Blindness in Nepal: Report of the 1981 Nepal Blindness Survey. Edited by G. Brilliant.

CHAPTER 2 Program Participation

Three different types of vitamin A deficiency control interventions were evaluated, and each type entailed different levels of difficulty for mothers and children. Bringing a child to receive a capsule two or three times a year takes much less effort than changing dietary habits. More demanding still is attending evening literacy classes while meeting all the responsibilities of maintaining a farm and family in rural Nepal. It is difficult to precisely define participation in an intervention in a way that takes into account the level of effort required of mothers in different interventions.

This difficulty is compounded by different levels of participation in all of the activities. Did a child that received three capsules participate in the capsule distribution program more than a child who received only one capsule? For even the simplest of the interventions, the capsule distribution activity, there were varying levels of participation.

In the primary health care intervention, to fully participate, a child would have to be dewormed twice, receive two capsules, be fully immunized (if the child was older than 24 months), receive oral rehydration therapy for cases of diarrhea, and Co-trimoxazole for acute respiratory infection. At the same time, all the primary health care activities other than deworming also took place in the other intervention sites that had ongoing government primary health care programs.

The nutrition education intervention was the most difficult in which to define participation. By the 24-month measurement, in three contacts with the field teams, all mothers in all the interventions had heard of vitamin A. The number of mothers who knew which of seven foods had vitamin A was considerably less. Some mothers had learned that wild greens were a good source of vitamin A, while others had not. Some mothers felt weight gain during pregnancy was good, but most felt that it was not. Not all mothers lived in villages where weighing sessions were held, but of those who did, some had their children weighed, and others did not. Some attended adult literacy programs, but in some of the nutrition education sites literacy programs were not held, or were discontinued because of low attendance.

Different activities were part of each intervention. All children with eye signs were treated with vitamin A, and the children of all mothers who reported seeing worms in the stool recently were given Mabendazole. Some Program effects were seen in all interventions. For instance, knowledge of which foods contained vitamin A, though highest in the nutrition education cohort, was also found among many of the mothers in other cohorts.

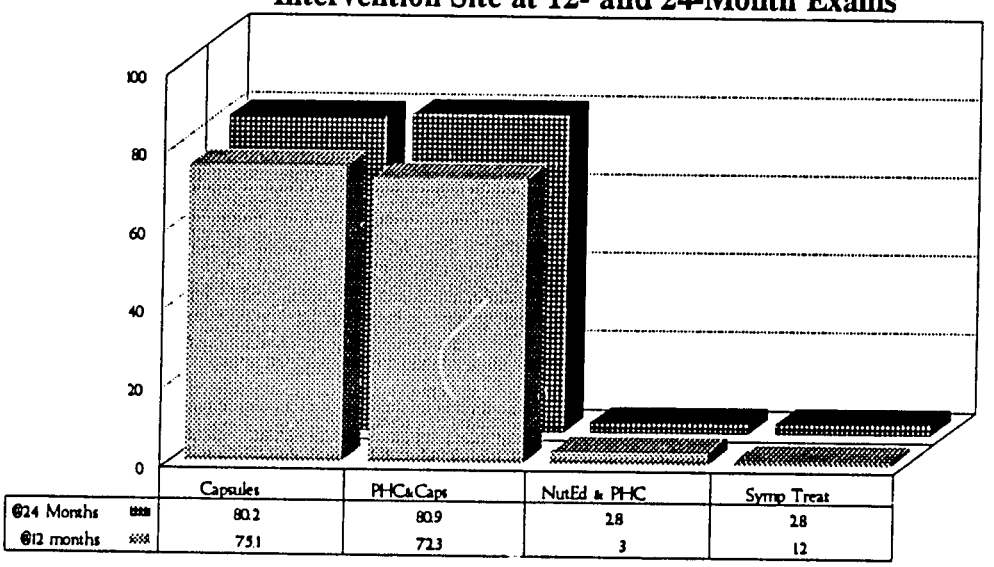
The capsule distribution program took place in the capsule sites, as well as in the primary health care sites. Bi-annual deworming, promotion of: (1) Oral rehydration therapy for diarrhea, (2) Co-trimoxazole for acute respiratory infection,

and (3) immunization, took place in both primary health care and nutrition education sites. The scarcity of supplies limited capsule distribution and primary health care activities to those areas where it was undertaken as part of a specific program, but nutrition education messages often filtered through to the general population. Literacy programs were initially targeted to nutrition education sites. They proved so popular with village mothers, that during the second year district education offices started more literacy programs where there was demand for them, including some of the areas covered by other interventions. Participation in specific activities will be discussed across interventions. We will demonstrate variations in coverage and review factors that appear to influence coverage. We will discuss how these findings might be used in improving the participation of these programs, not only in Nepal, but in other countries utilizing these approaches in the future.

2.1 Capsule Distribution Program

Distribution of capsules in the selected sites was generally high (Figure 2.1). Some capsules were distributed to nutrition education and symptomatic treatment groups as well, but only to children that were diagnosed as having eye signs of xerophthalmia at the time of examination. Capsules were regarded favorably by mothers and there seemed to be no reluctance to participate in the program. Considering the economic and political uncertainty in Nepal during the Project, participation is quite high.

Figure 2.1 Percent of Children Reported as Receiving Vitamin A Capsule by Intervention Site at 12- and 24-Month Exams



Overall coverage increased in both the capsule distribution sites and the primary health care site from the first to the second year, indicating that the Project became

more accepted over time. During the monitoring it was found that records kept by the village health worker (VHW) tended to be in agreement with what was reported by the mothers. VHW's records showed slightly higher levels of participation than the mothers themselves, so there should be no concern about over-reporting by mothers. These participation rates are averages, and at least 50% of the sites had increased coverage over time. At the end of the first year coverage in the capsule distribution program was slightly better (75.1%) than in the primary health care program (72.3%). By the end of the second year the coverage was slightly higher in the primary health care cohort (80.9%) than in the capsule distribution cohort (80.2%) coverage.

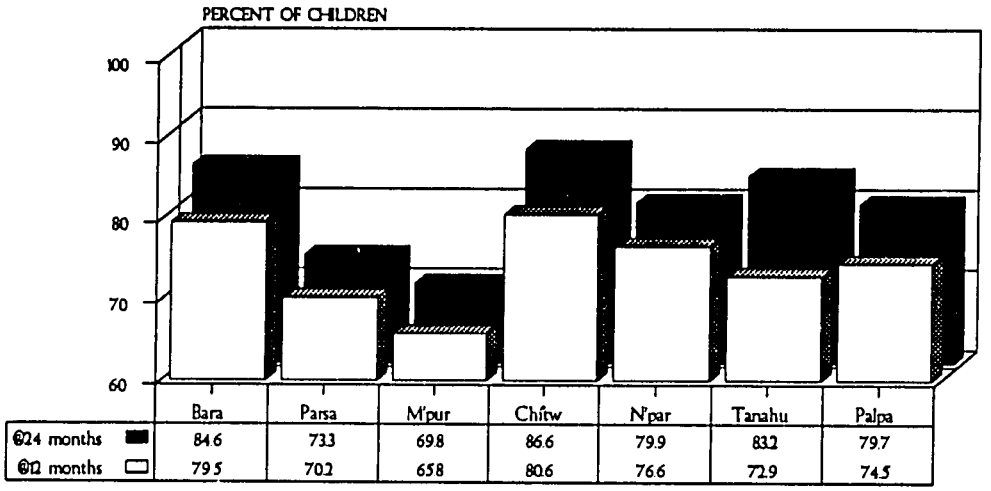
A second measure of the level of participation is the number of capsules that were received by the mother. This measure relies on the memory of participating mothers, and may be somewhat unreliable. By the 24-month exam there is a much higher prevalence of mothers knowing that her child had received a capsule, but not being sure how many. Whereas in the earlier measurement only 0.1% of mothers forgot how many capsules their children had received, figures are much higher in the second measurement, 12.2% of mothers were not sure in the capsule distribution program, and 10% of mothers were not sure in the primary health care program.

One aim of this study was to consider the operational feasibility of distribution of vitamin A supplements three times a year. In 12 of the 25 capsule distribution sites, the village health worker (VHW) or community health volunteer (CHV) had been instructed to dose the children three times a year. Had the programs been working perfectly, therefore, 50% of the mothers in this cohort would have reported their children having received 2 capsules, while the remaining 50% would report their children having received 3 capsules. Results showed only 6.1% reporting the receipt of three capsules in the first year, increasing to 10.4% in the second year. For some reason, the three-capsule distribution cycle does not result in higher levels of full participation. Even the primary health care activity has higher levels of full coverage at 24 months.

District-level differences in participation/ capsule distribution

The capacity and level of interest of district health offices were key in determining overall level of participation. Figure 2.2 shows the percentage of mothers reporting that their children received capsules by district. Chitwan and Bara had the highest rates of participation throughout the Project. All districts improved capsule coverage from 12 months to 24 months. The biggest improvement was in Tanahu (72.9% to 83.2%). Makwanpur, the only district to have less than 70% coverage at 12 months (65.8%), continued to have the lowest rate of participation at 24 months (69.8%).

Figure 2.2 Mothers Reporting Receipt of a Capsule Within the Last 12 Months by District at 12 and 24 months by District



	Bara	Parsa	M'pur	Chitw	N'par	Tanahu	Palpa
@24 months	84.6	73.3	69.8	86.6	79.9	83.2	79.7
@12 months	79.5	70.2	65.8	80.6	76.6	72.9	74.5

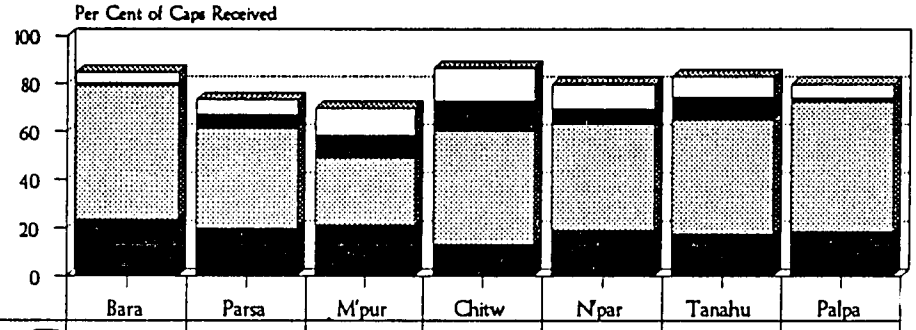
Capsule and PHC Cohort Combined

During the period between 12 and 24 months into the Project, there was considerable staff turnover of district health officers. In the second echelon of the district health office there was less turnover, and coverage rose during this period. The ability of district health offices to manage and assist in supervision varied across the seven districts.

District variation is even more marked where comparing the number of capsules reportedly received by mothers. Bara district not only reports the highest percentage of children covered, but it also has the highest number of children reporting "full participation" in the program (55.7%, Figure 2.3). Makwanpur not only has the lowest coverage rates overall, but also has the lowest level of children receiving full coverage (27.6%). Chitwan had the highest level of compliance to the 3 capsule distribution cycle (12.6%), while Bara (1%) had the lowest. Chitwan district also had the highest number of mothers who were unsure of how many capsules their children had received (13.8%).

Figure 2.3 Number of Capsules Received Within the Last 12 Months by District at 24 Months by District in Capsule and PHC Sites

at 24 Months by District in Capsule and PHC Sites



	Bara	Parsa	M'pur	Chitw	N'par	Tanahu	Palpa
not sure	4.3	6.2	11.4	13.8	10.4	8.9	5.7
3 Caps	1	5.7	9.6	12.6	6.2	9.4	1.7
2 Caps	55.7	41.5	27.6	47	44.1	47.4	53.8
1 Caps	23.6	19.9	21.2	13.2	19.2	17.5	18.7

District

As report by primary caretaker at exam

Ward-level differences in participation/ capsule distribution

Wards are similar to villages. Rural life in Nepal is generally agricultural and defined by the caste system, however, some groups in the study area are tribal and therefore casteless. The caste system tends to stabilize certain labor markets and skill areas by ensuring a steady supply of children born into that market. The caste system also defines living arrangements in rural areas, with wards tending to be predominately one caste or another. While wards are interdependent, they maintain a certain autonomy in the function and activities of daily living.

One can gauge program participation at the ward level over the life of the Project. The average overall participation of 80% is unevenly spread across all wards. In some of the wards almost all mothers reported that their children had received the capsule, while in a few wards participation was almost 0% by 24 months into the study.

At 12 months into the Project only a few of the wards had coverage above 90%, but by 24 months, over 50% of the wards in the Project area had achieved a 90% or better coverage rate. Some VHWs and CHVs improved their program performance while others became discouraged.

Determinants of participation/ capsule distribution

A functioning, well-motivated VHW or CHV seems to be the essential determinant contributing to high participation rates in the capsule distribution program. An analysis was performed to examine the effect of different community, household, and individual factors on participation rates between the activities undertaken.

At the ward level, key factors affected levels of participation. Wards near passable roads showed lower rates of participation The proximity of the ward to economic centers seemed to be the most important consideration, as indicated by a reduced participation in wards with access to public transport, a passable road or a primary school. Coverage for capsule distribution was lower in urban areas compared to rural areas. Wards that were extremely isolated (more than 6 hours walking) also had substantially lower levels of participation. The availability of a village health worker in the ward greatly increased coverage. In capsule distribution cohorts, being in the terai was associated with higher coverage, while in the primary health care cohort it was associated with lower capsule coverage.

Household factors influenced whether or not a child received a capsule. Economic factors appeared to be the most important, with children of households that own land and their own house more likely to participate. Non-literate mothers were also more likely to participate in the capsule distribution program.

At the individual level, sex and age were important factors of participation, with girls participating more than boys and older children having considerably higher rates of participating compared to younger children. In terms of nutritional status, children who were stunted were more likely to receive a capsule, although wasting did not seem to be a factor. Children with Bitot's spots had extremely high levels of participation, although children developing corneal eye signs during the study period tended to have lower levels of participation, though all those showing signs were given special treatment.

Participation for the capsule program was highest in rural villages of moderate size that, while not close to an economic center, were also not too isolated. In these areas better-off families with non-literate mothers, with male children that were over 60 months were the most likely to participate.

This intervention did not present many implementation problems, and appears to be the most easily replicated. Like the other interventions, the percentage of literate community health volunteers was very low and the manual had to be revised and compiled in a simple way to prevent children from being given more than one capsule at a time during mass distribution. The community health volunteers did not have many problems in keeping a record of the children in the ward and those who received the capsule. Mostly, they were assisted by a literate person; the school teacher, their sons or others. The biggest problem for this intervention was the presence of cultural

barriers or differences in caste, because households in the poorest neighborhoods and those most in need of the intervention were sometimes avoided by the VHWs or CHVs.

2.2 Primary Health Care Activities

Some components of primary health care were implemented in 50% of the sites. In 25% of the sites primary health care and capsules were implemented together, and in another 25% of sites nutrition education and primary health care were implemented together. Primary health care as defined by the World Health Organization has 13 basic prevention activities such activities as improved access to medical care and basic sanitation and water supply.[37] In 1982, another approach was developed, called selective primary health care, differing types of health care activities might be selected.[38] Determining factors include the nature of common health problems and the feasibility of appropriate control activities. In this study, primary health care activities promoted were not comprehensive, but selected based on the relationship of the health problem to the risk for Xerophthalmia.

Specific health risk factors have been documented in all areas with endemic Xerophthalmia. These risk factors include severe diarrhea, acute respiratory infections, generalized illness among children, and severe cases of worms, especially *Ascaris lumbricoides*. Low-cost activities for this intervention were effective in reducing these risk factors. These activities include deworming of the children bi-annually with Mabendazole (a wide spectrum anti-helmithic that requires six tablets over three days); the promotion of oral rehydration therapy for the management of diarrhea, the promotion of therapy for acute respiratory infection, and the promotion of immunization for polio, measles and diphtheria (DPT). Deworming and treatment for acute respiratory illness had not previously been a part of Nepal's Primary Health Care package.

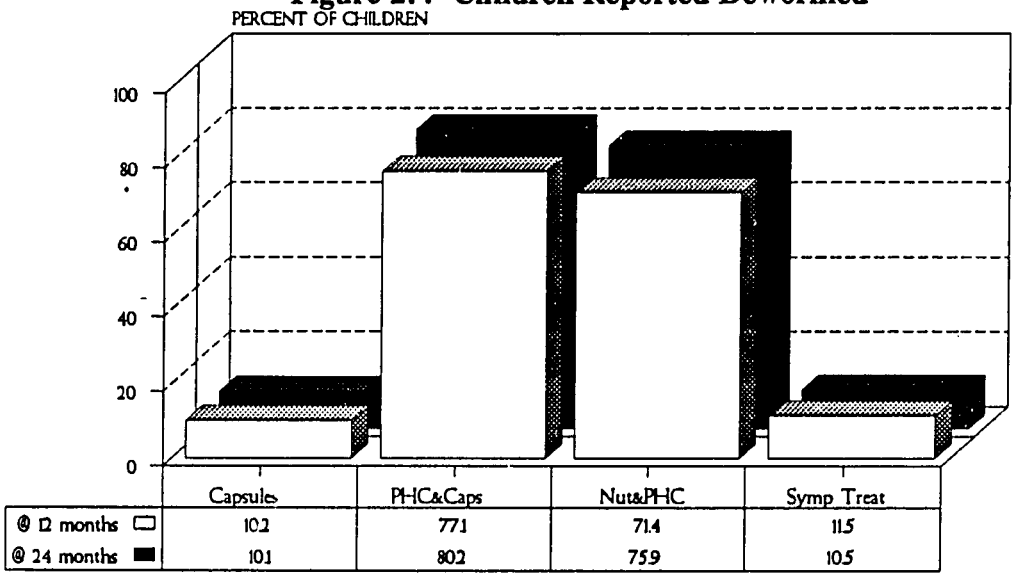
While deworming activities were focused in the primary health care and nutrition education sites, children whose mothers reported seeing worms in the stool or who had distended abdomens during exams were treated with Mabendazole in all sites. Likewise, only primary health care and nutrition education sites had Co-trimoxazole for the treatment of acute respiratory infection, although the lines of supply to the community health worker were through the health post, and its availability there also made it available to other sites.

Oral rehydration therapy for diarrhea is a well-established activity in community health programs, and the Ministry of Health developed packages of oral rehydration solution called Jevan Jaal ten years ago. The project made Jevan Jaal available at no cost to families in the primary health care and nutritional education sites, and available in all the Project sites. Immunization coverage was relatively high throughout Nepal, with coverage rates above 70% for all districts in the Project.

Deworming

Most of the children in the primary health care and nutrition education sites received Mabendazole therapy for deworming in both years (Figure 2.4). Coverage in the primary health care at 12 (77.1%) and 24 months (80.5%) were higher than in the nutrition education cohort (71.4% at 12 months and 75.9% at 24 months). Deworming was also undertaken in the other sites for ill children. Deworming coverage was slightly over 10% in both the capsule and symptomatic treatment cohort at both follow-up examinations.

Figure 2.4 Children Reported Dewormed



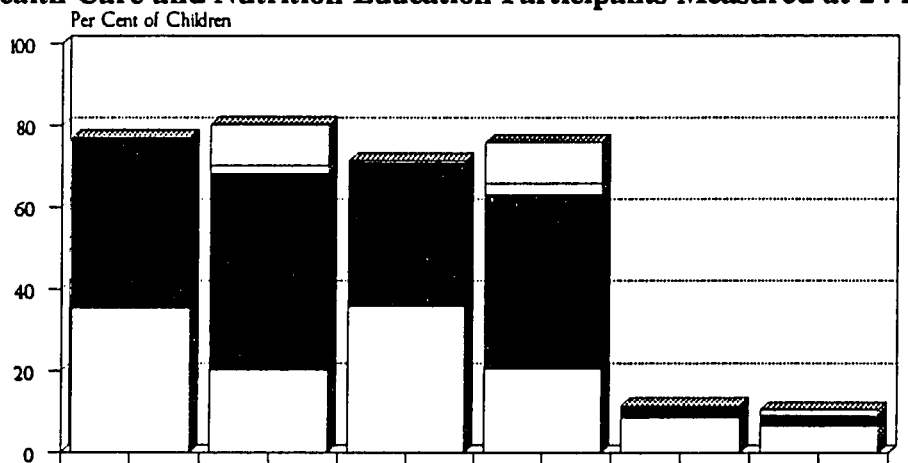
Deworming was undertaken in the primary health care sites approximately seven days before the distribution of the mega-dose capsule. Mabendazole is quite effective in clearing the gut of most species of helmiths (including *Ascaris lumbricoides*), and it was thought that a higher proportion of the vitamin A dose would be absorbed if the gut were first cleared of parasites.

In these highly endemic areas for *Ascaris lumbricoides*, mothers actively complied with this intervention. Many at the first dose got immediate proof that their children had been afflicted, and as a consequence, high levels of coverage were maintained throughout the Project in both primary health care and nutrition education sites. The primary health care activities resulted in about 5% higher deworming coverage than nutrition education areas at both 12 and 24 months.

The level of participation as measured by the prevalence of children receiving two doses was also high in the primary health care sites at both 12 (41.1%) and 24 (48%) months. Participation in nutrition education sites (35% at 12 months and 42.5% at 24 months) was somewhat less, as shown in Figure 2.5.

The problem of mothers forgetting the number of doses their children had received was not widespread in the first year, but by the second year about 10% of the mothers could not recall the number (9.9% in primary health care and 10.2% in nutrition education). (This is approximately the same level as seen in the capsule distribution program).

Figure 2.5 Number of Times Dewormed in the Previous 12 Months--Primary Health Care and Nutrition Education Participants Measured at 24 Months

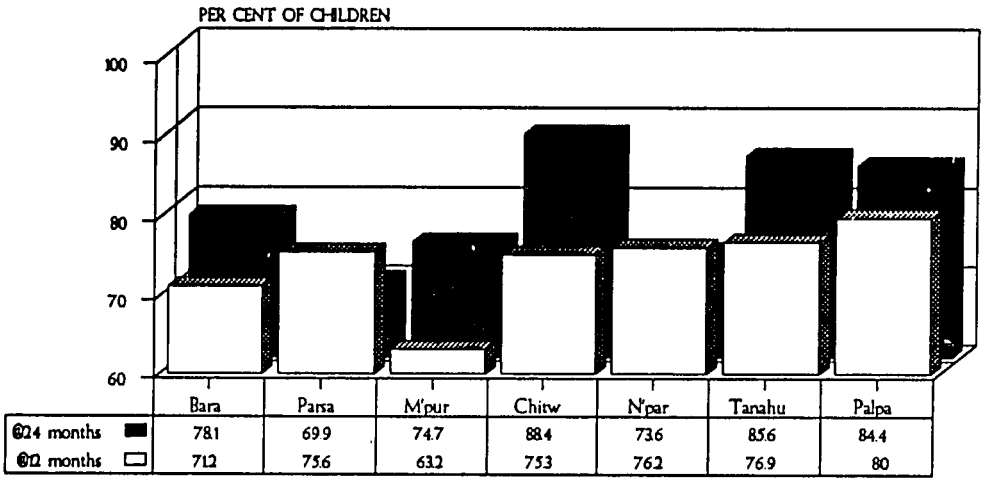


	PHC @ 12	PHC @ 24	Nut Ed @ 12	Nut Ed @ 24	S Treat @ 12	S Treat @ 24
Not sure	0.2	9.9	0.1	10.2	0	1.2
3 doses	0.3	2	0.4	2.5	0.1	0.4
2 dose	41.1	48	35	42.5	2.8	2.4
1 dose	35.5	20.3	35.9	20.7	8.6	6.5

District-level differences in participation/ deworming

At 12 months, coverage was generally above 70% for all districts except Makwanpur (63.2%). By 24 months, Makwanpur had achieved almost 75% coverage, but Parsa had fallen to 69.9%. At the 24-month examination, three districts were above 80% coverage: Chitwan (88.4%), Tanahu (85.6%) and Palpa (84.4%). Narwalparasi, which had 75.3% coverage at the 12-month exam, had slipped to only 73.6% at the 24-month examination, as shown in Figure 2.6.

Figure 2.6 Distribution of Deworming Coverage Among Districts At 12 and 24 Months, by District



	Bara	Parsa	M'pur	Chitw	N'par	Tanahu	Palpa
@24 months	78.1	69.9	74.7	88.4	73.6	85.6	84.4
@12 months	71.2	75.6	63.2	75.3	76.2	76.9	80

PHC and Nutrition Education Cohort Combined

Over 52% of the children in the primary health care and nutrition education sites in Palpa received two doses, while only 32% of the children in Makwanpur, and 33.2% of the children enrolled in Chitwan received full coverage.

Ward-level differences in participation/ deworming

Levels of participation generally increased from the 12-month exam to the 24-month exam. At 12 months only 8% of the wards in the primary health care wards had achieved 90% deworming coverage, while 14.4% of the wards in the nutrition education sites had coverage of deworming greater than 90%. By the 24-month exam 40.9% of the primary health care wards had participation rates exceeding 90% deworming, and 42% of the nutrition education wards of achieved 90% participation rates.

The 24-month exam also showed that several of the wards in some sites had reduced coverage of Mabendazole. Some of the decrease may be because a primary health care site there had been washed away by a flood. Problems with low coverage (10-50% participation rates) in a few wards continued in the 12-month exam and the 24-month exam.

Determinants of participation/ summary -- deworming

Participation in deworming activities was heavily influenced by several ward and household characteristics. Isolated villages had slightly higher participation rates, most pronounced in areas without public transport. As with the capsule distribution program, the availability of a VHW or CHV living in the ward helped ensure high coverage rates. The availability of electricity increased the probability of coverage with deworming, but decreased the probability for receiving capsules. Finally, those sites located in the terai had lower coverage than areas in the hills.

Additional household-level economic factors affect participation with the deworming program. House and land ownership, and using land both to generate income and for planting of kitchen gardens, indicated a greater rate of deworming than other households. A sound house and the availability of facilities for sanitation and hand-washing were more common among the children who had been dewormed, but the children of literate mothers were no more likely to be dewormed than the children of non-literate mothers.

At the individual level, girls were dewormed at the same rate as boys, and older children were dewormed at higher rates than younger children. Children that had low weights or were wasted were more likely to be dewormed than children whose nutritional status was normal. Children who were seen with corneal Xerophthalmia at 12 months had substantially lower rates of deworming than normal children. Deworming among children with Bitot's spots was at approximately the same rate as normal children.

Oral Rehydration Therapy

The technology for oral rehydration was not introduced by the Project. The Ministry of Health in Nepal had developed a commercially available oral rehydration product, which had been available for over 10 years. The year before the Vitamin A Project started UNICEF had carried out a oral rehydration therapy campaign, which included nationwide radio spots.

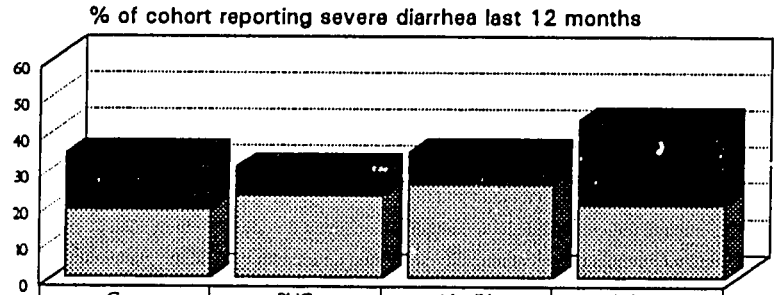
The Project ordered approximately 2 packages of oral rehydration salts for each child in the Project area and made ORS packets available through the health posts. There were some problems coordinating these supplies with the existing supply system, but they were not serious, since utilization of the oral rehydration therapy increased significantly in intervention areas.

Besides ensuring a constant supply of the oral rehydration therapy product, Jeevan Jall, in the Project areas, messages and promotional materials were developed, including special materials for the training of the community health workers.

Twelve months after implementation, ORT utilization rates for severe diarrhea were reported to be over 50% in all the cohorts except for symptomatic treatment, (Figure 2.7). In nutrition education study areas, reported oral rehydration therapy utilization rates were the highest, and the reported rate of utilization was significantly higher in the areas where supplies had been provided and promotion materials utilized.

Figure 2.7 Utilization of ORT at the 12-Month Exam

Severe Diarrhea reported last 12 months and utilization of ORT at 12 month exam

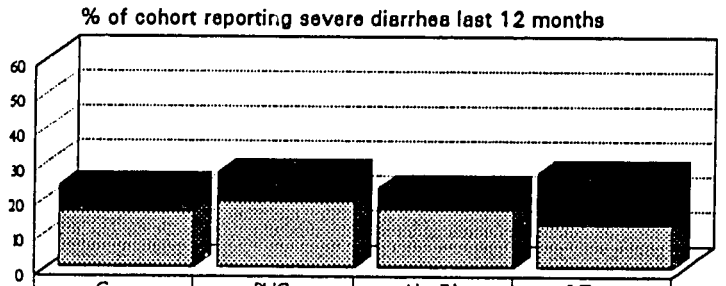


	Caps	PHC	Nut Ed	S Treat
Total Dia	34	30.3	34.4	43.1
not treated	15.5	7.9	8.9	23.1
ORT	18.5	22.4	25.5	20

as reported by primary caretaker

Figure 2.8 Severe Diarrhea and Utilization of Oral Rehydration Therapy

Severe Diarrhea Reported the Last 12 months and Utilization of ORT at the 24-month exam



	Caps	PHC	Nut Ed	S Treat
Total Dia	23.4	27.2	22.7	27.1
not treated	7.4	8.2	5.9	14.6
ORT	16	19	16.8	12.5

as reported by primary caretaker

The differences in utilization by intervention area suggest that promotional activities and increasing the availability of ORS had the desired effect of increasing the use of oral rehydration therapy.

The amount of reported severe morbidity of diarrhea at 12 months is also noted. Figure 2.8 represents the memory of the mother concerning the past year, whereas most literature suggests that even two weeks after illnesses, severity may be underestimated.

At the 24-month exam, an overall decrease in the amount of severe diarrhea within the last 12 months was reported in all intervention groups, with the largest decrease seen in the symptomatic treatment, nutrition education, and capsule distribution cohorts. The decrease was the lowest in the primary health care cohort. At the 24-month exam, utilization rates were highest in the nutrition education and capsule distribution cohorts, although utilization had actually decreased in the primary health care and symptomatic treatment cohorts, as shown in Table 2.1

Table 2.1 Percent Utilization of Oral Rehydration Therapy at 12 and 24 months

	Capsule Distribution	Primary Health Care	Nutrition Education	Symptomatic Treatment
at 12 months	54.4	73.9	74.1	46.4
at 24 months	68.4	69.9	74.0	46.1
Change	+26.0	-5.7	-0.1	-0.3

District-level differences in participation/ ORT

Reported ORT utilization varies greatly by district as shown in Table 2.2, and generally increased in all the districts between measurements. The districts with the highest areas of utilization were Bara and Chitwan at both the 12 and 24-month exams. Parsa had the highest level of increase, while utilization of oral rehydration therapy in Narwalparasi was the lowest at both exams. It appears that the utilization of ORT was higher in the terai areas than in the hill areas.

Table 2.2 Utilization of Oral Rehydration Therapy by District at 12 and 24 Months
Ranked by Percentage Change

District	at 12 months	at 24 months	% Change
Bara	65.1%	70.0%	7.5
Parsa	50.2%	71.0%	42.0
Makwanpur	55.0%	62.8%	14.6
Chitwan	62.3%	71.3%	27.3
Narwalparasi	43.7%	53.9%	23.3
Tanahu	53.7%	60.8%	13.2
Palpa	59.0%	62.0%	5.1

We note too, that patterns of morbidity can be cyclic. For example, Bara, had the highest percentage of severe diarrhea at the 12-month exam, but reported one of the lowest percentage rates at the 24-month exam.

Ward-level differences in participation/ ORT

The distribution of oral rehydration therapy at the ward level did change between 12 and 24 months in both the primary health care and nutrition education cohorts. At the 12 month exam, over 50% of the sites in the primary health care and nutrition education cohorts had utilization rates of ORS in severe diarrhea in less than 50% of the cases. This had improved by the 24-month exam to over 50 % of the sites reporting utilizing oral rehydration therapy in over 70% of the cases of severe diarrhea.

The project was successful in promoting the utilization of ORT in the areas where supplies were available and active promotional activities were going on. This component of the program was already a well-established component of the primary health care activities of Nepal. It is possible to raise utilization with well-targeted promotional activities if the necessary medical supplies are available.

Acute Respiratory Infection Therapy

Therapy for acute respiratory infection had not existed in the Project area prior to the start of this program. John Snow Inc., an international provider of health programs, had implemented ARI control for a number of years before the Project's beginning in another part of the country: the mountainous Jumlah area in northern Nepal. Like the oral rehydration supplies, acute respiratory infection therapy supplies were delivered through health posts to VHWs and CHVs. Training and promotional materials were created for the communities participating in the program. Unlike the oral rehydration promotion, the ARI control program was new to both VHWs/ CHVs and mothers. Table 2.3 shows a lower percent utilization of ARI control than ORT therapy.

Table 2.3 Percent Utilization of Co-trimoxazole Therapy in the Treatment of Acute Respiratory Infection, at 12 and 24 Months

	Capsule Distribution	Primary Health Care	Nutrition Education	Symptomatic Treatment
at 12 months	12.2	27.8	36.4	0.1
at 24 months	26.4	38.4	40.1	13.2
% Change	+14.2	+10.6	+3.7	+13.1

It is difficult to develop simple guidelines for diagnosis of acute respiratory illness and the determination of cases that should be treated. Breathing count measurements were impractical since VHWs/ CHVs did not have watches. The symptom of an "indrawn chest" was more easily detected. Therefore, the instruction to treat all children with cough, fever and indrawn chests was given to all VHWs and CHVs handling co-trimoxazole during the refresher training. The percentage of children treated increased.

An additional problem was the dosage of co-trimoxazole, which varies according to age. The Project utilized a pediatric dosage, procured through UNICEF, and the risk was more of under-dosage than over-dosage. To help the VHWs/CHVs, the Project developed a dosage chart for co-trimoxazole and paracetamol according to the age of the child, which was successfully used as a reference by even non-literate volunteers.

Village health workers and CHVs had to be trained to view respiratory infection with fever and rapid breathing as a potentially life-threatening condition requiring immediate treatment. VHWs and CHVs then had to communicate this to mothers, and advise them that treatment was available. VHWs and CHVs were at first unsure of themselves in implementing this activity, since dispensing antibiotics such as co-trimoxazole was an unfamiliar activity for them. While their training included the symptoms for which it was to be used, they utilized it with caution, only on children that were severely ill or wasted. Co-trimoxazole was used least often in children of normal height and weight.

By the 24-month exam the utilization of co-trimoxazole therapy increased from 36% to 40% in the nutrition education cohort and from 27.8% to 38.4% in the primary health care group.

Utilization of Co-trimoxazole therapy was also reported by 12.2% of the mothers in the capsule distribution cohort at 12 months. By 24 months 26.4 % of the mothers reported receiving therapy for acute respiratory infection. Utilization rates also increased from 0.1 at 12 months to 13.2% at 24 months for the symptomatic treatment group. Through the health post staff, the therapy was beginning to spread to areas outside those with ARI therapy interventions, due to demand from mothers who had heard of these services from other project sites.

District-level differences in participation/ARI therapy

There was a great deal of variation by district, as shown in Table 2.4

Table 2.4 Utilization of Co-trimoxazole Therapy by District

District	at 12 months	at 24 months	Percent Change
Bara	19.1%	28.8%	+50.8
Parsa	8.7%	37.7%	+333.3*
Makwanpur	16.9%	22.5%	+33.0
Chitwan	23.8%	30.2%	+26.9
Narwalparasi	28.5%	26.5%	-7.0
Tanahu	38.5%	29.6%	-23.1
Palpa	34.8%	29.4%	+15.5

The district with the lowest coverage at the 12 month exam was Parsa, with only 8.7% of the cases of acute respiratory infection receiving therapy, but the figure rose to 37.7% at 24 months, the highest rate at the time. Rates were lowest in Makwanpur at 24 months, and second lowest at 12 months. The district with the highest rates of Co-trimoxazole utilization at the 12-month exam was Tanahu (38.5%), but by the 24-month exam, the rates of utilization had decreased to 29.6%.

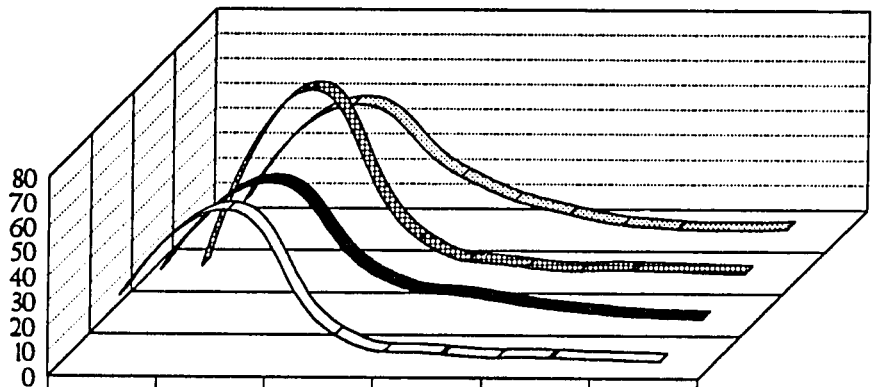
The risk for severe acute respiratory infection is not spread evenly over the population, and varies between regions from year to year. Accordingly, in our survey, rates of ARI varied between the 12- and the 24-month exams. Parsa, which had the lowest overall acute respiratory infection rate at the 12-month exam (24.1%) had the highest rate at the 24-month exam. Bara, which had the highest rates at the 12-month exam (37.6%) had the second lowest rates at the 24-month exam.

Ward-level differences in participation/ ARI therapy

The utilization rate did not reach over 90% at the 12-month exam within any of the primary health care or nutrition education wards, but by the 24-month exam a few of the wards (1.2% and 2.3% respectively) had reached the 90% utilization rate. Only 21.7% of primary health care sites and 7.7% of the nutrition education sites had increased their utilization above 50%. treatment of the severe acute respiratory infection cases. Around 25% of the primary health care wards and 20% of the Nutrition education wards had less than 20% of the cases receiving treatment at 12%, only 3.6 of the primary health care wards and 12.6 of the nutrition education sites remained at this low level of utilization at the 24-month exam.

Figure 2.9 Utilization Rates Among Wards

ARI Coverage
By Intervention at 12 and 24 months



	< 10%	10-50%	50-70%	70-80%	80-90%	90-100%
PHC @ 12	25.6	60.3	10.2	2.6	1.3	0
Nuted @ 12	18.9	54.4	16.7	7.8	2.2	0
PHC @ 24	3.6	74.7	14.5	3.6	2.4	1.2
Nuted @ 24	12.6	51.8	23	8	2.3	2.3

395 Wards from 100 Sites

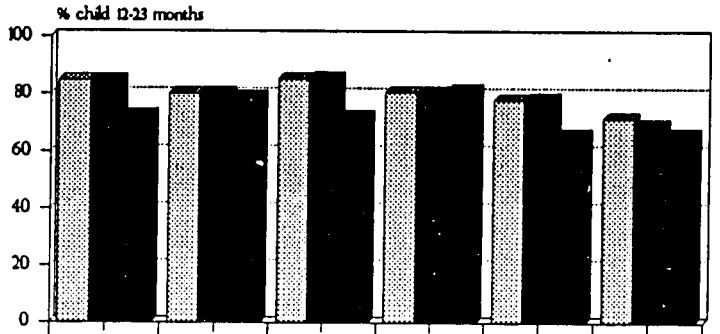
Childhood Immunization for Diphtheria, Polio and Measles

Child immunization already has high coverage and participation rates in Nepal. Yet decreasing rates of coverage with immunization services appeared, in part due to the changing political environment. This is unlikely to be the only reason, because the immunization program was the only part of the health care services to be thus affected.

Immunization rates (for diphtheria, Polio, and Measles) in the symptomatic treatment cohort were the lowest at the 12-month measurement, as was coverage for this group in all areas. By 24 months the coverage had further decreased.

Figure 2.10 Immunization Coverage in Project Areas

Immunization Coverage Rates Year 2 and 3
Children 12 - 23 Months by Intervention



	PHC @ 12	PHC @ 24	Nuted @ 12	Nuted @24	S Treat @ 12	S Treat @ 24
DPT	84.9	80.3	85.3	80.7	78.1	71.7
Polio	84.9	80.6	85.7	80.7	78.5	69.3
Measles	72.7	79.2	72.4	81.6	65.9	66.2

The highest participation rates were seen in the primary health care and nutrition education cohorts at the 12-month exam. By the 24-month exam all coverage rates had decreased except for measles, which increased in both cohorts.

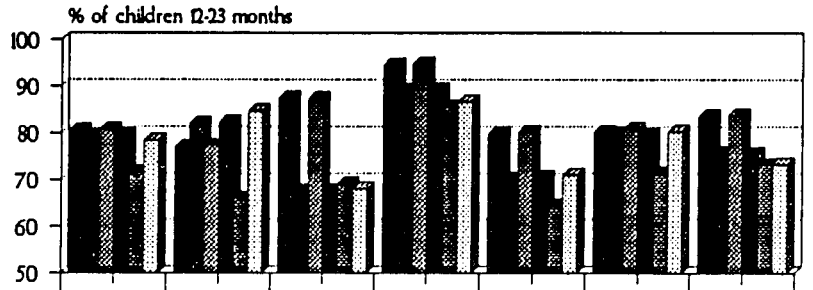
When compared to the symptomatic treatment cohort, the various interventions had 6-10% better immunization coverage. Considering the high initial coverage in the Project, it may be difficult to increase participation in immunization.

District-level differences in participation/ immunization

Not all the districts had the same coverage with immunizations. One district, Parsa, actually increased coverage from the 12- to the 24-month measurement. All other districts had decreased levels of coverage during the 24-month exam (with the exception of the aforementioned measles vaccinations).

Figure 2.11 Immunization Coverage by District and Immunization

Children 12 - 23 Months



	Bara	Parsa	M'pur	Chitw	N'par	Tanahu	Palpa
DPT 3 (Y 2)	80.6	77.2	87.6	94.5	79.9	80.3	83.7
DPT 3 (Y 3)	79.5	82.2	67.7	89.1	70.2	79.9	75.8
Polio 3 (Y 2)	80.8	77.5	87.4	94.8	80.2	81	83.9
Polio 3 (Y 3)	79.7	82.5	67.8	89.2	70.6	79.7	75.7
Measles (Y 2)	71.7	66	69.2	85.6	64.6	71.5	73.3
Measles (Y 3)	78.6	84.8	68.1	86.7	71	80.4	73.4

Only Chitwan had coverage of over 90%, and that was only at the 12-month exam. At the 24-month exam, Chitwan continued to have the highest levels of coverage, but the overall rate had decreased from over 94% to 89% in the preceding twelve months. It is suspected that coverage in all areas has continued to decrease since 1991.

2.3 Nutrition Education Activities

The nutrition education activities promoted a very different orientation from the capsule distribution or primary health care programs. While nutrition education activities contained the elements of the primary health care (PHC) program, and while PHC and capsule distribution programs required mothers only to make sure their children complied with occasional, specific, short-term activities, nutrition education required more sweeping behavioral changes (increasing the intake of vitamin A-rich food during the dry season, serving wild greens in areas not close to jungle areas, etc.). Mothers complied in some cases, but in others they did not even though the messages were received and understood. Some mothers understood the correct messages, but did not have the capacity to act on them. In other cases mothers might have heard the messages, but incorrectly understood, and in others the VHWs/ CHVs may have

delivered faulty information.

With some messages, mothers refused to pay attention because of existing folklore. Conventional wisdom in the area expoused that a women should lose weight during pregnancy because small women were ensured an easier delivery. While unsuccessful in convincing mothers that weight gain was good, the Project at least influenced some mothers to believe that maintaining the same weight during pregnancy was preferable to weight loss, and to include more vitamin A rich foods in the diet while pregnant.

The following are six messages that were included in the nutrition education activity:

1a) Promote consumption of vitamin A-rich food.
b) Promote the consumption of wild foods from the forest as a source of vitamin A.
2a) Promote oral rehydration therapy in cases of severe diarrhea.
b) Promote the feeding of liquids and appropriate vitamin A-rich foods when the child has diarrhea.
3a) Promote nutrition for pregnant mothers.
b) Promote breast feeding. Emphasize feeding of Colostrum.
4) Promote weaning foods and growth-monitoring of children.
5) Promote education about a special diet for children during and after illness.
6) Recognize the warning signs of vitamin A deficiency.

To measure participation in this activity the following criteria may be used: full understanding of all the messages, compliance with all the messages, or simply knowing that vitamin A is important to children's health. The number of mothers contacted by their local VHW/ CHV about vitamin A deficiency was as high as 100% in most nutrition education wards. However, the percentage of mothers able to correctly identify which of seven foods contained vitamin A were as low as 16%.

The problem of defining participation was compounded because mothers in the nutrition education intervention had the lowest baseline levels of literacy. The study area in general had lower literacy rates than the national average in 1989.[39] Many VHWs and CHVs were also non-literate. All training materials, manuals, posters and flip-charts were revised, reducing the written component to a minimun to be understandable. This is important for the mothers who receive the messages and for the VHWs and CHVs who deliver the messages. After pre-testing and evaluation, the initial set of materials were modified and improved.

Adult literacy classes for non-literate mothers were part of this intervention. In general, the literacy classes were well received, and the increased prestige and involvement served as an incentive for the community health volunteers. The first

literacy course, which lasted six months, was followed by a post-literacy class, which included health and nutrition subjects and was the forum where the VHWs and CHVs delivered their messages. During the two years of program implementation the literacy classes became a very popular activity. Because the classes were restricted to mothers, they became a place for socialization, the sharing of experience and reinforcement for positive feeding practices.

Another complication in evaluating nutrition education is that, while medicines can be targeted to specific localities, it is more difficult to promote the communication of ideas through populations. The three exams of children's eyes, spaced 12 months apart, helped to spread nutrition education. The project was required to educate mothers about vitamin A and the eye exams to fulfill requirements for the informed consent of subjects. At other times of the year the field examination teams served as trainers and program monitors for the different interventions, and combined both functions during exams. Finally, mothers would talk among themselves within the local area, at markets, and with their extended families, and many of the ideas promoted began to find their way into the information pool of mothers from other intervention areas.

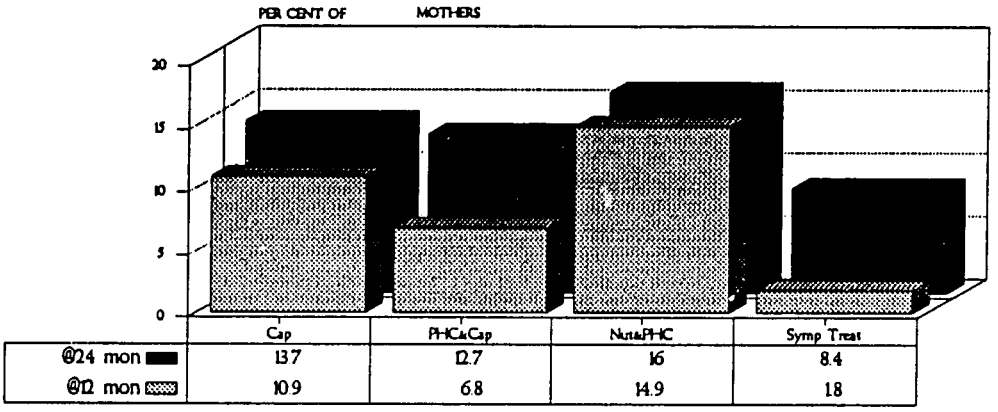
The objective of the nutrition education intervention was to change the behavior of mothers. Correspondingly, the measures of participation for nutrition education are: compliance with the program, knowledge, attitudes and practices regarding vitamin A in the family diet.

Knowledge of vitamin A

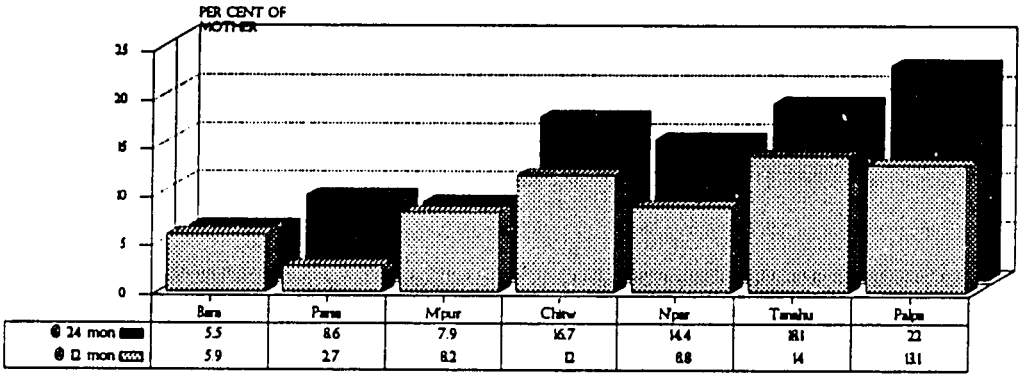
The Project used several approaches to ascertain knowledge about vitamin A. The first was simply to ask the mother if she had heard about vitamin A, and identify why it is important. By the 12-month exam most of the mothers in all the intervention areas were aware of both vitamin A, and the fact that it was related to the health of the child.

Figure 2.12 Mothers Knowing Foods

Mothers knowing food with Vitamin A



Mothers knowing food with Vitamin A
Year 2 and Year 3, by District



A second approach for measuring knowledge of vitamin A was to give the mother a "pop quiz" at the 12-month exam to see if she could correctly identify which of six foods (rice, dark green leafy vegetables, yellow fruits, eggs, potato, and meat) contained vitamin A. If the mother correctly identified the four foods that had vitamin A and the two that didn't, then she was graded as knowing, which foods contained vitamin A. Figure 2.12 shows how many mothers in each intervention area correctly identified the foods at the 12-month examination and the 24-month examination.. The nutrition education cohort scored highest both years. But from the 12-month exam to the 24-month exam the other interventions had even greater increases than the nutrition education area, suggesting that the messages were beginning to reach mothers. On the other hand, by the 24-month exam only 16% of the mothers of the nutrition education cohort had fully understood which foods had vitamin A.

There was great variation between the districts in terms of the number of mothers knowing which foods contained vitamin A. At 12 months, Parsa had the lowest level of mothers knowing foods (2.7%) while Chitwan (12%), Tanahu (14%) and Palpa (13.1%) all had rates at or above 12 %. By the 24-month exam, Palpa had the highest rates at 22%. Parsa(8.6%) which had been the lowest at the 12-month

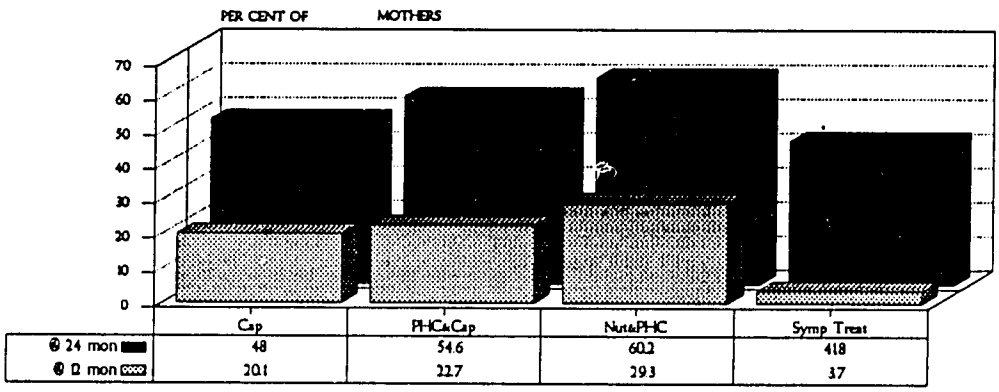
exam (2.7%) moved ahead of Bara (5.5%) and Makwanpur (7.9%) in terms of mothers knowing which foods contained vitamin A.

Attitudes about vitamin A

The attitude of mothers about vitamin A was assessed by several questions, best summarized by whether or not the mother recognized dark green leafy vegetables (DGLVs) as the cheapest source of vitamin A within the diet.

Figure 2.13 Percent of Mothers Recognizing the Importance of Dark Green Leafy Vegetables

Mothers Recognizing DGLV as Best and Cheapest source of Vitamin A



At the 12-month exam the nutrition education cohort (29.3%) had the highest level of mothers knowing that dark green leafy vegetables were the best and cheapest source of vitamin A available to them. The symptomatic treatment group had only 3.7% knowing this at the 12-month exam, but the primary health care and capsule cohort both had over 20% of the mothers knowing that DGLVs were the cheapest and best source of vitamin A.

By the 24-month exam all the cohorts had substantially increased rates of mothers knowing about DGLVs, but while the rates had doubled in the Nutrition Education, Primary Health Care and Capsule cohorts, rates had increased 10 fold among the symptomatic treatment group. This suggests a very rapid diffusion of this knowledge throughout the Project area.

There was some difference by district. At the 12-month exam ,Chitwan and Tanahu both had higher levels of knowing about DGLVs. These districts also had the highest rates at the 24-month exam. All the districts increased in rates of knowing about DGLVS from the 12 to 24-month exam, but Parsa had the lowest level increase. Bara, Makwanpur, Narwalparasi, and Palpa all had similar rates of knowing about DGLV at the 12- and 24-month exam.

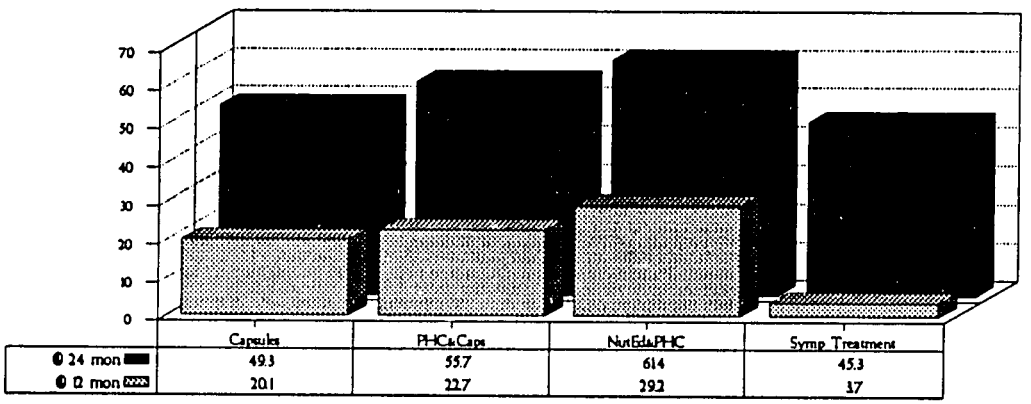
Practice and feeding habits related to vitamin A

Several vitamin A practice parameters for mothers were measured during the Project. They included; (1) whether or not mothers fed vitamin A rich foods to their family, (2) whether or not mothers fed wild sources of vitamin A to their families, (3) whether or not mothers fed Colostrum to babies, and (4) whether or not mothers participated in the monthly weighing program.

Mothers feeding vitamin A-rich food

Figure 2.14 Mothers Feeding Vitamin A-Rich Foods

Percent of Mothers by Intervention Areas



At the 12-month exam, the nutrition education group had the highest rates of mothers reporting feeding their families vitamin A rich foods at 29.2%. The primary health care and capsule cohort areas reported 22.7% and 20.1% . Only 3.7% of mothers in the symptomatic treatment group fed their family vitamin A rich foods.

By the 24-month exam there had been an increase in all cohorts in mothers reporting feeding their families vitamin A rich foods. While the Nutrition education cohort again had the highest proportion, the number of mothers in the symptomatic treatment cohort reporting feeding their families vitamin A rich food dramatically increased from 3.7% to 45.3%.

The districts with the highest reported levels of mothers feeding families vitamin A rich foods at the 12-month exam, Chitwan (26.2%) and Tanahu (29.5%), also had the highest levels at the 24-month exam. The other districts which all been between 13- 19% increased approximately three fold by the time of the 24-month exam.

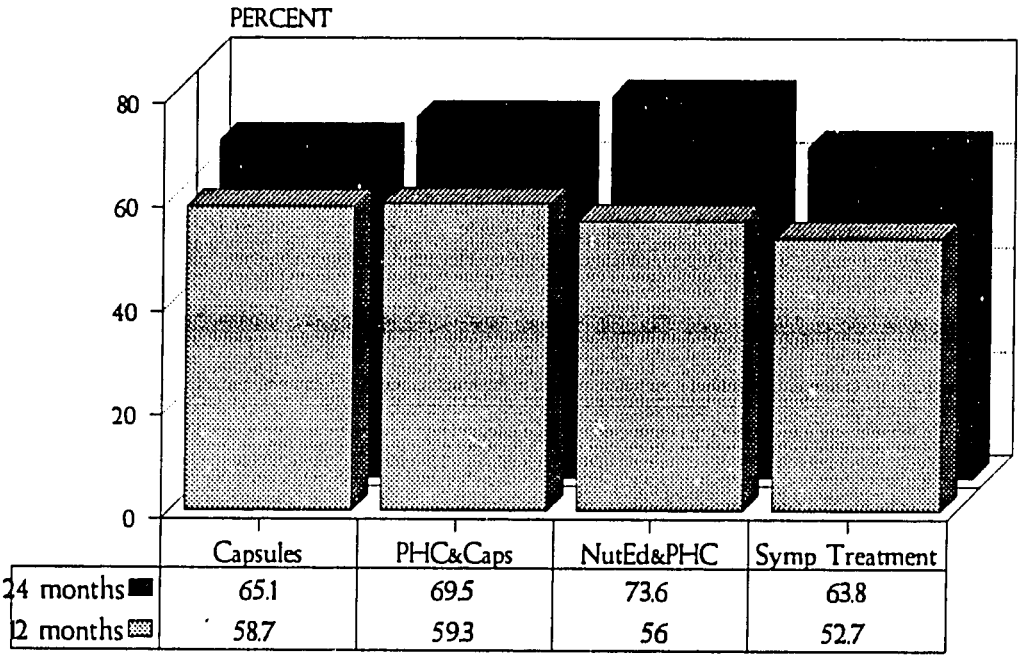
While mothers might report they were feeding vitamin A rich foods to their families when they were not, the results show that mothers begin to see that feeding

their families vitamin A rich foods is a beneficial activity.

Mothers feeding wild sources of vitamin A-rich food

Figure 2.15 Percent of Mothers Feeding Wild Greens

Feeding Wild Sources of Vitamin A, by Intervention Area



Wild vegetables were viewed as cattle fodder by some mothers at the beginning of the study, especially by mothers in secondary economic centers that were not close to any of the forest or jungle reserve areas. In more rural sites close to forests the collection of wild greens from the forest was a common practice.

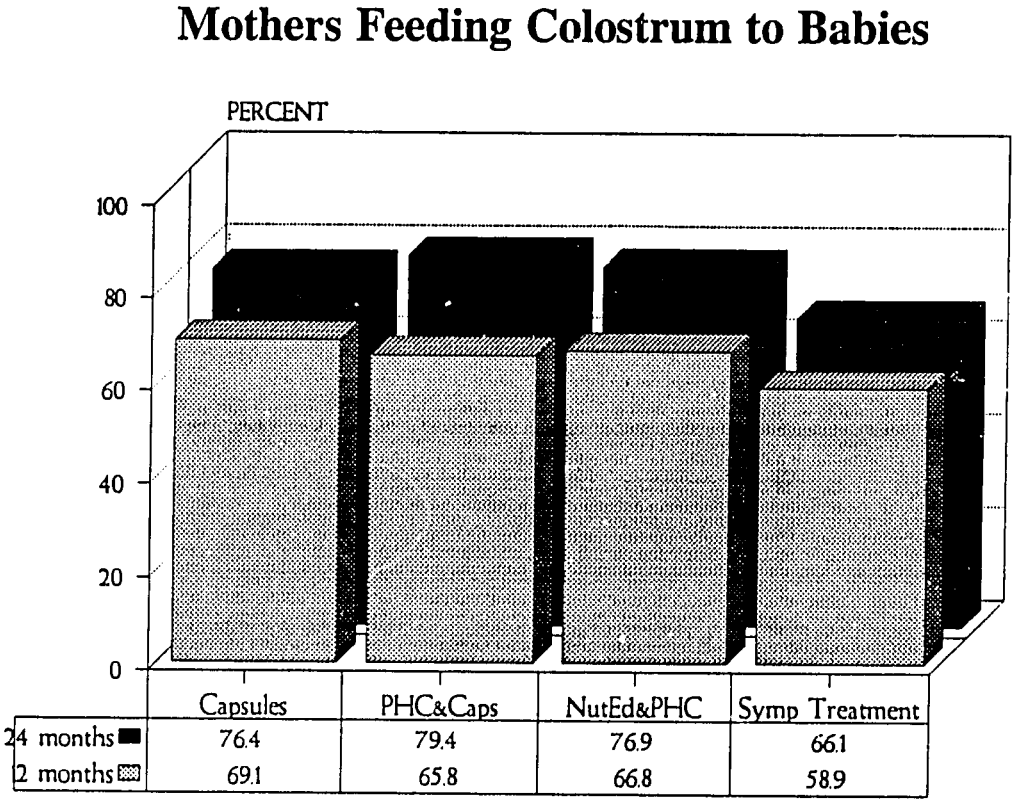
By the 12-month measurement from 52.7% to 59.3% of the mothers served wild sources of vitamin A to their families. Primary Health Care (59.3%) and the capsule sites (58.7%) both had higher rates of mothers feeding their families vitamin A rich foods than the nutrition education cohort (56%). The symptomatic treatment cohort had the lowest levels.

By the 24-month exam, mothers in the nutrition education cohort reported feeding the most wild sources of vitamin A to their children (73.6%). Mothers in the capsule distribution, primary health care and symptomatic treatment cohorts all showed an increase in serving wild sources of vitamin A from the 12 month exam.

There was a great deal of variation at the district level in mothers feeding their families wild sources of vitamin A rich foods. The lowest levels at baseline were in Parsa and Bara, while Makwanpur, Chitwan, Tanahu and Palpa all had rates over 80%. Narwalparasi, which had only 63.4% of its mothers reporting serving wild greens at the 12-month exam, had increased to 91.1%, putting it in the same range as Tanahu, Palpa, Chitwan and Makwanpur. Bara and Parsa remained low at the 24-month exam, although they had increased levels of wild green consumption between the two follow-up examinations. It appears that this message is also quickly spread.

Feeding colostrum to newborns

Figure 2.16 Mothers Feeding Colostrum to Babies



Even though at baseline almost 20% of the mothers felt that colostrum was dirty and not meant for infants, the message that colostrum should be fed to newborns was quickly diffused through communities.

Even though messages were aimed at the nutrition education cohort, at the 12-month exam, both the capsule and primary health care activities have similar rates of mothers feeding infants colostrum. Mothers in the symptomatic treatment cohort fed slightly less colostrum to infants than those in the intervention cohorts.

By the 24-month exam this had increased by about 16-18% in the intervention cohorts and by about 8% in the symptomatic treatment cohort.

Bara had the lowest rates of mothers feeding colostrum to infants (34.5%), and Makwanpur had the highest (81.6%). In most districts the percentage stayed about the same. The rate increased by almost 20% between measurements in Bara, but Bara still had the lowest rate in the study area. These results indicate that future efforts to promote colostrum will be effective.

Monthly weighing

Scales were provided to all the community health workers in nutrition education sites. However, the growth monitoring cards received from the Nutrition Unit were not well received by the mothers. Furthermore, the training of community health workers did not adequately emphasize monthly weighing.

At 12 and 24 months, weighing among the nutrition cohort remained static at 16-17%. Mothers in the capsule, primary health care and symptomatic treatment cohorts also participated in a weighing program. By 24-months, monthly weighing appeared to be increasing in areas outside the nutrition education area, but not in the nutrition education area.

Participation rates decreased in four districts from the 12-month to the 24-month exam, while it increased in three (Narwalparasi, Tanahu, and Palpa). The rates of participation at the 24-month exam were higher in the hill areas than in the terai.

Literacy

At baseline, only 6.8% of the mothers reported being literate. The highest number of literate mothers was in the capsule distribution, and the lowest in the symptomatic treatment programs, followed closely by the literacy rates among the nutrition education cohort.

Because of low literacy rates, maternal literacy programs were started in some nutrition education sites. At the 12-month exam, the number of literate mothers increased to 13.8%, and the figure rose to 16.8% by the 24-month exam. (Figure 2.17). The highest levels, however, were reached by the capsule distribution program (18.4%), which increased the literacy rates for mothers in this intervention to greater than the national average for Nepal.

Chitwan had the highest level of maternal literacy, while Bara and Parsa had relatively low levels. In general, the hill areas had higher levels of maternal literacy than the terai, except for Chitwan.

By the 24-month exam, the rates of literacy had significantly increased in four of the districts; Makwanpur, Chitwan, Narwalparasi, Tanahu, and Palpa. In Bara and Parsa, where the rates of maternal literacy did not increase, household literacy in general was low, and often husbands refused to let their wives attend classes, because non-literate husbands did not want literate wives.

Figure 2.17 Mothers Literate

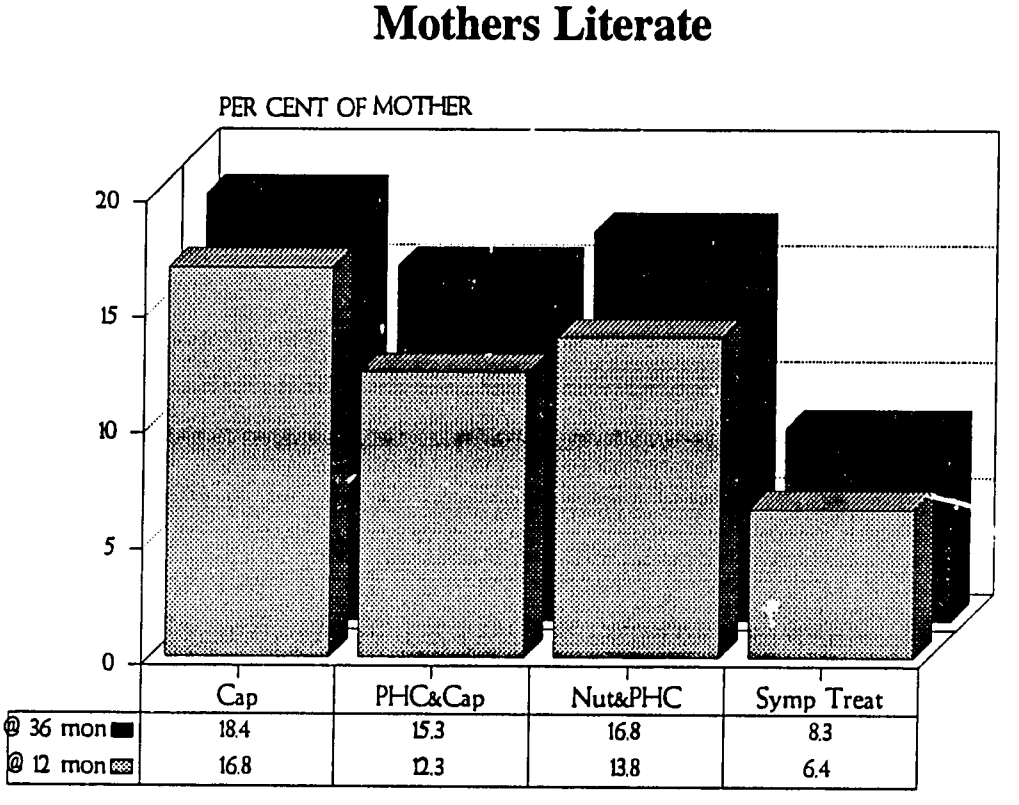
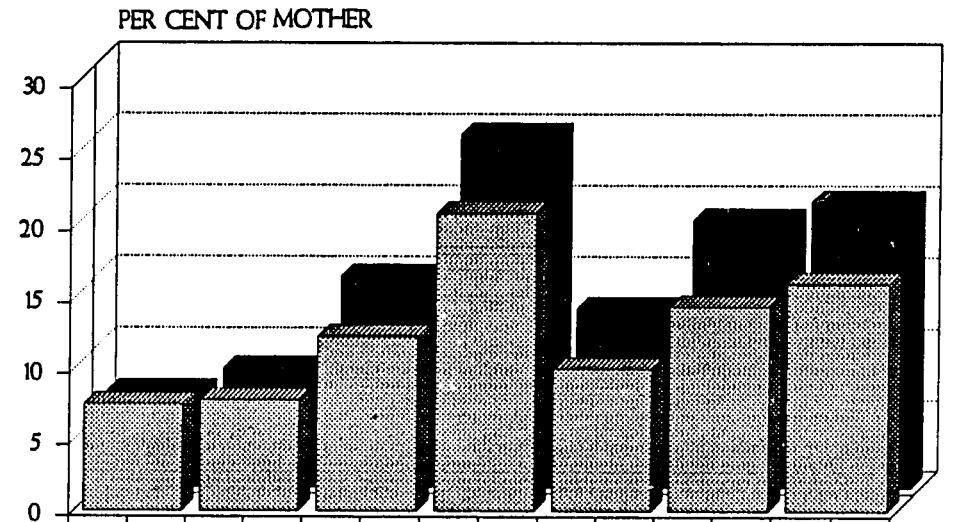


Figure 2.18 Mothers Literate by District

Mothers Literate, Year 2 and Year 3 by District

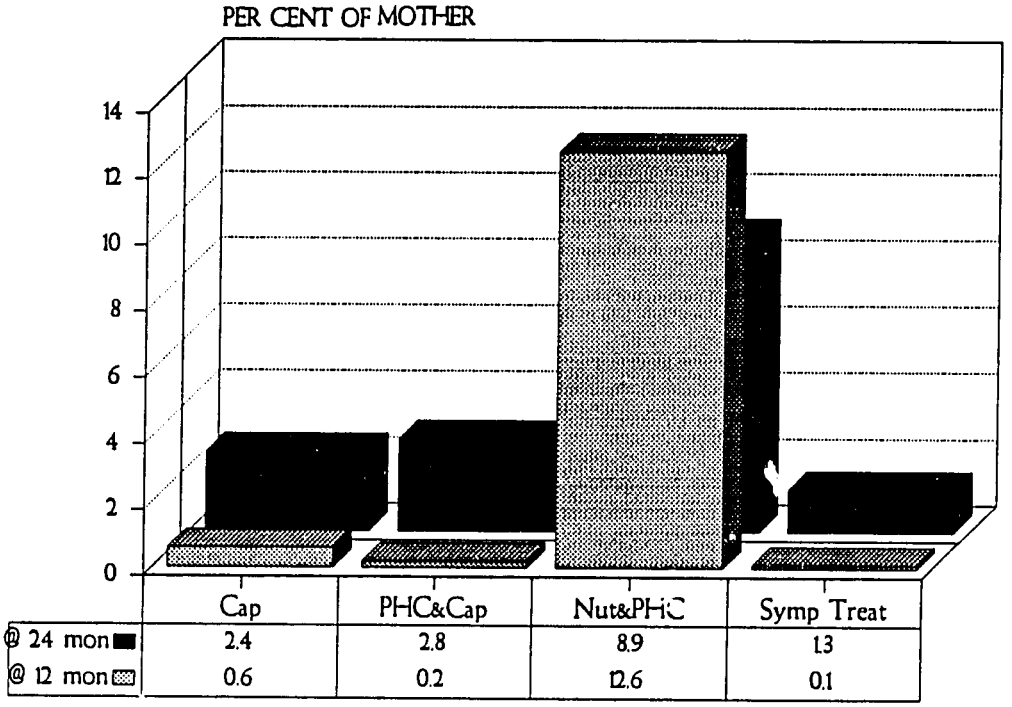


	Bara	Parsa	M'Pur	Chitw	N'par	Tanahu	Palpa
@ 24 mon	6.8	8.4	14.9	24.8	12.6	18.8	20.1
@ 12 mon	7.5	7.8	12.3	20.9	10	14.4	16

Literacy classes sponsored by the Project appeared to be the only literacy classes in the Project area during the first 12 months of its implementation. This program was popular with mothers and donors, so that when requests for sponsorship were received in district offices, donors were prepared to sponsor the village literacy programs.

Figure 2.19 Mothers attending literacy classes

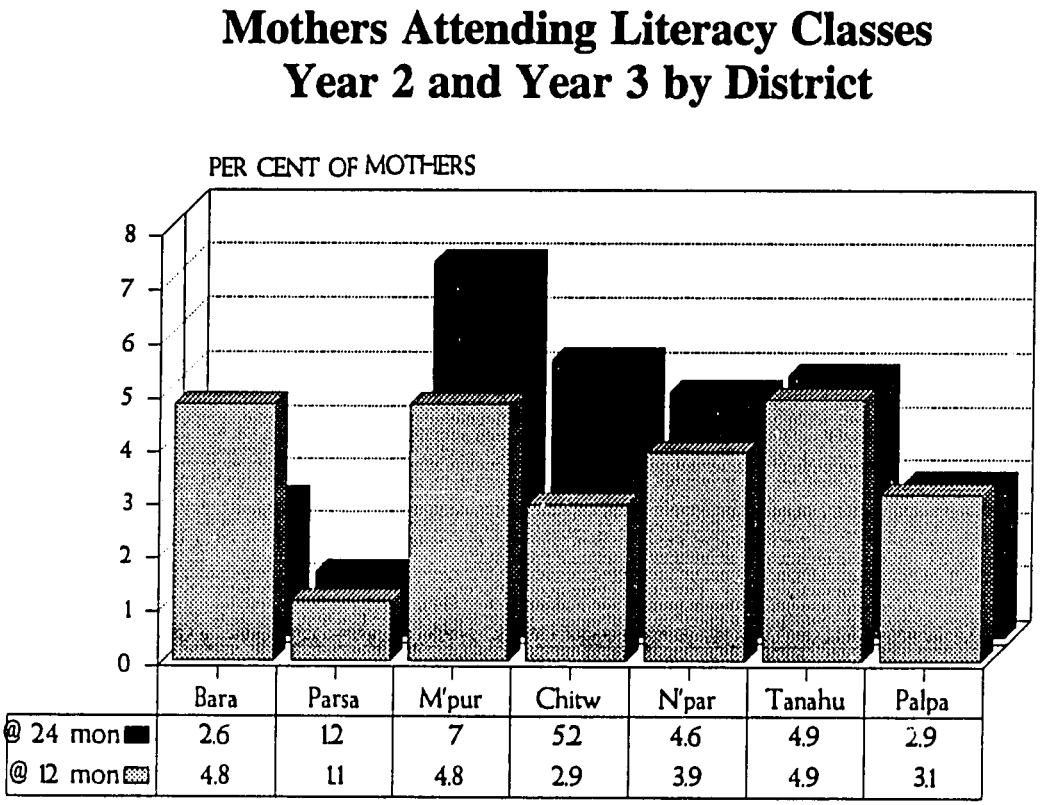
Mothers Attending Literacy Classes



The increase in demand and potential support for literacy programs increased literacy programs outside of the nutrition education areas. This can be demonstrated by the1.3 - 2.8% of mothers in non-nutrition education sites attending literacy classes.

It should also be noted that women attended the classes for approximately 4 months, resulting in basic skills in reading and writing. The 8.9% of the mothers at the 24-month exam in the nutrition education cohort represent a different group of mothers than the 12.6% at the 12-month exam.

Figure 2.20 Mothers Attending Literacy Classes by District



Programs in some villages where attendance was low were discontinued (Bara and Parsa). But in some areas participation increased in the12 to 24 month period -- most notably in Makwanpur and Chitwan.

The low rates of attendance in Parsa, and the decrease in attendance in Bara suggest that perhaps a wider adult literacy program that does not exclude the husbands might be a way to develop support for the literacy classes.

2.4 Summary of community, household, and individual factors influencing participation

As we have discussed, there is much variation in the compliance to the different components of the nutrition education program. In some wards it was well appreciated, and mothers not only utilized the public health services provided, but also a proportion changed their family dietary patterns.

Compliance with the nutrition education messages were more closely tied to specific community and household factors than the capsule or primary health care

activities. Urban areas tended to have very low compliance to nutrition education as did secondary economic centers. Proximity to a passable road or public transport lowered participation dramatically. However; this effect seemed to be counteracted if a primary school was located in the ward, suggesting that schools can act as entry points for the information concerning diet. Once again, the presence of an active VHW or CHV in the ward made an important contribution to participation.

Interestingly, the coverage for nutrition education (both alone and in conjunction with primary health care) is not affected by an increase in the number of children in the ward, although in the other two interventions, there is a lower compliance with the activities for those wards with more children. This may be attributed to the diffusion of messages between mothers and other community members regardless of formal contacts with the village health worker or other health post staff.

Household factors included economic status, with the more wealthy families more likely to comply in the programs. The presence of a household garden was also correlated with high compliance rates of knowledge, attitude and practice concerning the six nutrition education messages. Hygiene factors, including whether children washed their hands before eating, and whether children had access to pit latrines were also associated with the desired knowledge and practice. Literate mothers were more likely to act on nutrition education messages than non-literate mothers, the opposite of the effect of maternal literacy on capsule distribution.

There was a lower participation in both primary health care and the nutrition education activities for children who were diagnosed as having Xerophthalmia at baseline. There was a considerable difference in rates of practice by age with the mothers of older children complying more often than the mothers of younger children. There was no difference associated with the sex of the child. In terms of physical growth, the highest rates of participation in nutrition education occurred among those children least at risk for both stunting and wasting.

---

37 World Health Organization (1979), "Alml Ata Declaration"

38 Walsh and Warren. Selective Primary Health Care: An Interim strategy for Disease Control in Developing Countries. Social Science and Medicine Vol. (14C) pp. 145-163.

39 The 1989 average literacy rate in Nepal was 13% and the rate in the study area was 6.8%.

Chapter 3 The Effect of Program Activities on Health Status

Health status was measured during this study by Bitot's spots (X1B) corneal xerophthalmia (X2, X3A, and X3B), and nutritional status, as suggested by the IVACG guidelines.[40] A history of night blindness was also recorded as were corneal scars. No attempt was made to record the presence or absence of conjunctival xerosis (X1A) without Bitot's spots. Nutritional status indicators have been used in this study to access health status and the results will be offered in this chapter. Three components of health status assessment not in the original work plan were included in this study: (1) serum vitamin A, (2) serum Pre-albumin, and (3) iron levels. These assessments were done on a sub-sample of children within a sub-sample of the total sites. In addition to collection of blood, stool exams were performed. Slides were examined and egg counts done by species of parasite observed.

Before we look specifically at program impact on health status indicators let us review several factors that appear to influence the distribution, measurement and/or risk of xerophthalmia. These factors include: nutritional status, maternal literacy, clustering of vitamin A deficiency by location, seasonality of signs of deficiency, age/sex differences for susceptibility, non-responsive bitot's spots and loss to follow-up of portions of the sample population. These factors in the context of Nepal will be discussed in this chapter.

The primary measures of health status; xerophthalmia, wasting and stunting, were not uniformly spread among the wards. Risk for all these problems is higher in some wards and almost nonexistent in others. A logistic regression analysis to derive community-level characteristics or correlates to predict risk for xerophthalmia, severe wasting, stunting or high mortality was completed. Independent variables for this analysis were (1) indicators of community development, (2) community agricultural patterns, (3) history of disease epidemic, (4) different indicators of ward-level economic activity, (5) the presence and absence of government development projects, (6) household characteristics of community status, (7) sanitation (8) income, as well as individual characteristics such as (9) nutritional status and (10) participation in the different program activities. The results from this analysis can be found in Appendix A.

3.1 Factors that influence the distribution, measurement and/or risk of Xerophthalmia

Affordable and well-utilized vitamin A deficiency programs can not improve health status if they are insufficient to cover the biological deficit responsible for the problem. Nepal's poverty and harsh climate cause a variety of health-related problems in the population. Rates of wasting and stunting are as high as have been reported anywhere else in the world. Maternal literacy rates in Nepal are low, and the rates in

the study area were even lower than the national average. Income is low, and while much of the production of staple foods is for subsistence, only a small proportion of the households grow enough for the whole year, and over 50% of households go 5 months with insufficient food.

For over three months in summer, the season of food shortages, daytime temperatures reach over 100° F. This season is associated with lack of water and high levels of diarrhea. In this season, vegetables can't be grown and markets sell out of supplies. Other agricultural activities to absorb labor are not available, and living conditions become difficult for the families.

During this Project poor rainfall reduced food availability between the 12- and 24-month exams, there was an economic boycott by India (which benefited communities on the border due to black market activities) and Nepal underwent political upheaval and a change of government (which left the rural population largely unaffected).

Overview of the Nutritional Status of the Study Population

Several types of malnutrition are associated with vitamin A deficiency in Nepal. Children suffer from excessive disease and chronic insufficient caloric intake that causes them to be small, and often wasted. The iodine content of water and soil in many areas is marginal, so many children suffer from iodine deficiency disorder. Anemia also appears to be endemic in children over most of the study area.

Nepal borders the plains of India and the Himalayan plateau of Tibet. While the majority of the children in the study live on the flat plains adjoining India, some of the areas extend into the hills. Agriculture changes with elevation, which also moderates the climate. The study population includes an area where two different races meet. The Hindu population of Bara and Parsa are Caucasian, and most of the other areas have oriental descendants. While over the ages inter-marriage between the races (especially Nobility) has moderated this distinction, the difference can be noted in the anthropometric measurement of the children.

Over the life of the Project all children within the study were weighed, measured for height, mid-upper arm circumferences, elbow breadth and skin fold thickness. Different parameters appear to be sensitive to different aspects of the study, but all the measurements were influenced by the overall deteriorating household food security situation that occurred between the 12-month and 24-month exam. When food availability was not critical, vitamin A deficiency control activities improved the nutritional status of children. When food availability became critical, Project activities seemed to mitigate the severe negative consequences.

The changes in ocular status associated with Project participation are even more

pronounced than the above anthropometric indices. The changes occur across intervention cohorts, with marked changes occurring even in the symptomatic treatment group, suggesting that the program intensity threshold for moderating nutritional problems is lower for physical growth than for vitamin A deficiency. The risk for mortality increased in the symptomatic treatment from the 12- to the 24-month exam. The Project effect on health status then was the most pronounced on parameters of growth, significant on the most severe signs and symptoms of vitamin A deficiency, and mortality risk reduction suggesting that the activities can maintain the children's vitamin A nutrition in times of household food insecurity.

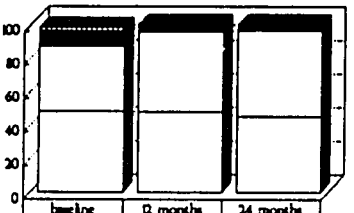
Figure 3.1 shows the nutritional status of children using the different Waterlow categories of nutritional status by age cohort. The categories used are normally nourished children, children who are stunted only (< -2 S.D. height for age), wasted only (< -2 S.D. weight for height), and wasted and stunted. Stunted children, while small in stature, have no significant increase in risk for xerophthalmia from children with normal nutritional status. Wasted children though, are at increased risk for xerophthalmia, morbidity, and mortality.

The nutritional status of the different age cohorts differ significantly at baseline, with infants having the lowest overall level of wasting and stunting in all examinations. The nutritional status of children aged 12-60 months was the worse of all the three age cohorts, but the nutritional status of children aged 61-120 months was only marginally better.

The overall effect of the activities was slightly different for each of the age cohorts. In infants under 12 months, the percentage of the population in the normal category decreased, while the amount of stunting increased. The increase in stunting, which is associated with increased household food insecurity, was not limited to infants. Preschool children age 12-60 months also were more stunted at the end of the Project than the beginning. Although among this age cohort, the percentage of children in the normal category also increased. Among the older children stunting was more common at the 12-month exam than at baseline, but decreased again by the 24-month exam.

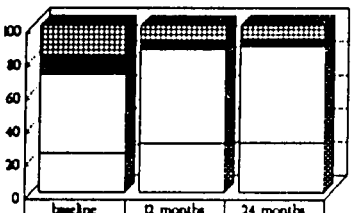
Figure 3.1 The Nutritional Status of the Study Area Population at Baseline, 12 and 24-Month Exam

Nutritional Status of infants under 12 months



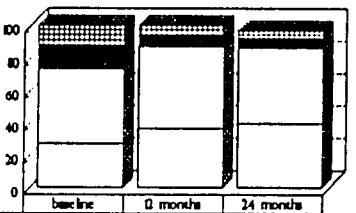
	baseline	12 months	24 months
Stunted and Wasted	2.8	1.6	1.2
Wasted Only	8.6	3.1	2.7
Stunted Only	38.8	47.7	51.1
Normal	47.9	47.6	45

Nutritional Status of infants under 12-60 months



	baseline	12 months	24 months
Stunted and Wasted	17.5	8.8	7.8
Wasted Only	11.7	5.6	4.8
Stunted Only	47.5	56.4	58
Normal	23.3	29.2	29.5

Nutritional Status of children 61 -120 months



	baseline	12 months	24 months
Stunted and Wasted	12.7	6.1	4.8
Wasted Only	14	7.2	6.3
Stunted Only	46.2	50.7	46.6
Normal	27.1	36.1	39.3

The effect of the activities was to reduce the amount of wasting occurring among the study population. This was true of all groups where the prevalence of wasted only and wasted and stunted was at least 60% reduced in all age groups, with the largest reduction being seen in children from 12 to 60 months.

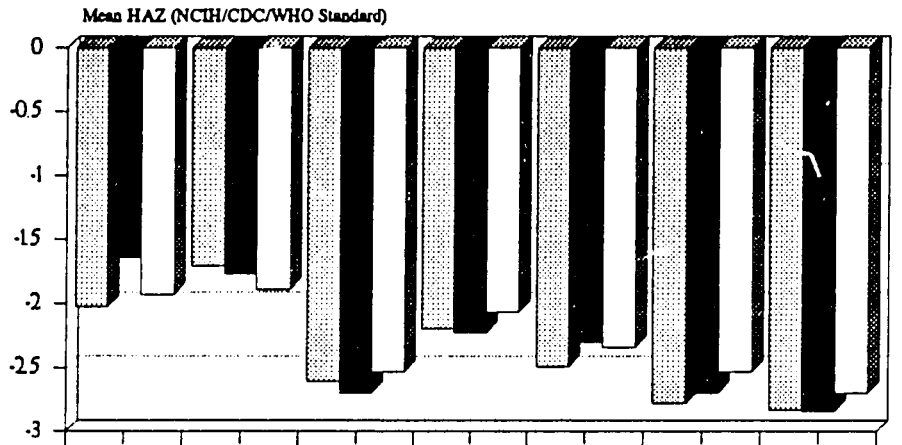
There are several ways to consider malnutrition within a population. This study has opted to compare the nutritional status of the study population with the WHO/CDC/NICH reference population, and express the difference between what was seen in the study population and the international reference population expressed as standard deviations. Using the Waterlow approach two ways were utilized in the study to categorize the nutritional status of the population. One approach is to use the height of the child compared to the reference population at each age in months (height for age). The other is to consider weight of the child for his height (weight for height) as compared to the reference population. This ratio indicates how the body mass of the child is stretched over its frame. Tall skinny children would have low weight for height indices, while short chubby children would have high weight for height indices.

Additionally, in this analysis we express the results in two different ways; one is to consider the percentage of the children who are stunted and wasted using a set cut-off point (< -2 Z scores from the reference population), and the other is to look at measures of central tendency (means). The means are used when discussing nutritional trends by intervention over time. Percents of the population being either above or below the cut off point is normally the way in which this type of information is presented on individual risk.

Stunting and wasting within study area

Figure 3.2 Height for Age by District

Means of Height for Age (HAZ)



	Bara	Parsa	M'pur	Chitwan	N'parasi	Tanahu	Palpa
Year 1	-2.03	-1.71	-2.61	-2.2	-2.49	-2.78	-2.83
Year 2	-1.64	-1.77	-2.7	-2.23	-2.3	-2.7	-2.84
Year 3	-1.93	-1.89	-2.53	-2.07	-2.34	-2.53	-2.7

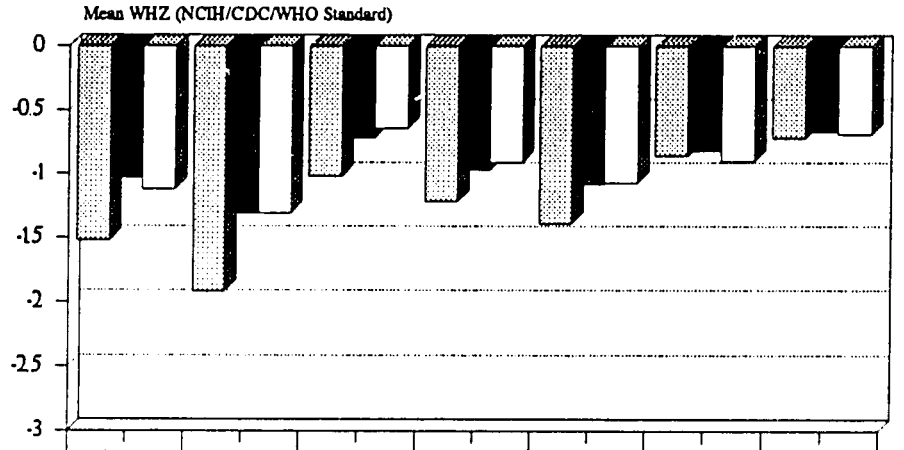
District

The height of the children varies greatly by district. Those districts closest to India, with the largest composition of Hindu population, Bara and Parsa, have the tallest children. In Figure 3.2, these are the shortest bars. The districts that lie entirely in the hills have the shortest children at every age. The districts that are composed of both hill and terai, have a slightly higher index of height than the hills, but it is shorter than the outer terai.

Although taller, these children of the outer terai are not necessarily better nourished. They do, in fact, suffer from levels of wasting twice as high as found in children in the hill districts. These tall thin children also suffer from levels of xerophthalmia that are 5-10 times higher suggesting that the body type difference seen between outer terai and hill children is associated with increased xerophthalmia risk, even though there are undoubtedly some racial differences.

Figure 3.3 Means of Weight for Height by District

Means of Weight for Height (WHZ)



	Bara	Parsa	M'pur	Chitwan	N'parasi	Tanahu	Palpa
Year 1	-1.52	-1.92	-1.02	-1.22	-1.39	-0.86	-0.72
Year 2	-1.03	-1.31	-0.72	-0.97	-1.08	-0.82	-0.67
Year 3	-1.12	-1.31	-0.64	-0.91	-1.07	-0.9	-0.69

District

Wasting of all the nutritional parameters seemed the most positively affected by the Project. The rates of wasting went down in all the districts but Tanahu during the Project. In the terai areas, this reduction was as much as 30%, while in the hill districts it stayed the same, or as in the case of Tanahu, went up slightly, and Makwanpur, where it dropped 40%. It should be noted that these z scores are means, and as such not very much influenced by measurement variation.

Another point is that the big improvement occurred between the baseline exam and the 12-month measurement. During the period from the 12-month and 24-month exam, the situation did not improve much, and in some cases deteriorated, but not to the baseline levels (except for Tanahu). This suggests that despite problems with food availability, the program helped mothers make sure that their children maintained adequate levels of body mass.

Skin fold and mid-upper arm circumference

Skin fold measurements for Nepal in general are low as might be expected in a population with high rates of infection, and in a country where agricultural output has consistently been below caloric needs. There was some variation among interventions. The primary health care cohort, had the highest skin fold thickness at baseline, and nutrition education cohort the lowest. By the 24-month exam, the capsule and primary

health care were the highest and the symptomatic treatment group the lowest.

This measurement was more sensitive to the household food security situation than was the prevalence of wasting. There was a major increase in all intervention cohorts from the baseline to the 12-month measurement. Between the 12-month exam and the 24-month exam when the household food security became even more critical than normal the skin fold thickness decreased among all the intervention cohorts.

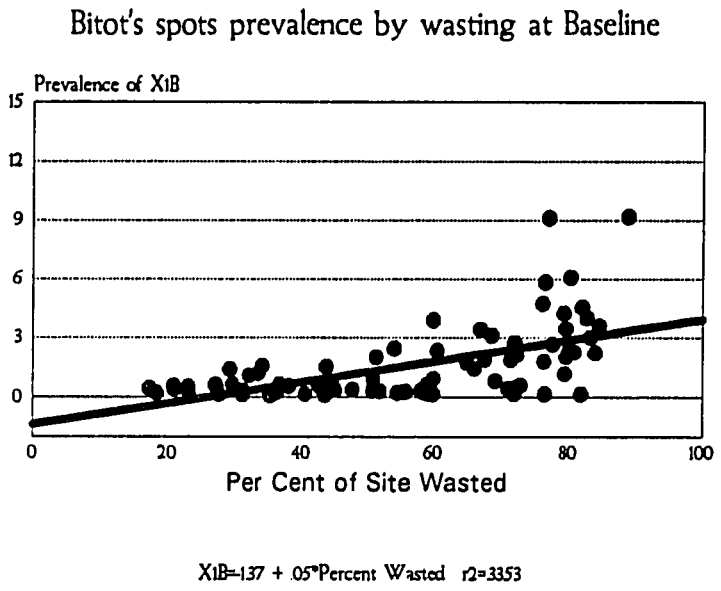
The importance of skin fold thickness as a risk factor for xerophthalmia also changed during the survey due to the interactions of the Project activities and the deteriorating household food security situation. At baseline, significant skin fold thickness differences were observed between the Bitot's spots, the cases of corneal xerophthalmia, and the rest of the study population. There was no observed difference at the 12-month examination between cases of xerophthalmia and the rest of the study population as the Project activities were disrupting the natural ecology of vitamin A deficiency within the study area. By the 24-month exam when household food supplies were extremely limited, the skin fold thickness between cases of Bitot's spots, corneal xerophthalmia, and the rest of the study population was statistically significant again, with the risk for Bitot's spots and corneal xerophthalmia approximately at the same levels as had been seen at baseline. The 12-month exam is markedly different with no significant difference in skin fold thickness between Bitot's spots and normal children.

The mid upper arm circumference also seems to not be affected by the program at all. At baseline all interventions had approximately the same levels. By the 12-month exam children appeared to have arms that were 0.1 - 0.3 cm smaller in circumference than had been seen at baseline. This drop continued through the 24-month exam, or in the case of nutrition education stayed the same. The smallest drops were seen in the capsule and the primary health care cohorts.

Wasting and risk for xerophthalmia

This decrease in skin fold thickness and mid arm circumference was seen in the same time period that rates of wasting dropped dramatically and rates of stunting were increasing. The interplay of the Project activities with background risk associated with availability of food, and employment opportunities for heads of households suggest that these interventions might have had an even greater impact on nutritional status, had the agricultural situation been more favorable.

Figure 3.4 Bitot's Spots Prevalence by Wasting at Baseline



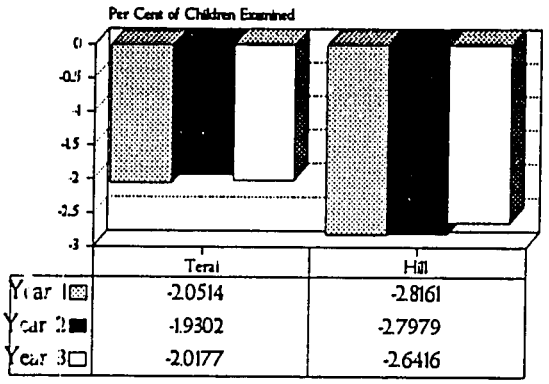
At the baseline exam, the effect of the wasting on risk for xerophthalmia was significant. If one plots the risk for xerophthalmia in those sites where xerophthalmia was found against the percentage of the children in a site that were less than -2 standard deviations from the reference population in terms of wasting (WAZ) several things can be seen. One is that xerophthalmia did not occur in sites where less than 18% of the population was wasted, hence the negative 'y' intercept of the regression line. Sites with prevalence of new Bitot's spots above 3% all had greater than 60% of their children wasted. The wasting, while strongly associated with risk in Nepal, is not the only significant factor. The r^2 of the regression equation is 0.33, which is significant, and suggest that 33% of the time you would get the right answer by using wasting to predict xerophthalmia. There are some exceptions as can be seen in the Figure 3.4, with one site having a prevalence of wasting above 80% and a prevalence of xerophthalmia of 0.2%. As will be seen in a later section, the power of nutritional status to predict risk was reduced after the introduction of the program activities.

While wasting has always been seen to have increased risk for xerophthalmia on the individual level, it was not seen to be a good estimator of community risk for xerophthalmia in Indonesia during the 1977 national prevalence survey,[41] or during the 1991 Eastern Island Nutritional Assessment.[42] The longitudinal experience of this study suggests that at baseline without any strong vitamin A program, wasting was associated with risk for xerophthalmia. Other factors began to be predominant in the determination of community risk after the activities began and wasting itself became less frequent

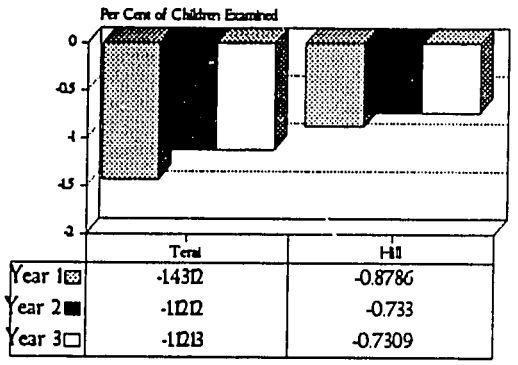
. Effect of location on nutritional status

Figure 3.5 Stunting and Wasting by Terrain and Year

Means of HAZ by Terrain



Means of WHZ by Terrain



As stated earlier, there was a marked difference in both stunting and wasting from the hill areas to the terai areas. Children in the terai while taller, are generally more wasted, or have less body mass on their frames. The shorter hill children tend to have more weight on their frames and are less wasted.

Besides the racial differences between these areas, there are also marked agricultural differences. The terai, in general, tends to be more agriculturally productive than the hills, but much of its products are sold to India, as transportation cost into the hills cuts into the profit margin of the grain wholesalers. This was less of an issue at the 12-month exam, when due to the Indian economic boycott, all over-land shipment between the two countries stopped. By the 24-month exam, trade had resumed, although the amount produced was reduced because of the weather.

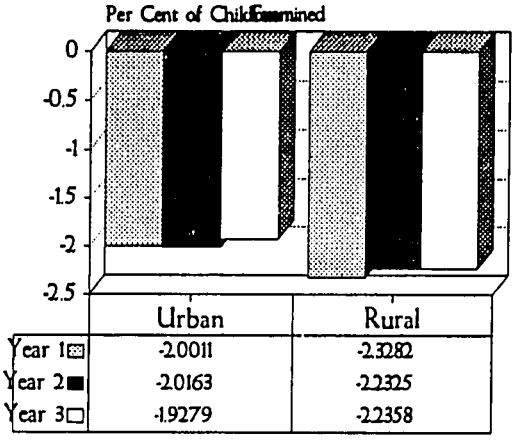
Wasting decreased primarily in both areas between the baseline measurement and the 12-month exam. There was little reduction in mean WHZ scores for wasting after that time. For stunting, however, improvement was seen in the terai from baseline to the 12-month exam, but not in the hill areas, which only showed an improvement from the 12-month to 24-month exam, when the terai stunting increased.

There was also some difference of risk between urban and rural areas with wasting and stunting found at baseline, and the effect of the program over time. The rural areas were more stunted initially than the urban areas. While some improvement in height was seen in the rural areas from baseline to the 12-month exam none was seen in the urban areas. However, from the 12- to the 24-month exam, the mean Height for Age score of the urban areas improved while the mean HAZ score in the rural areas stayed the same.

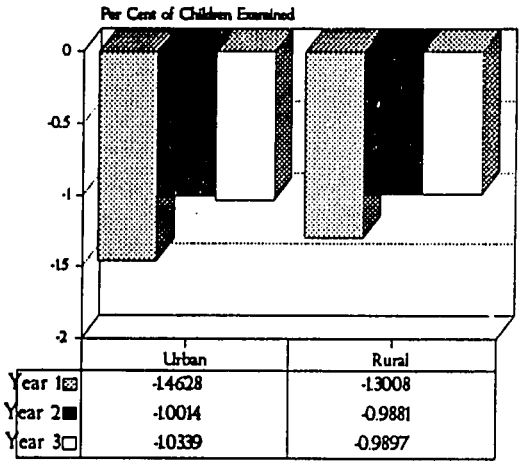
At baseline wasting was higher in the urban areas, but by the 12-month exam there was no difference between urban and rural areas in the amount of wasting found as measured by the mean WHZ score. This lack of significant difference between rural and urban areas continued into the 24-month exam, although wasting increased slightly in urban areas from the 12 to 24-month exam.

Figure 3.6 Urban/Rural Stunting and Wasting by Year

Means of HAZ by Urban and Rural



Means of WHZ by Urban and Rural



Effect of education on nutritional status

As noted before, the level of maternal education in the Project area was low, even by national Nepalese rates. At baseline, the children of educated mothers were not at significantly reduced levels of risk for being wasted compared to children of mothers who were not educated, nor was the educated mother less likely to have a stunted child. The educated mother was only more likely to have a heavier child at baseline, than an uneducated mother.

Table 3.1 Relationship of Site-Level Maternal Literacy to Nutritional Parameters During the Project

	WHZ		WAZ		HAZ	
Exam	r^2	sig.	r^2	sig.	r^2	sig.
baseline	.01522	.2213	.11905	.0004	.00601	.4432
12-month	.05275	.0215	.14757	.0001	.03445	.0645
24-month	.11193	.0007	.3119	.0000	.09942	.0014

This situation altered after the introduction of the program activities. By the 12-month exam, educated mothers were much more likely to have children not wasted than uneducated mothers, and the biggest change was seen in communities with the highest

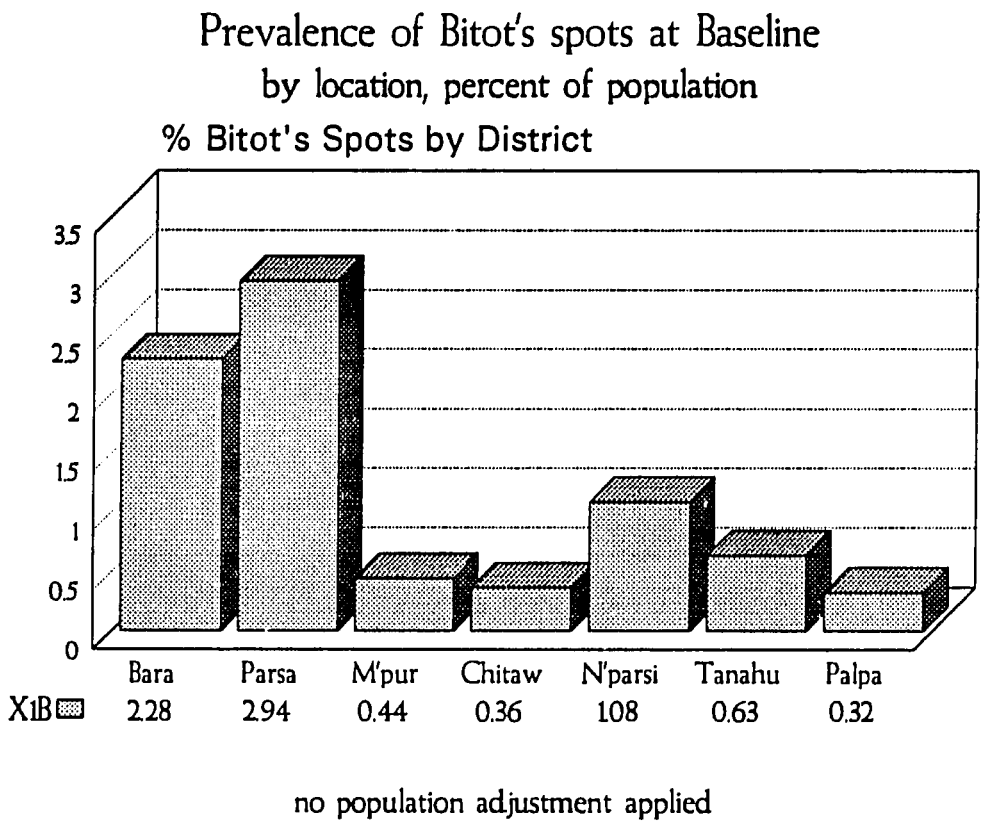
level of education. The mothers' education also was much more significant in terms of stunting as was the regression co-efficient, but still just beyond the boundaries of statistical significance.

By the 24-month exam maternal literacy was very significant in determining risk for wasting, stunting and underweight. The increase in regression coefficients during the Project also suggest that maternal literacy's importance in determining risk also was increased by the Project activities. This suggests that maternal literacy by itself was insufficient to reduce risk of wasting and stunting. However, when coupled with an active nutrition education program, maternal literacy can become an important factor in determining risk of wasting.

Clustering by district and site

An interesting characteristic in risk for community Xerophthalmia is its tendency to cluster by location. In Indonesia, for example, Tarwotjo and Sommers found that West Java, Nusa Tenggara Barat, and Daereh Istamewah Aceh contain over 60% of Xerophthalmia cases found in the 24 provinces surveyed in 1978.[43] In our study, covering seven districts, we also found the risk concentrated in two districts (Figure 3.5). Bara and Parsa are boarder districts with India and are located in the terai.

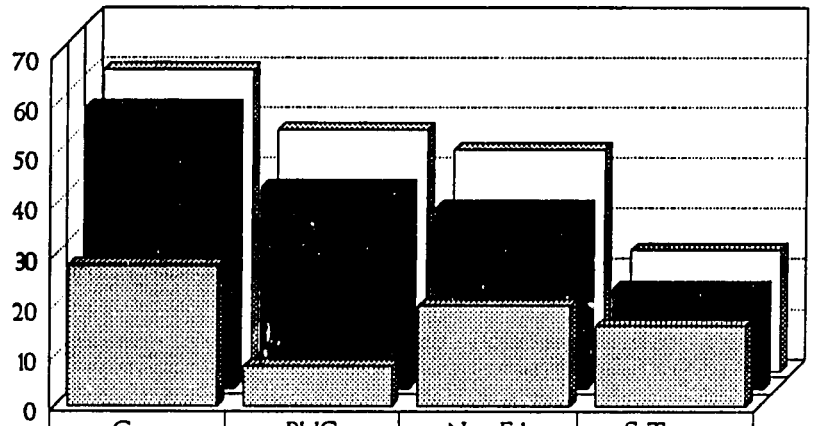
Figure 3.7 District-Level Bitot's Spot Rates at Baseline



Within districts (including the high-risk districts), the risk for Xerophthalmia was not evenly spread (Figure 3.6). At baseline, about 25% of the sites had no signs or symptoms of Xerophthalmia. By the end of the evaluation, 50% of the sites with vitamin A programs had no cases of Xerophthalmia. Some of the districts were located in the terai area, and some in the hills. The highest risk tended to be found in the terai, although a few of the sites located in the hills also had high levels of risk.

Likewise, within the sites, risk was not evenly distributed. A mapping exercise was undertaken in all wards with cases. The survey team map with household numbers was photocopied and all the households with cases at baseline were marked. The households for the 12-month and 24-month exam were also plotted and the results examined for clustering.

Figure 3.8 Percent of Sites with No Risk for Xerophthalmia



	Caps	PHC	Nut Ed	S Treat
Baseline	28	8	20	16
12 months	56	40	36	20
24 months	60	48	44	24

Most of the cases at baseline were concentrated in just a few households. At-risk households tended to be located in one or two small clusters, usually next door to each other. The major determinant of risk at 12 or 24 months was if the household was located in a cluster site from the previous year, and new cases usually occurred in the same households or in those of next door neighbors.

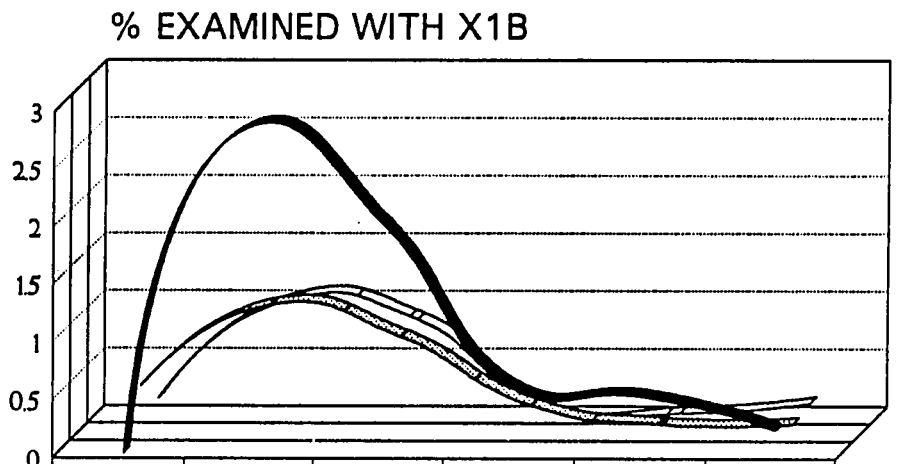
Seasonality

There is a marked seasonality of the risk for Bitot's spots (Figure 3.9). The highest level of cases found in all three exams was in May. The examinations were spread across six months, with the baseline survey starting in May, and the 12 and 24-month exams being started in April.

There are three predominant seasons in the study area, with the hill areas having much more moderate conditions than the terai. From March until June, the temperature becomes extremely hot and dry. There is usually no rain, and there is little in the preceding months, so that rivers dry up and plants will not grow. The air is dusty and temperatures exceed 100 degrees Fahrenheit daily.

Figure 3.9 Seasonality of Bitot's Spots

New Bitot's Spots Prevalence by Month



	APRIL	MAY	JUNE	JULY	AUG	SEPT
BASELINE	0	2.84	1.97	0.55	0.48	0.2
12 MONTHS	0.43	1.13	0.85	0.26	0.1	0.1
24 MONTHS	0.17	1.02	0.85	0.07	0.04	0.13

Rains commence in late June or early July, but the temperature remains hot, above 90° F daily, with humidity above 90% for several months. The weather moderates during September, with cooler temperatures and less rain until January, when warming starts.

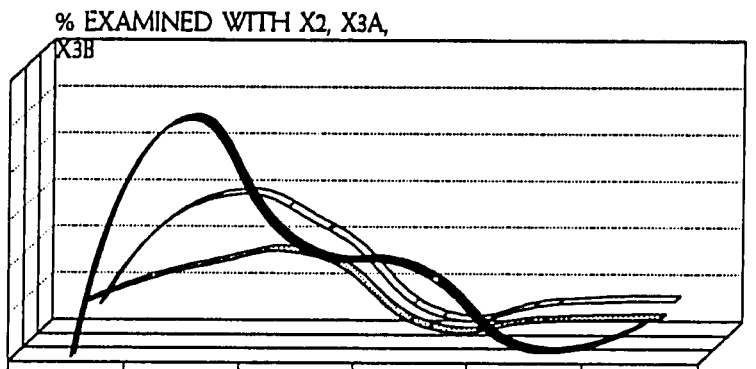
The peak season of risk for new Bitot's spot appears to be at the beginning of the hot season. During baseline survey, we did not sample in April, but the risk in May was higher than April at the 12- and 24-month exams.

The seasonality of corneal Xerophthalmia is similar to that of Bitot's spots. The peak month for risk at baseline and at the 24-month exam is in May. At the 12-month exam, however, the month of peak risk is June. The difference in level of risk by season, while pronounced, is lower for corneal signs than for the Bitot's spots. The increase in risk from the 12-month to the 24-month exam is not seen with Bitot's spots. It is curious that the rates of new Bitot's spots decrease between 12 and 24 months, while the rates of corneal Xerophthalmia increase, and in one month (July) exceed baseline levels. As mentioned earlier, decreasing household food availability leads to an increasing overall risk for severe Xerophthalmia, even though the prevalence of Bitot's spots decreased.

There was a marked seasonality in the patterns of wasting, and to a lesser degree stunting. The season for wasting was approximately the same as the season for high risk of xerophthalmia at baseline. The peak risk for wasting was in May and June at baseline, and generally after the July monsoons, the prevalence of wasting appeared to decrease. At the 12- and 24-month exams the seasonality of wasting was less marked, but still occurred. The reduction of wasting seen from baseline; moreover, was far greater in the hot dry season than the reduction of wasting seen at other times of the year. This suggests that the Project was the most effective in reducing the risk for wasting during the peak season, and less effective during the low risk seasons for xerophthalmia.

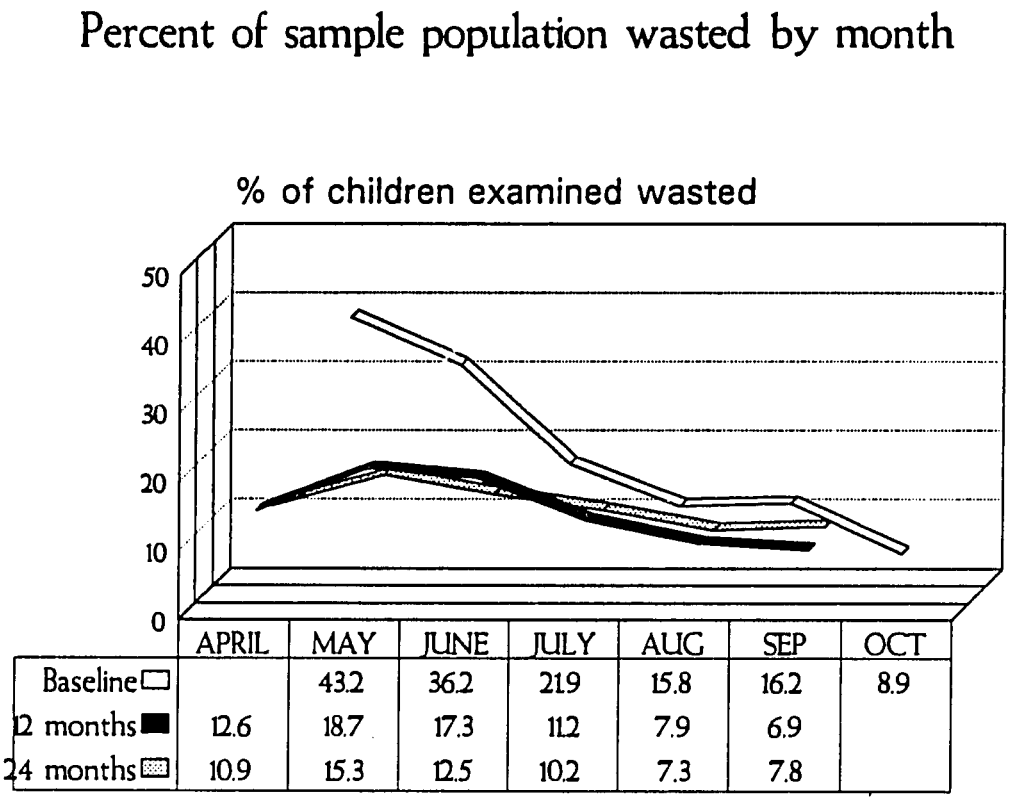
Figure 3.10 Seasonality of Corneal Xerophthalmia

CORNEAL EYE SIGNS BY MONTH



	APRIL	MAY	JUNE	JULY	AUG	SEPT
BASELINE	0	0.2543	0.1167	0.0943	0.008	0.0376
12 MONTHS	0.0436	0.0833	0.0935	0.0176	0.0247	0.0273
24 MONTHS	0.0271	0.1413	0.1066	0.0146	0.0284	0.0313

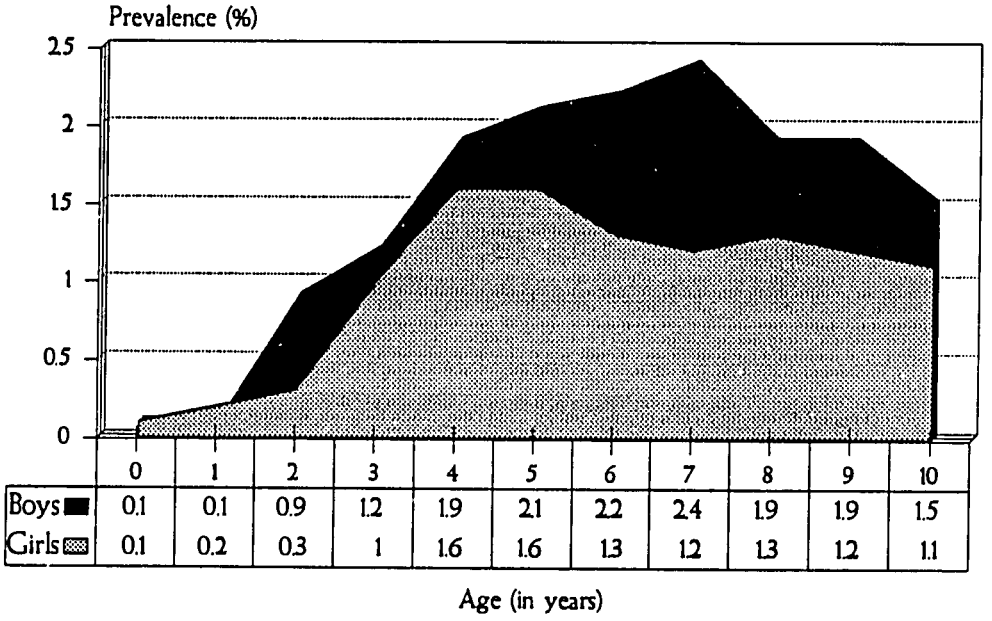
Figure 3.11 Percent of Sample Wasted by Month



Age/Sex

The age and sex of children are significant factors in determining the magnitude and the types of influences that affect risk. Children's risk increased until the age of 7 years for boys and until 4-5 years for girls (Figure 3.12). Participants in this study included children up to the age of 10 years at baseline, and some older children came to the examinations. Sex differences in risk have been well documented worldwide.

Figure 3.12 Prevalence of Bitot's Spots by Age and Sex at Baseline



	0	1	2	3	4	5	6	7	8	9	10
Boys	0.1	0.1	0.9	1.2	1.9	2.1	2.2	2.4	1.9	1.9	1.5
Girls	0.1	0.2	0.3	1	1.6	1.6	1.3	1.2	1.3	1.2	1.1

Appendix C gives the distribution of anthropometric indicators by age, sex and intervention. Several interesting trends can be seen when reviewing this appendix. Sex difference in wasting, stunting, weight for age, skin ford thickness, mid-arm circumference, and the estimated fat and muscle area change in different age groups. Boys are shorter than girls as infants, grow taller than girls in the 12-60 month age, and then become shorter than them again in the 60-120 month age. This trend holds through all three examinations.

The Program activities had different impact on the sexes and on the different measurements. The sex difference in Bitot's spots also seems to be associated more with the fat difference seen between the sexes at all ages past 12 months, with girls having more estimated fat area, although boys have larger estimated muscle area at all ages. While with reduced muscle and body mass one has much higher risk for xerophthalmia, the adiposity of the child also seems to affect risk. These measurements and how they interact to define risk is an area of future research that holds much potential for the formulation of targeting policy.

Attrition at follow-up exams

Not all the children examined at baseline were brought to the central exam site for the 12- and 24-month exams. The study was designed for children between the

ages of 6 months and 10 years. While new children were allowed into the study, older children, after censuses, were not actively recruited for exams unless they were previous cases. Approximately 20% of our baseline sample was lost because of aging (becoming older than 10 years).

Also, many Project areas have population that migrates seasonally, and children might stay with members of the extended family outside the study area after baseline. One site was devastated by a flood, and several wards resettled outside the study area. Unfortunately, some of the children died during the study. There was also loss to the study due to mother's indifference or lack of time to participate in the day-long exams.

Non-responsive Bitot's Spots

A puzzling aspect of Bitot's spots is that they do not always respond to therapy, or if they do, they can, on occasion, reappear. It is generally assumed that the original cause of the appearance of the lesion is related to vitamin A deficiency, but that after sufficient time, it is difficult to alter the morphological changes having occurred due to chronic vitamin A deficiency. It is generally assumed that the risk of non-responsive Bitot's spots increases with age. This is the primary reason that most studies limit their focus to children under 60 months.

At baseline the age group of 12-60 months had the highest proportion of Bitot's spots that were seen at future exams. At subsequent exams, the 60+ month cohort had the highest rate of non-responsive Bitot's spots.

At the 12-month exam, many persistent Bitot's spot cases from the baseline survey were found. All the children had all been previously treated, and their mothers had been given additional capsules. At least 50% of these children were in sites that also received two capsules a year, so some children with persistent Bitot's spots had as many as six capsules since the preceding year.

Figure 3.13 Prevalence of Bitot's Spots Responsive and Non-Responsive to Therapy

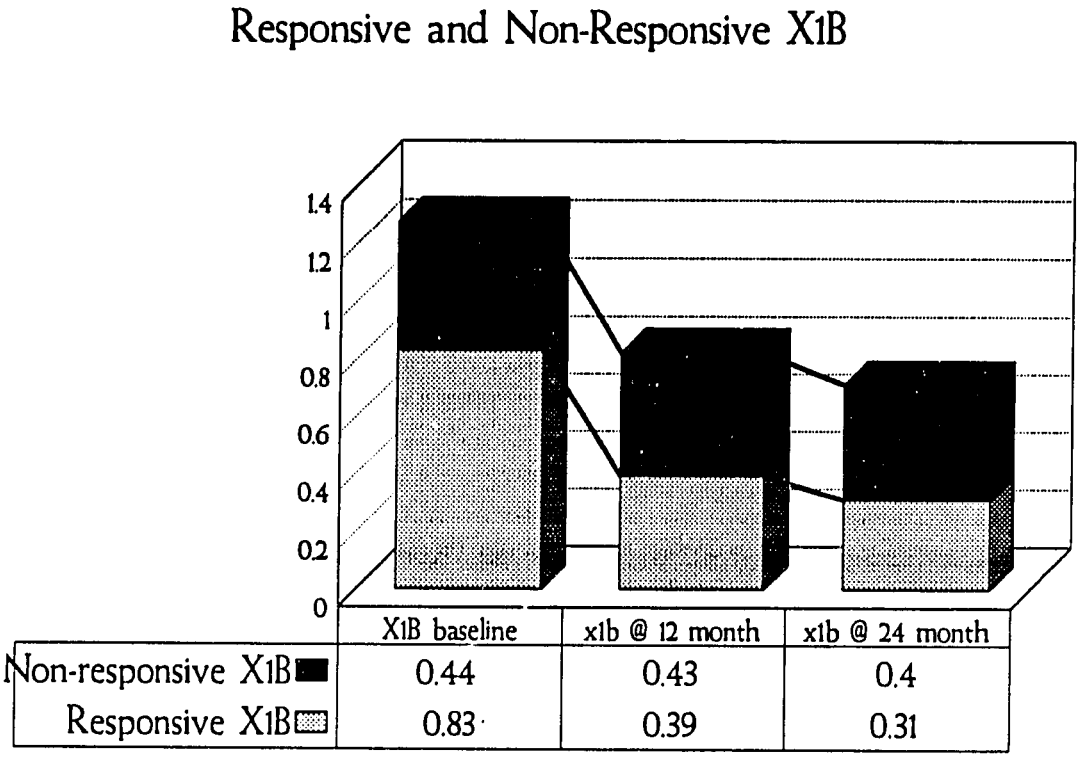


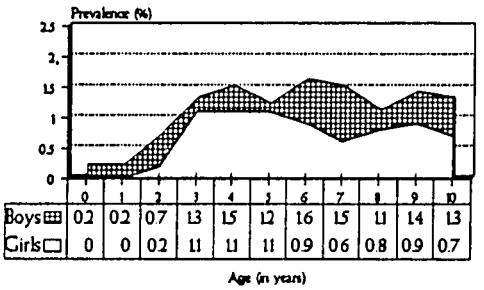
Figure 3.13 shows the total Bitot's spots that were seen in all study areas combined at each of the three examinations, with about one-third of the Bitot's spots at baseline reappearing at the 12- and 24-month exams (non-responsive to therapy). By the 12-month exam, the overall prevalence of Bitot's spots decreases, but of those that are found, 52% are non-responsive. By the 24-month exam, the overall prevalence of total Bitot's spot does not decrease; but the percentage of Bitot's spots found to be non-responsive climbs to 56%. It is not clear to the investigators whether the spot had been eliminated and then reappeared in the high risk season, or had progressed during the 12 months between the exams.

Distribution of Bitot's spots at the 12- and 24-month exams are shown in Figure 3.14. The top charts show the age/sex distribution of all Bitot's spots seen during those examinations. The lower charts show the age/sex distribution of new Bitot's spots in children previously diagnosed as normal.

Figure 3.14 New and Total Bitot's Spots by age and Sex

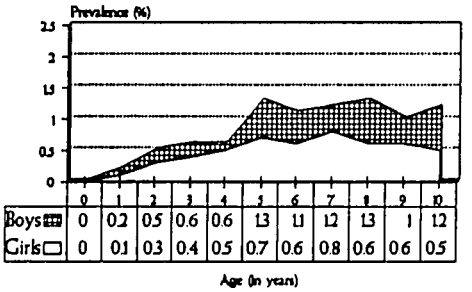
Bitot's Spots by Sex and Age (in years)
at 12 and 24-month Exams

All Bitot's Spots 1990



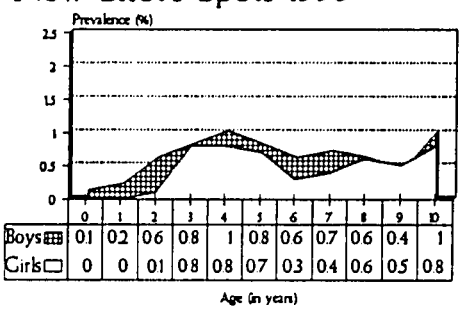
	0	1	2	3	4	5	6	7	8	9	10
Boys	0.2	0.2	0.7	1.3	1.5	1.2	1.6	1.5	1.1	1.4	1.3
Girls	0	0	0.2	1.1	1.1	1.1	0.9	0.6	0.8	0.9	0.7

All Bitot's Spots 1991



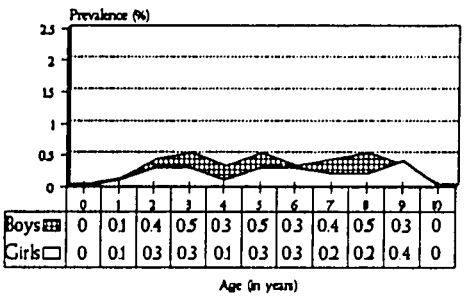
	0	1	2	3	4	5	6	7	8	9	10
Boys	0	0.2	0.5	0.6	0.6	1.3	1.1	1.2	1.3	1	1.2
Girls	0	0.1	0.3	0.4	0.5	0.7	0.6	0.8	0.6	0.6	0.5

New Bitot's Spots 1990



	0	1	2	3	4	5	6	7	8	9	10
Boys	0.1	0.2	0.6	0.8	1	0.8	0.6	0.7	0.6	0.4	1
Girls	0	0	0.1	0.8	0.8	0.7	0.3	0.4	0.6	0.5	0.8

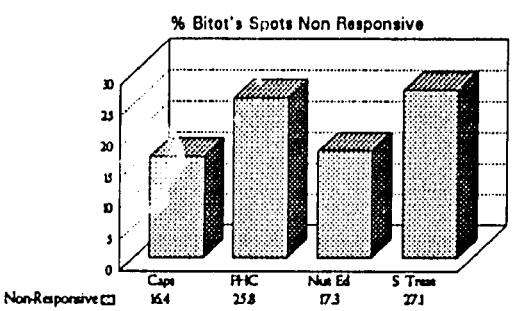
New Bitot's Spots 1991



	0	1	2	3	4	5	6	7	8	9	10
Boys	0	0.1	0.4	0.5	0.3	0.5	0.3	0.4	0.5	0.3	0
Girls	0	0.1	0.3	0.3	0.1	0.3	0.3	0.2	0.2	0.4	0

The decline seen in Bitot's spots in intervention cohorts was greater than in the general population, as by the end of the survey at least 50% of the new Bitot's spots were occurring among the symptomatic treatment cohort.

Figure 3.15 Non-Responsive Bitot's Spots at Baseline

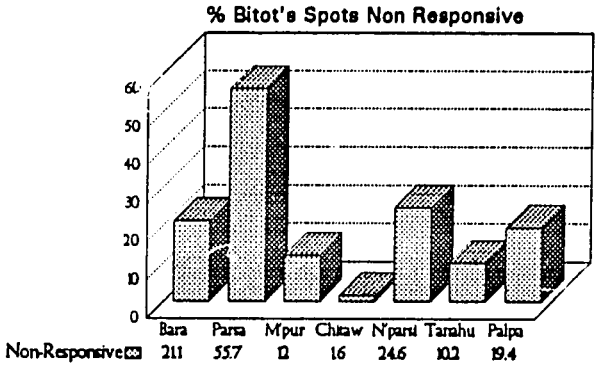


All baseline cases of Bitot's spots were subsequently followed up. Children who were not cured of their Bitot's spots were tagged as having non-responsive Bitot's spots. These baseline non-responsive Bitot's spots did not fall equally cross all the interventions (see Figure 3.15). Both the symptomatic treatment and primary health care cohorts showed a 30% higher risk for non-responsive Bitot's spots.

In addition, risk did not fall evenly across districts (see Figure 3.16). Over 50% of Bitot's spots seen at baseline in Parsa were seen in subsequent exams. In most

of the other districts the level of non-responsive Bitot's spots were between 10-20% of the total Bitot's spots seen. In Chitwan, however, only 1.6% of the Bitot's spots found at baseline did not respond to therapy and were seen in future exams. These districts represented two different terrain types--terai (Parsa) and hills (Chitwan). By terrain, 28.2% of the Bitot's spots found at baseline in the terai were non-responsive, while only 10.5% of the Bitot's spots found in hill areas were non-responsive.

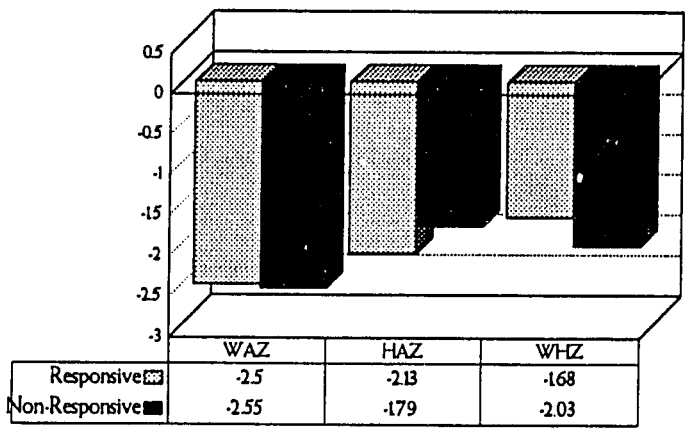
Figure 3.16 Baseline Non-Responsive Bitot's Spots by District



Other factors besides age also seem to influence whether a Bitot's spot will respond to therapy. Children's nutritional status showed a definite risk pattern.

Figure 3.17 distributes baseline risk based on child nutritional parameters. The figure shows the nutritional parameters of responsive and non-responsive Bitot's spots, not the general nutritional status of the population examined. The rates found among cases was somewhat worse for weight-for-age and wasting, but not for height-for-age. Non-responsive Bitot's spots appeared to have slightly better height for age scores and were on average slightly taller than children without Bitot's spots.

Figure 3.17 Nutritional Status of Children with Responsive and Non-Responsive Bitot's Spots



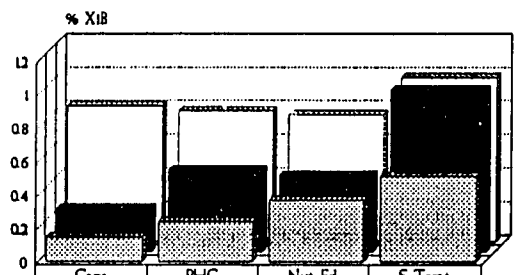
Among children with cases of Xerophthalmia, weight-for-age was similar between responsive and non-responsive Bitot's spots. Children with non-responsive Bitot's spots were taller than those with responsive Bitot's spots, but were more likely to be wasted. This suggests that non-responsive Bitot's spots are more likely to occur

among taller children, who are more likely to be more wasted (have less body mass), thus profiling tall, thin children as being more likely to have non-responsive Bitot's spots.

Record keeping for non-responsive Bitot's spots influences the estimates of program effectiveness. One way to handle these non-responsive Bitot's spots is to eliminate all baseline cases from subsequent recordkeeping. This would eliminate non-responsive Bitot's spots from the 12 and 24-month exam measurements but leave them at the baseline measurement. At baseline, risk for Bitot's spots is unequal across interventions. Across the years, this difference in risk between interventions increases, with the biggest reduction in risk at 12 and 24 months occurring in the cohort of children receiving the mega-dose capsule. Another approach is to eliminate Bitot's spots that turn out to be non-responsive from the baseline measurement. This approach gives results that are shown in Figure 3.18.

Figure 3.18 New X1B at Baseline, 12- and 24-Month Exams by Intervention and Year

New X1B by Intervention Cohort by Year
Non-responsive correction to Baseline



	Caps	PHC	Nut Ed	S Treat
@ 24 mon	0.15	0.24	0.37	0.51
@ 12 mon	0.26	0.49	0.46	0.97
Baseline	0.81	0.78	0.76	0.98

All Baseline Bitot's spots seen @ 12 and 24 month exam excluded from baseline

In this instance, the difference in risk at baseline is reduced, and for the symptomatic treatment group there is little difference in magnitude at the 12-month exam. One drawback to this approach is that it reduces the number of children who appear to have Bitot's spots at baseline.

To statistically summarize relative risk reduction for the programs, we have chosen to use risk for new Bitot's spots (not seen at baseline) between participants at the 12- and 24-month exams. This approach has the advantage of being able to segregate the interventions into their respective activities. It is assumed that none of the activities as fielded in this study are exactly appropriate to the conditions causing Xerophthalmia in Nepal and the limitations of its community health infrastructure. This approach allows policy makers in Nepal not to have to accept a bundle of activities that we have called an intervention, but to selectively choose among activities appropriate for replication in a national program.

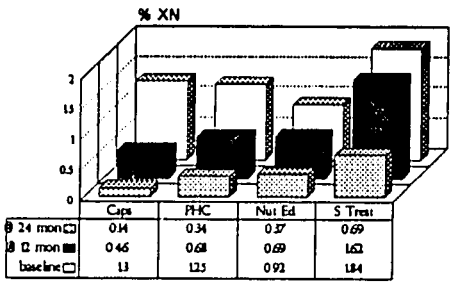
3.2 Program Impact on Specific Health Status Indicators

Two ways will be considered in reviewing the effect of the vitamin A programs on health status as measured by Bitot's spots, xerophthalmia and nutritional status of

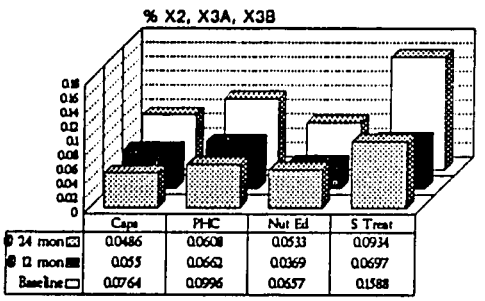
the population. One approach will be to look at the combined effect of the program activities on the aggregate statistics for the entire intervention cohort. The other will be to consider the specified measure of health status outcome between participants and non-participants of Project activities within and across the different interventions.

Figure 3.19 Night blindness, Corneal Xerophthalmia, and Corneal Scarring by Intervention and Year

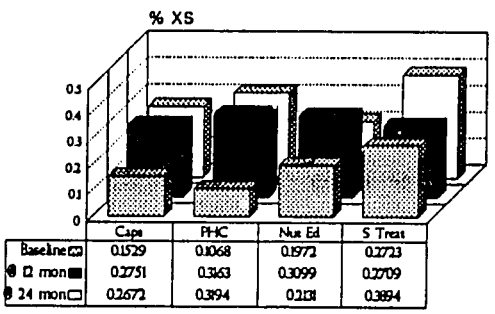
Night Blindness by Intervention Cohort by Year



Corneal Xerophthalmia by Intervention Cohort by Year



Corneal Scarring by Intervention Cohort by Year



Eye signs other than Bitot's spots were monitored throughout the Project. More cases were seen at baseline among the symptomatic treatment cohort for X1B. For night blindness, risk decreased more for the intervention cohorts than for symptomatic treatment. The risk for night blindness is the lowest at the 24-month exam. The ranking of risk between interventions is approximately the same for Bitot's spots.

For the more severe, potentially blinding corneal Xerophthalmia, another pattern appears. While risks for all study subjects decrease between baseline and the 12-month exam, the overall level of risk increases between the 12-month and 24-month exams.

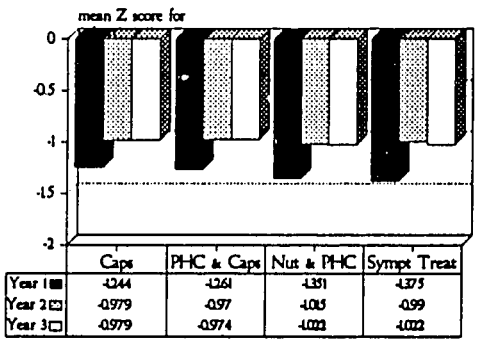
The relative risk for corneal Xerophthalmia starts at a higher level in the symptomatic treatment cohort than in the other interventions, and while for Bitot's spots, the alternatives widen their risk gap, and with corneal eye signs the risk between cohorts stays about the same. One concludes that something other than the interventions was responsible, or at least partly responsible for the decrease seen from baseline to 12 months, and that this was also true at the 24-month exam. In the absence of an uncontaminated control group at the 24-month exam, one can only speculate that the amount of corneal Xerophthalmia might have been even greater

without the interventions.

In comparing the effect of the program activities on nutritional status at the aggregate intervention level statistics, two approaches are used. One is to look at the mean measure of stunting and wasting, and the other is to look at the number of individuals below a specific cut off point considered as wasted and stunted.

Figure 3.20 Mean Weight for Age and Height for Age by Intervention

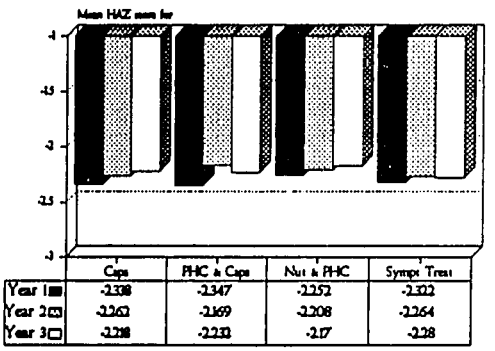
WAZ by Intervention



	Caps	PHC & Caps	Nut & PHC	Sympt Treat
Year 1	-1.244	-1.261	-1.351	-1.375
Year 2	-0.979	-0.97	-1.015	-0.99
Year 3	-0.979	-0.974	-1.022	-1.022

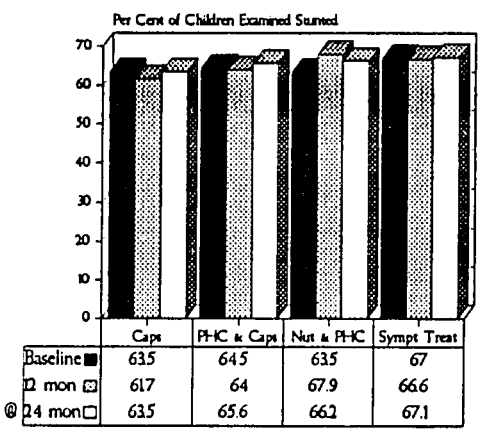
Z scores using WHO/CDC/NCH reference standards

HAZ by Intervention



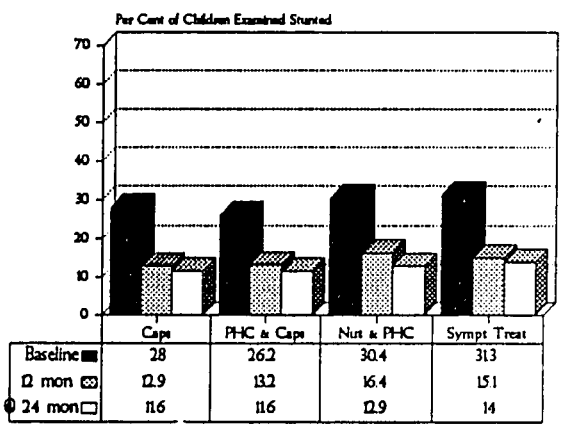
	Caps	PHC & Caps	Nut & PHC	Sympt Treat
Year 1	-2.338	-2.347	-2.252	-2.322
Year 2	-2.262	-2.169	-2.208	-2.264
Year 3	-2.218	-2.233	-2.17	-2.28

Percent Stunted by Intervention and exam period
children 12 -60 months



	Caps	PHC & Caps	Nut & PHC	Sympt Treat
Baseline	63.5	64.5	63.5	67
12 mon	61.7	64	67.9	66.6
@ 24 mon	63.5	65.6	66.2	67.1

Percent Wasted by Intervention and exam period
children 12 - 60 months



	Caps	PHC & Caps	Nut & PHC	Sympt Treat
Baseline	28	26.2	30.4	31.3
12 mon	12.9	13.2	16.4	15.1
@ 24 mon	11.6	11.6	12.9	14

Capsule Distribution

Risk of Bitot's spots and Corneal Xerophthalmia by receipt of Capsule

Table 3.2 shows the distribution of risk of Bitot's spots by program participation at the 12-month exam. This table also shows how the nutritional status of the child, the age and sex category of the child as well as the location of the child effects the relative risk of the activity in reducing Bitot's spots.

Table 3.2 Risk for Bitot's Spots by Receipt of Capsule at 12-Month Exam

CATEGORY N=total sample		X1B Rate with capsule	X1B Rate of No capsules	Relative Risk	(95% ..CI)	Chi Square p-value
Total Sample		**0.30**	**0.67**	**0.45**	**(0.33 , 0.60)**	********
By Intervention	Capsule	0.17	0.66	0.27	(0.13 , 0.56)	****
	PHC & Caps	0.37	0.49	0.75	(0.38 , 1.48)	N.S.
	Nut Ed & PHC	0.51	0.35	1.48	(0.24 , 5.19)	N.S.
	Sympt Treat	3.47	1.04	3.34	(1.22 , 7.93)	***
By Nutritional Status of Child	Normal	0.46	0.86	0.54	(0.35 , 0.84)	***
	Stunted alone	0.18	0.53	0.34	(0.21 , 0.58)	****
	Wasted alone	0.58	0.55	1.04	(0.37 , 2.93)	N.S.
	Wasted & Stunted	0.43	0.89	0.49	(0.16 , 1.27)	N.S.
By Age of Child	0-4 years	0.30	0.65	0.47	(0.30 , 0.74)	****
	5-9 years	0.28	0.70	0.40	(0.27 , 0.61)	****
By Sex of Child	Boys	0.31	0.76	0.41	(0.27 , 0.61)	****
	Girls	0.29	0.58	0.51	(0.33 , 0.79)	***
By Area	Urban	0.00	0.28	0.00	(0.00 , 3.41)	N.S.
	Rural	0.31	0.68	0.46	(0.34 , 0.62)	****
By Terrain	Hills	0.00	0.12	0.00	(0.00 , 0.46)	***
	Terai	0.44	1.00	0.44	(0.33 , 0.60)	****

Note to this and future relative risk tables:

(a) Relative risk is the Bitot's spot rate seen in the participants divided by the risk of Bitot's spots seen in the non-participants. Lower relative risk implies greater impact of that activity on the health status of the intervention or population sub-group.

(b) 95% CI is the 95% confidence interval around the relative risk.

(c) The stars in the significance columns should be interpreted as follows:

N.S. = >0.1 * = <0.01 ** = <0.05 *** = <0.001 **** = <0.0001

Capsule receipt is associated with an overall reduction of risk for Bitot's spots that is significant at baseline. In the nutrition education and symptomatic treatment

cohorts, capsules were given to children with eye signs or who were ill; so it is associated with increased risk in those areas. In the capsule cohort risk reduction is 0.27. This suggests that the capsule, when given by itself, is much more productive in reducing risk for Bitot's spots, than when given with Mabendazole (as was done in the primary health care cohort). The relative risk is higher in the primary health care than the capsule cohort and it is not a statistically significant reduction in risk.

The capsule appears to be the most effective if the child receiving it is either normal or stunted. Children that are wasted alone and receive the capsule at the 12-month exam have approximately the same risk as children that don't receive capsules. Wasting is widespread in Nepal, and is a significant obstacle in the introduction of an effective national vitamin A deficiency control effort.

The effect of the capsule distribution program was slightly higher on Bitot's spots at the 12-month exam in older children (> 60 months) than in younger children. Its effect on girls was also slightly less than on boys.

Children in urban areas who received capsules had no Xerophthalmia, while Xerophthalmia was seen in children who did not receive capsules. However, the small numbers of children who reported receiving capsules in urban areas at the 12-month exam make this finding insignificant. Likewise, children in the hills who had received capsules at the 12-month exam had lower risk for Bitot's spots, and in this case it was significant. The relative risk of a child who had received a capsule in the terai was 0.4.

The effect of the vitamin A capsule program on corneal eye signs is somewhat less than on Bitot's spots (see Appendix D).

Risks between participants and non-participants at the 12-month exam for corneal Xerophthalmia are not significantly different, partly due to the a small number of cases of corneal Xerophthalmia as compared to Bitot's spots. Also, the capsule is not as effecacious against corneal Xerophthalmia for children receiving it. In the primary health care cohort, risk is reduced in participants, but not enough to be significant.

Wasted children who received capsules did not develop corneal Xerophthalmia, even though their risk for Bitot's spots was unaffected. Again, the capsule appeared to have more of an effect in older children, and those residing in urban and in hill areas. While these differences are similar to the reductions for Bitot's spots and corneal Xerophthalmia at the 12-month exam, they did not appear to have an affect on the level of risk.

By the 24-month exam, the reduced overall risk in all intervention cohorts is beginning to cloud the significance of capsule distribution. While the relative risk is significant for all interventions combined, when one looks across interventions, there is

no significant difference in risk of Bitot's spots between the children who received capsules and those who did not. In the primary health care cohort, receipt of a capsule is associated with an increased risk (by 50%) for Bitot's spots. The prevalence of Bitot's spots is much higher in the non-capsule cohorts at 24 months, so that overall, receipt of a capsule is associated with reduced risk. However, it does appear that capsule cohorts had the greatest reduction of risk for Bitot's spots over the study, but at 24 months, it appears that the capsule distribution intervention was also influencing the risk of Bitot's spots for those children not receiving the capsule (Appendix C).

Older children at the 24-month exam were at lower risk if they participated, and girls' risk for Bitot's spots was reduced more than boys' risk. Like the 12-month exam, there were no cases of Bitot's spots in urban children that received capsules, but again it was not significant. And while the reduction of risk appeared to be greater in the hills, it was only significant in the terai.

The lack of impact of the capsule program on corneal eye signs seen at the 12-month exam is reinforced by the results of the 24-month exam (Appendix C). The overall relative risk for corneal Xerophthalmia is increased among children receiving capsules over those not receiving capsules, but it is not significant. The capsule areas and primary health care participation as reported by the mothers appears to have captured all the risk for corneal eye signs, and in the 20% of the children not participating, no corneal eye signs occur. While it is impossible to calculate relative risk under this condition, children who are ill and underweight are more likely to participate in the program than children who are well and normally nourished[44]. In that light, mothers of children at greater risk for Xerophthalmia had made sure their children had participated, and non-participating children were not at so much risk for corneal Xerophthalmia.

One major difference in risk worthy of note is in the terrain. Children who received capsules at the 24-month exam in the terai were at significantly increased risk for corneal Xerophthalmia. While increased risk that is non-significant can be explained by increased participation of high risk children, the level of significance here suggests something else is happening.

Risk of Wasting and Stunting by receipt of capsule

The capsule distribution activity was associated with reduced risk for wasting at the 12 and the 24-month exam, but had no apparent impact on overall risk of stunting as measured by percentage of the children < -2 S.D. height per age. However, within different population sub groups there were several interesting differences in risk.

The risk of wasting was lower in the children not receiving capsules than those participating in the capsule intervention cohort, but in the PHC cohort receipt of capsule is associated with a lower risk for wasting. However, the overall risk of wasting for the participants within the capsule cohort is lower than in any other cohort

of participants or non-participants, suggesting that there is a reduction in this cohort as well as the PHC cohort. Increased risk in the symptomatic treatment cohort reflects the targeting of capsule distribution to high risk children who were ill during the baseline exam.

The overall risk reduction for wasting at the 24-month exam between children who received capsules and those that didn't continued to be important. The risk was lower for children receiving capsules than for children who didn't, and the lowest overall risk was in the capsule cohort, suggesting that the capsule by itself could reduce the risk for wasting.

Table 3.3 Wasting by Receipt of Capsule at 12- and 24-Month Exams

at 12 months		Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		**12.13**	**14.42**	**0.84**	**(0.80 , 0.88)**	********
by Intervention	Capsule	12.12	10.13	1.20	(1.04 , 1.37)	**
	PHC & Caps	12.64	12.97	0.97	(0.87 , 1.09)	N.S.
	Nut Ed & PHC	15.22	15.14	1.01	(0.78 , 1.30)	N.S.
	Sympt Treat	19.23	13.66	1.41	(0.99 , 2.01)	*
by Area	Urban	8.18	13.02	0.63	(0.45 , 0.87)	***
	Rural	12.64	13.92	0.91	(0.86 , 0.95)	****
by Terrain	Hills	6.84	5.15	1.33	(1.16 , 1.51)	****
	Terai	14.98	18.85	0.79	(0.75 , 0.84)	****
at 24 months						
Received Vitamin A Capsule		**11.12**	**12.50**	**0.89**	**(0.85 , 0.94)**	********
by Intervention	Capsule	10.50	10.81	0.97	(0.82 , 1.15)	N.S.
	PHC & Caps	11.48	11.39	1.01	(0.85 , 1.19)	N.S.
	Nut Ed & PHC	14.41	12.73	1.13	(0.83 , 1.55)	N.S.
	Sympt Treat	15.97	12.59	1.27	(0.96 , 1.68)	N.S.
by Age of Child	1-5 years	11.48	13.21	0.87	(0.80 , 0.94)	****
	5-10 years	10.85	11.96	0.91	(0.85 , 0.97)	***
by Sex of Child	Boys	11.72	13.68	0.86	(0.80 , 0.92)	****
	Girls	10.47	11.21	0.93	(0.86 , 1.01)	*
by Area	Urban	12.31	21.36	0.58	(0.45 , 0.74)	****
	Rural	11.08	12.29	0.90	(0.85 , 0.95)	****
by Terrain	Hills	6.29	6.01	1.05	(0.92 , 1.19)	N.S.
	Terai	13.29	15.97	0.83	(0.79 , 0.88)	****

For Key refer to Table 3.2.

Although associated with decreased risk for wasting, the capsule does not seem to affect the overall rates of stunting found with the study. However, within different sub-groups it appears to have significant opposite effects that are canceling each other. Stunting appears to be more common in children older than 60 months that had the capsule at both the 12- and 24-month exams, while in children under 60 months the risk for stunting is at the same time reduced significantly for both exams. In the hills, children who received capsules were at significantly reduced risk of stunting, while in the terai they were at increased risk of stunting.

Table 3.4 Stunting by Receipt of Capsule at 12- and 24-Month Exams

at 12 months		Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		**60.60**	**60.86**	**1.00**	**(0.98 , 1.01)**	**N.S.**
by Intervention	Capsule	59.33	55.08	1.19	(1.08 , 1.31)	****
	PHC & Caps	61.09	53.04	1.39	(1.28 , 1.51)	****
	Nut Ed & PHC	61.65	61.30	1.02	(0.81 , 1.27)	N.S.
	Sympt Treat	56.59	60.51	0.85	(0.60 , 1.21)	N.S.
by Age of Child	1-5 years	63.22	66.02	0.96	(0.94 , 0.98)	****
	5-10 years	57.84	55.63	1.04	(1.01 , 1.07)	***
by Terrain	Hills	74.16	74.74	0.99	(0.97 , 1.01)	N.S.
	Terai	54.09	51.03	1.06	(1.04 , 1.08)	****
at 24 months						
Received Vitamin A Capsule		**59.29**	**59.37**	**1.00**	**(0.98 , 1.01)**	**N.S.**
by Intervention	Capsule	60.19	55.97	1.08	(1.02 , 1.13)	***
	PHC & Caps	58.66	56.44	1.04	(0.99 , 1.09)	N.S.
	Nut Ed & PHC	59.41	59.79	0.99	(0.89 , 1.10)	N.S.
	Sympt Treat	52.87	59.68	0.89	(0.79 , 0.99)	**
by Age of Child	1-5 years	64.33	66.24	0.97	(0.95 , 0.99)	***
	5-10 years	55.55	54.11	1.03	(1.00 , 1.05)	**
by Area	Urban	53.42	46.31	1.15	(1.03 , 1.29)	**
	Rural	59.52	59.68	1.00	(0.98 , 1.01)	N.S.
by Terrain	Hills	72.45	75.10	0.96	(0.95 , 0.98)	****
	Terai	53.42	50.29	1.06	(1.04 , 1.09)	****

For Key refer to Table 3.2.

Primary Health Care

The primary health care program was comprised of selective activities designed to help the mothers better manage common childhood infections that are often associated with xerophthalmia, malnutrition, and childhood mortality.

Primary health care activities were made available to approximately 50% of the total study population. At the 12-month and 24-month exam, information was gathered on each child's participation from their primary caretaker. In the case of deworming, all the children were questioned about their participation. In the case of immunization, information was only collected on children 12 to 24-months of age, to comply with the WHO-recommended immunization coverage surveillance approach. This precludes assessment of risk reduction associated with immunization for the older ages (which are more at risk).

Oral rehydration therapy and therapy for severe acute respiratory infection were dispensed by the primary care taker reporting a case of severe diarrhea, or severe acute respiratory infection within the preceding 12 months. Only if the child had reported a severe case of one of these diseases was information on the utilization of any of these activities asked. For a child to have utilized one of these interventions, they would have had a severe case of illness. Children not utilizing these activities were less likely to have a severe episode of diarrhea or acute respiratory infection in the preceding 12 months.

While these activities were effective in some sub-groups in promoting reduced risk for wasting or stunting the first year, during the 24-month period, during the food shortage, only immunization retained its association with reduced risk.

What became apparent during this Project was the counter-productive nature of promoting linear growth without weight gain. Worse yet during the times of food shortage, activities that promote primarily linear growth or increase the basal metabolism rate, appear to increase risk for wasting.

The effect on the primary health care activities on the nutritional status of the study population then was not nearly as straight forward as one might have expected.

Risk of Bitot's Spots and Corneal Xerophthalmia / PHC Deworming

The report of participation in deworming activities at the 12-month exam was associated with a slightly decreased risk for Bitot's spots, but the difference between those participating and those not participating was insignificant. The relative risk at the 12-month exam was lowest in children in the primary health care cohort. In the nutrition education cohort, deworming is associated with a 10% increase in risk for Bitot's spots, and in the symptomatic treatment, where it was targeted to ill children at examination, there was a 130% increase in risk.

Risk for Bitot's spots among dewormed children increased among children who were only wasted (not stunted). It appeared to reduce risk the most among children that were only stunted (not wasted). Refer to Appendix C.

The age group that showed a significant positive benefit at the 12-month exam was children over 60 months old, where deworming reduced risk for Bitot's spots by over 30%, while in the younger children it appeared to be associated with a 10% (insignificant) increase in risk among children under 60 months. There was no important difference of risk by sex or terrain, and no children in urban sites that had been dewormed had Bitot's spots at the 12-month exam.

Where deworming appeared to have the most positive impact at the 12-month exam was on the risk for more severe corneal eye signs such as corneal xerosis (X2), corneal ulceration (X3A), and Keratomalcia (X3B). The difference in risk for these rare events was much reduced for children that were dewormed. This was especially true in those areas where the deworming activities were promoted as part of the intervention. Refer to Appendix C.

The reduction of risk for corneal zerophthalmia appeared to be the greatest at the 12-month exam for children who were wasted and stunted. The risk reduction for normal children was much less, and was insignificant. No "only wasted" child who reported being dewormed had corneal Xerophthalmia, but children both wasted and stunted who participated appeared to be at much less risk.

While the deworming reduced risk in children above and below 60 months for corneal eye signs, the reduction of risk was greatest in the younger children. The same activity that decreased risk for corneal eye signs, increased risk for Bitot's spots at the same time. It was also significantly more effective for boys than for girls in reducing for corneal eye signs. It reduced risk in all locations, but was significant for rural areas and the terai.

By the 24-month exam the effect of deworming remains approximately the same, associated with lower but insignificant risk for Bitot's Spots. That risk remains the same in the nutrition education cohort, suggests that the net effect of deworming on the dynamics of endemic vitamin A deficiency with massive household food insecurity has little positive effect on risk for Bitot's spots. One concludes either that the capsule and deworming programs increase risk for Bitot's spots, or that at-risk mothers in this cohort were more likely to be misinformed about participation.

The risk of Bitot's spots does not appear to be reduced for dewormed, well nourished children. The greatest risk reduction is for marginal children who were either stunted or wasted. While the risk for wasted and stunted children is increased by deworming, none of the nutrition parameters differ by a statistically significant level. Refer to Appendix C.

Deworming in younger children again appears to increase their risk for Bitot's spots at the 24-month exam, although again it is insignificant. The reduction of risk for Bitot's spots does not appear to be much affected by location, except in that no

children in urban areas who were dewormed developed Bitot's spots.

In the presence of extensive household food insecurity at the 24-month exam, deworming appeared to lose its beneficial effect on risk reduction for corneal eye signs (being associated with a 50% increase in risk for corneal eye signs). When deworming takes place with a vitamin A capsule, or when only a small proportion of the children are dewormed, as with the symptomatic treatment group, deworming appears to still reduce risk for corneal eye signs. In the nutrition education cohort, while it reduces risk for Bitot's spots, it appears to increase risk for corneal eye signs. This increased risk at the 24-month exam would have been significant if only one case of corneal eye signs had been found among the non-participants.

An insignificant reduction of risk is seen in children who have normal nutritional status, while in all classes of malnutrition, overall risk is increased. In stunted children, who had shown significant reduction of risk in the previous year, had at the 24-month exam an association with increased risk for corneal Xerophthalmia. Refer to Appendix C.

In children under 60 months of age, risk was significantly increased for corneal Xerophthalmia at the 24-month exam. Boys appeared to be more at risk than girls. No cases of corneal Xerophthalmia were found in urban sites.

This popular intervention received enthusiastic support from mothers. It has great potential for reducing risk for certain segments of the population if targeted correctly to specific children. Universal coverage in times of food insecurity appears to have some complications in the ecology of malnutrition.

It would be logical to feel that reducing the worm load of children would have stronger beneficial effects in times of household food insecurity as it reduces calories wasted by maintaining *Ascaris lumbricoides* nutritional needs, and the diarrhea often associated with worm infestation. It should be considered that dewormed children often experience growth spurts. During these periods of rapid growth the overall caloric needs of children increase to support body building activities. When overall metabolism needs, to maintain appropriate balance, increase and the basal metabolism rate increases.

This increased caloric demand seems to have little significance for overall risk of Xerophthalmia in times of caloric sufficiency, as in the 12-month exam, but appears to play a crucial role in defining risk when the needs of the body exceed the available caloric supply. The role of nutritional status in defining risk at the 24-month exam suggests that deworming, especially in younger children during times of food insecurity, should be accompanied by caloric supplementation.

Risk of Wasting and Stunting / PHC -- Deworming

At the 12-month exam children who were dewormed were at a slightly increased but insignificant risk of wasting in the overall study population. Within the primary health care and nutrition education cohort however, the risk for wasting was increased significantly for children who were dewormed as compared to those that were not. The greatest difference in risk was in the primary health care cohort where children were dewormed and then dosed with vitamin A seven days later. By the 24-month exam children who were dewormed were still at a higher but insignificant risk for wasting than children not dewormed. Within the primary health care and nutrition education cohort the risk of wasting was reduced by deworming. The switch in direction of risk of wasting after time, could be due to any number of factors, but this suggests that while it may take time, in programs that increase a child's metabolism rates, for the child's body mass to catch up with the linear growth of the body, this catch up process may eventually occur, even in times of poor household food security. Refer to Appendix C.

The risk for stunting was much like the risk for wasting. In the first year, it increases the risk of the child for stunting in the primary health care by 32% and in the nutrition education cohort by 14%, with increased risk in the hills and rural areas. By the second year it gave mixed results with significant reduction of risk in the capsule cohort, and an insignificant risk increase for the nutrition education area. Refer to Appendix C.

It would appear that a therapy that reduces the caloric wastage associated with high levels of infestation of worms (over 80% at baseline) would benefit the nutritional status of the population. In some instances it appears to have done so; however, in general it appears that the children who did not receive therapy grew better than the children who did. This suggests that this activity, while the only intervention to significantly affect blinding xerophthalmia, did little to improve the overall nutritional status of the children who participated in it.

It is expensive, but it has the support of the mothers of the community. One might speculate that the effect of mild and moderate worm loads is to maintain the body at lower basal metabolism rate, and more at balance with reduced caloric availability. However, it remains to be seen what the effect of deworming will be under-conditions where the food supply is adequate. What is apparent for Nepal, is that deworming must be more targeted to children with symptoms, and not distributed universally. Universal deworming should only be done in areas of food adequacy, or under programs with food supplementation distribution, to ensure adequate growth of the child after deworming.

Risk for Bitot's spots and Corneal Xerophthalmia / PHC -- ORT

The use of oral rehydration therapy (ORT) for diarrhea had been widely promoted and was utilized throughout the Project areas in all interventions. The reduction of risk for Xerophthalmia associated with this utilization is generalized throughout the study area, and is generally insignificant except in specific sub-populations. Unlike deworming, it is never associated with increased risk. Refer to Appendix C.

The risk for Bitot's spots at the 12-month exam decreased for children who were reported to have utilized ORT for severe diarrhea, although this was insignificant throughout the general population. The difference in risk was significant, however; in children who were normal and wasted, as well as among children under 60 months. This intervention appeared effective across all areas, more so in urban than rural areas, though the difference was insignificant. The difference in risk was significant, however; for children living in the terai, although the relative risk was similar but insignificant in the hills.

The risk for corneal eye signs was also reduced 37% among children who were reported as having utilized oral rehydration therapy for diarrhea. This risk reduction was only statistically significant only for stunted children. Children in the nutrition education area, and children with nutritional status of normal or "wasted alone," who had corneal Xerophthalmia all reported utilizing ORT, and no cases were reported among children not utilizing this activity.

The lower risk for Bitot's spots for children reported to have utilized oral rehydration therapy continued to be observed at the 24-month exam, regardless of deteriorating food security. This appears to be especially true for children in the primary health care and nutrition education cohort. The risk reduction is only significant in the nutrition education cohort.

The poorer the nutritional status of children, the greater the beneficial effects of participation appear, although it is insignificant. The only increased risk seen is for girls, and it is insignificant.

The risk for corneal Xerophthalmia by utilization of oral rehydration therapy at 24-months is even more pronounced than it had been at the 12-month exam, but the risk difference was non-significant. The lowest risk reduction for corneal Xerophthalmia seen was in the capsule distribution program, but it was insignificant. The most significant reduction in risk was among children over 60 months of age.

Reduction of risk is pronounced and significant across sex and location, as shown in Appendix C, Table D.4.

Utilization of oral rehydration therapy appears to reduce the risk for all signs

and symptoms of Xerophthalmia. Further increasing the availability of ORT and promoting its utilization should help reduce the amount of Xerophthalmia occurring in program areas. Its effects are particularly beneficial with vitamin A capsules, but its effectiveness in reducing risk for corneal Xerophthalmia appears to be compromised by deworming at the 24-month exam.

Risk of Wasting and Stunting / PHC -- ORT

Oral Rehydration therapy is an activity that also has mixed effect on the nutritional status of the children who participate. The risk for wasting was insignificantly increased at the 12-month exam for children who had diarrhea and were treated with oral rehydration therapy over those children with diarrhea that did not receive oral rehydration therapy. By the 24-month exam this increased risk for wasting was significant with significant increase in the capsule and symptomatic treatment cohort, and a decrease in risk of wasting by ORT in the primary health care cohort (Appendix C).

This increase in wasting is caused by a decrease in risk for stunting. That is, on average the child whose diarrhea has been treated with oral rehydration therapy has grown taller than the child whose diarrhea was untreated. While the child has on the average grown taller, they have not gained weight in proportion to the gain in height, hence the same body mass is stretched over a longer frame and the child is more wasted.

Risk for Bitot's spots and Corneal Xerophthalmia / PHC -- ARI Treatment

Therapy for severe acute respiratory infection was new to study participants. Village health workers and CHVs were unsure and reluctant at first and there was little demand from mothers in the study area until community motivation material became available and mothers began to understand its benefits.

Unlike oral rehydration therapy, which was widely available in the study areas, co-trimoxazole was only given to VHWs and CHVs in the primary health care and nutrition education cohort areas. In other areas it was available from health posts and was often given to ill children during exams.

At the 12-month exam, the risk for Bitot's spots was 28% lower in children who reported having acute respiratory infection in the last year and who had utilized co-trimoxazole. This difference was insignificant. The differences in risk between cohorts suggest that co-tri therapy for severe ARI played no role at all in differentiating risk for children in the areas where it was widely available in primary health care and nutrition education cohorts, and played a more crucial role for those children whose mothers had sought care from the health post or examination team in the other areas,

although the difference in risk is insignificant. Refer to Appendix C.

Co-trimoxazole therapy for ARI appears to be most effective in reducing risk among normal children, and to increase risk for children who are "wasted alone." Risk among younger children seems to be reduced more than among older children, and in the hills more than in the terai. Again, these observations are not statistically significant, although if the study had been larger they would have been.

Corneal Xerophthalmia at the 12-month exam was reduced overall among the population, but the reduction was both slight and insignificant. None of the children reported as having received treatment in the capsule and symptomatic treatment cohort had developed corneal Xerophthalmia at this examination. Refer to Appendix C.

Co-trimoxazole therapy tended to reduce risk for corneal Xerophthalmia across nutritional status categories, but was associated with an increased risk among children older than 60 months. There was no difference in risk by sex. Children in the terai who received therapy appeared to have an elevated risk for corneal Xerophthalmia at this observation.

By the 24-month exam, co-trimoxazole therapy was associated with an increased risk for Bitot's spots, although insignificant. Risk for Bitot's spots was increased across all intervention cohorts except for primary health care. It was also observed to increase in children who had normal nutritional status or were stunted alone, while in children who were wasted alone or stunted and wasted risk was reduced (Appendix C).

The increase of risk for Bitot's spots seen at the 24-month exam was seen in both younger and older children, and in both sexes. In the hill area, where the household food insecurity situation was not as acute as in the terai, the utilization of co-trimoxazole therapy was associated with decreased risk for Bitot's spots.

Although none of these results were significant, co-trimoxazole was associated with increased risk for Bitot's spots at the 24-month exam and its reported utilization was associated with decreased risk for corneal eye signs at the same time. This trend was found for every intervention cohort except nutrition education, where no corneal Xerophthalmia was found in children not reporting utilization of co-trimoxazole therapy for acute respiratory infection. There was less risk reduction in normal children than among stunted or wasted children. Older children receiving therapy for ARI did not develop corneal Xerophthalmia, while in younger children, risk was increased. No girls reported to have received co-trimoxazole therapy developed Xerophthalmia, while boys receiving the therapy had a higher risk for corneal Xerophthalmia. Again, none of the results were significant (Appendix C).

Risk of Wasting and Stunting/ PHC -- ARI Treatment

At the 12-month exam children who had severe acute respiratory infection that had received therapy were at much lower risk for wasting than children who had severe acute respiratory infection and had not received therapy. At the same time, treated children were at increased risk of stunting, and had not grown more in height than had untreated children but gained weight, suggesting that the decreased risk for wasting was a matter of gaining more weight after an episode of severe disease (Appendix C).

This theory would make more sense if the situation had not reversed itself at the 24-month exam, when treatment of severe acute respiratory infection was associated with a significant increased risk of wasting and a decreased risk of stunting. This switch in impact from reducing risk from wasting to increasing risk for wasting and promoting growth, suggests that the nature of the participants also changed from the 12-month to the 24-month examination, and that the VHWs and CHVs may have begun to preferentially use the treatment on cases that were wasted.

Risk of Bitot's Spots and Corneal Xerophthalmia/ PHC -- Immunization

Eighty percent of the children were immunized by the expanded program of immunization (EPI) in all study areas. While immunization coverage was higher in the primary health care and nutrition education cohorts than in the capsule and symptomatic treatment cohorts, coverage was not particularly low in any cohort for any vaccination.

The Project collaborated closely with the Ministry of Health's expanded program of immunization, and one of the first steps of the collaboration was when the Project agreed to limit its collection of information about immunization coverage to children 12 to 24 months old, so that our district-level coverage figures would be in line with suggested WHO surveillance guidelines. While this did limit us in determining the effectiveness of immunization on risk for Xerophthalmia in older ages (where risk is greatest), it should be noted from the baseline data, that overall coverage in the study area was above 80%, and there was little difference in risk between children who had been immunized and those who had not.

Although overall risk for Bitot's spots was less than 0.25% at the 12-month exam, the children who were fully immunized had a lower level of risk (46% less), but it was insignificant due to the small number of children and the low level of risk. At the 24-month exam, immunization coverage was no longer associated with risk reduction and it remained insignificant (Appendix C).

The risk reduction for corneal Xerophthalmia was also large (46%) but insignificant at the 12-month examination. By the 24-month exam, no corneal cases were found among children either immunized or not immunized in the 12 to 24 month age cohort.

The primary health care activities were well accepted by the population. Risk decreased overall in this cohort, but not as much as in the capsule intervention cohort. Oral rehydration and immunization were consistently associated with insignificantly reduced risk, which suggests only a marginal contribution to the child's health. The results from co-trimoxazole therapy and deworming are both positive and negative. Under the circumstances found in the study area during this activity (household food shortage), their effect is probably diminished.

Risk of Wasting and Stunting/PHC – Immunization

Immunization is the one public health activity promoted by the Project that consistently reduced the risk for both wasting and stunting. The effect of activity on reducing infection in this cohort of children had and measurable nutritional benefits within the first year after the exam.

The effect of immunization on wasting is not significant at either the 12 or 24-month exam, but this is because only children aged 12-24 months are included in the analysis, and the number is small as compared to the risk comparison for other activities. At the 24-month exam, the difference of risk in the terai is strong enough that the difference is significant for that sub-cohort (Appendix C).

The decrease in risk for stunting is strong enough that it is significant for the immunization. Children fully immunized grow taller than children not immunized. This is true for all interventions and locations. The significance is lower at the 24-month exam, suggesting that limited caloric intake in children may also modify the biological response to immunization (Appendix C).

Nutrition Education

The nutrition education activities were targeted to the mothers. While primary health care activities were undertaken in these areas for the children, the primary focus in training was on changing mothers' attitudes and practice regarding the dietary needs of their children. Primary health care activities interested mothers most. Therefore, while delivering PHC activities, village health workers were encouraged to teach mothers to alter their feeding patterns, and to pass the message along to other mothers. Very few of the mothers participated fully in this program and made all of the behavioral changes promoted in the nutrition education cohort, however, many mothers grasped at least a portion of the information disseminated, and stunting and wasting risk like xerophthalmia risk was significantly affected.

Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: Mothers Know Importance of Vitamin A

Specific knowledge about vitamin A deficiency was measured, such as whether mothers thought that vitamin A was important to their children's health. By the time of the 12-month exam 96% of mothers had heard that vitamin A was important for their children's health (Table 3.5).

Table 3.5 Risk of Bitot's Spots by Mother Knowing Vitamin A is Important at the 24-Month Exam

	% Participation	X1B Rate of participants	X1B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance	96.76	0.29	1.45	0.20	(0.07 , 0.67)	****

For Key refer to Table 3.2.

Children of knowledgeable mothers had a 80% lower risk for Xerophthalmia than the children of the small number (3.24%) of mothers who did not know it was important. However, the knowledge that vitamin A was important did not keep these mother's children free from corneal Xerophthalmia at the 12-month examination (Appendix C).

By the 24-month exam, even more mothers were aware of the importance of vitamin A. It retained its importance for reduced risk for Bitot's spots, and was associated with significantly lower risk for corneal Xerophthalmia (Appendix C).

Mothers not knowing the importance of vitamin A have children who are at increased risk for Xerophthalmia throughout all intervention cohorts, but the difference is significant only in the primary health care cohort. This knowledge is associated with the lowest significant Bitot's spots risk reduction for normal children at 24 months, although risk was reduced in all nutritional status categories. Knowledge of vitamin A's importance was significant in the risk for children older than 60 months, but risk was also reduced for younger children. Even though there were no cases of Bitot's spots among knowledgeable mothers in urban areas, it was insignificant because of the small number of observations in this category. The reduction of risk was not nearly as great in rural areas, but it was significant because of the larger number of mothers.

At the 12-month exam, knowing vitamin A was important to child health was not very important in determining risk for corneal Xerophthalmia, but by the 24-month exam it was. Risk for corneal Xerophthalmia at this measurement, at the end of a household food-shortage period, was very much related to whether mothers thought that vitamin A was important to child health. This held for all intervention cohorts.

This measurement was more significant for stunted children than children of normal nutritional status.

The risk reduction for corneal Xerophthalmia at the 24-month exam was greater in children under 60 months than children over 60 months whose mothers knew vitamin A was important. This is the opposite of what was found for Bitot's spots at the same time period. By the 24-month period very little corneal Xerophthalmia occurred in either urban areas or the hill areas, but in the rural area of the terai, the mother's knowledge of vitamin A importance still appeared to be significantly reducing Bitot's spot risk.

Risk for Wasting and Stunting/Nutrition Education: Mothers Know Importance of Vitamin A

As mentioned in both the participation section and the xerophthalmia section, the majority of mothers knew that vitamin A was important to their child's health. At the twelve month exam mothers who did not know vitamin A was important were at substantially higher risk for wasting than children of mothers who did know it was important, thereby giving the children of mothers who did, a significantly reduced risk for xerophthalmia. Even though the risk for mothers who knew that vitamin A was important at baseline was approximately the same at the 24-month exam as the 12-month exam, the risk of wasting among mothers who did not know vitamin A was important had improved, so that the difference in risk between these two cohorts was no less, and no longer significant overall. Among the primary health care cohort, it was still associated with significant reduction of risk of wasting at 24 months, while in the hill areas it was, at the 24-month exam, associated with increased risk of wasting (Appendix C).

The effect of the mothers knowing the importance of vitamin A on stunting also followed a different pattern at the different exams. At the 12-month exam knowledge of the importance of vitamin A was associated with a small but significant increase risk for stunting. In the hills; however, at the 12-month and 24-month exams, the knowledge that vitamin A was important was associated with a significant decrease in risk for stunting. At the 24-month exam also it was associated with a decreased risk in the nutrition education cohort, among younger children and children living in the hill sites (Appendix C).

Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: Mothers Know Foods with Vitamin A

A more rigorous knowledge measure for the literacy program is success in identifying which of six foods contain vitamin A. Mothers who correctly identify all six foods were scored as knowing the foods correctly (pass). Mothers who missed any or all of the correct answers failed this test. As discussed, there was slow diffusion of knowledge out of the nutrition education area into other areas. By the end of the

survey, some mothers were still not sure exactly which foods had vitamin A and which did not, but those who did know which foods contained vitamin A had children who were at substantially lower risk for Xerophthalmia.

At the 12-month exam, mothers who knew which of the six foods contained vitamin A had children at substantially less risk for Bitot's spots than mothers who had failed the oral test. This was true for all intervention cohorts, but the risk was most pronounced and most significant among mothers in the Primary health care and nutrition education cohort (Appendix C).

Children of mothers who passed the test had lower risk for Xerophthalmia if they were normal nutritional status or "wasted only." Risk was reduced for all categories of nutritional status except "stunted and wasted," but the risk reduction was only significant for children with normal nutritional status. Children of all ages benefited when their mothers were able to correctly identify the foods. Risk for boys was reduced if mothers knew the correct foods with vitamin A, but the risk for girls was eliminated. Children of mothers with this knowledge had a special advantage in the rural terai areas.

At the 24-month measurement, mothers who knew which foods had vitamin A did not have children with corneal Xerophthalmia. This was true for all interventions, all nutritional status categories, children above and below sixty months of age, of both sexes and in all locations. While it is consistent across all population characteristics, it is not statistically significant.

Table 3.6 Risk of Corneal Xerophthalmia by Mother Knowing Foods with Vitamin A at the 24-Month Exam

	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows All Correct Foods	0.000	0.052	0.00	(0.02, 8.25)	N.S.

Knowing which foods contain vitamin A continues to protect the child from Xerophthalmia into the 24-month exam. While the primary health care interventions had less effect on risk of Bitot's spots over time, the knowledge of which foods have vitamin A reduces risk even greater at 24 months than it did at 12 months.

The pattern of risk reduction for Bitot's spots seen at the 12-month exam with this knowledge continues through the 24-month exam. The reduction in the primary health care cohort and among stunted children loses its significance. There is no risk for Bitot's spots among wasted children whose mothers know which foods have vitamin A at the 24-month measure. The risk for children under 60 months does become

significant at this exam.

At the 24-month exam; however, knowledge of which foods have vitamin A was not important in reducing risk for corneal Xerophthalmia. There was equal risk among children of mothers who knew and those of mothers who did not know.

Risk of Wasting and Stunting/ Nutrition Education: Mother Knows Foods with Vitamin A

Table 3.7 Wasting by Mothers Knowing Foods with Vitamin A at 12- and 24-Month Exams

at 12 months		Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows All Correct Foods		9.52	13.80	0.69	(0.62 , 0.77)	****
at 24 months						
Mother Knows All Correct Foods		11.74	12.02	0.98	(0.90 , 106)	N.S.
by Terrain	Hills	7.45	5.99	124	(105 , 147)	**
	Terai	14.35	15.10	0.95	(0.87 , 104)	N.S.

For Key refer to Table 3.2.

At the 12-month exam, mothers knowing which foods contained vitamin A was associated with a large significant reduction in risk for wasting that was spread across all interventions and other sub-groupings of the population. By the 24-month exam this association with reduced risk no longer held.

At the 12-month exam, children of mothers who knew which foods had vitamin A were at no significant increase or decrease of risk, except in the symptomatic treatment group, among children younger than 60 months or children living in the hills, who were at decreased risk of stunting if their mothers knew which foods had vitamin A. At 24 months, mothers knowing which foods had vitamin A appeared to decrease the overall risk of stunting.

Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: Mother Knows the Importance of Wild Greens

One of the practices promoted by the nutrition education activity was the consumption of wild greens as a vitamin A source. Knowledge of wild greens and the practice of feeding them to one's family were both associated with decreased risk for Bitot's spots and corneal Xerophthalmia.

Table 3.8 Risk of Bitot's Spots
by Mother Knowing the Importance of Wild Greens at the 12-month Exam

		X1B Rate of participants	X1B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Importance of Wild Greens		**0.31**	**1.01**	**0.31**	**(0.23 , 0.40)**	********
By Intervention	Capsule	0.22	0.44	0.50	(0.23 , 1.07)	*
	PHC & Caps	0.27	0.77	0.35	(0.19 , 0.65)	****
	Nut Ed & PHC	0.18	0.91	0.20	(0.10 , 0.38)	****
	Sympt Treat	0.60	1.72	0.35	(0.23 , 0.52)	****
By Nutritional Status	Normal	0.54	0.97	0.56	(0.36 , 0.85)	***
	Stunted alone	0.19	1.03	0.19	(0.12 , 0.29)	****
	Wasted alone	0.53	0.50	1.07	(0.33 , 3.69)	N.S.
	Wasted & Stunted	0.31	1.46	0.21	(0.07 , 0.55)	****
By Age of Child	0-4 years	0.33	0.98	0.34	(0.23 , 0.49)	****
	5-9 years	0.27	0.77	0.35	(0.19 , 0.65)	****
By Sex of Child	Boys	0.39	1.04	0.38	(0.26 , 0.54)	****
	Girls	0.22	0.97	0.23	(0.15 , 0.36)	****
By Area	Urban	0.00	0.25	0.00	(0.00 , 5.58)	N.S.
	Rural	0.31	1.06	0.30	(0.23 , 0.39)	****
By Terrain	Hills	0.09	0.08	1.04	(0.18 , 22.67)	N.S.
	Terai	0.50	1.11	0.45	(0.34 , 0.60)	****

For key refer to Table 3.2.

For risk of Bitot's spots at the 12-month exam, knowledge and practice concerning wild greens appear to have the most widespread, most significant impact. The children of mothers who reported utilizing this source of vitamin A had a 69% lower risk for Xerophthalmia. This practice is associated with reduced risk across all intervention cohorts, and reduced risk for all nutritional categories except for children who are "wasted only." It is a particularly important habit for reduced risk in rural areas, and appears to play a more important role in reducing risk in the terai areas but not in the hill areas.

Knowledge and practice concerning wild greens by mothers also appears to significantly reduce risk of corneal Xerophthalmia among their children at the 12-month exam (Appendix C). This risk reduction appears to be most important in the capsule distribution area. In contrast, all mothers of cases of corneal Xerophthalmia in the nutrition education cohort reported utilizing wild greens. Wild greens in the diet also reduced risk for corneal Xerophthalmia for all classes of nutritional status except for children who were both wasted and stunted.

At the 24-month exam, wild green utilization maintained its advantage of reduced risk for Bitot's spots. Risk reduction is just as great and just as significant, and follows the same patterns seen at the 12-month exam across population parameters (see Appendix C). The risk for corneal Xerophthalmia is also reduced at the 24-month exam. The reduction of risk, however, is not significant.

Risk of Wasting and Stunting/ Nutrition Education: Mother Knows the Importance of Wild Greens

Knowledge by mothers of the importance of wild greens as a source of vitamin A, and the use of them in feeding the family, significantly reduced the risk for wasting among their children at both the 12-month and 24-month exams (Table 3.9). This risk reduction was most pronounced among the nutrition education and the symptomatic treatment cohort, where dietary supplements were not employed.

This is balanced against a significant increased risk for stunting among mothers who utilized wild greens in their family's diets. This association appears to be the highest in the terai areas (Table 3.10).

Table 3.9 Wasting by Mothers Knowing Importance of Wild Greens at 12- and 24-Month Exams

at 12 months		Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Importance of Wild Greens		**11.24**	**18.58**	**0.61**	**(0.57 , 0.64)**	********
by Intervention	Capsule	11.00	13.42	0.82	(0.73 , 0.92)	***
	PHC & Caps	11.25	15.52	0.72	(0.65 , 0.81)	****
	Nut Ed & PHC	12.15	21.89	0.56	(0.51 , 0.61)	****
	Sympt Treat	10.59	19.84	0.53	(0.48 , 0.59)	****
by Area	Urban	10.38	11.55	0.90	(0.64 , 1.27)	N.S.
	Rural	11.27	18.37	0.61	(0.58 , 0.65)	****
by Terrain	Hills	5.81	6.30	0.92	(0.72 , 1.18)	N.S.
	Terai	15.76	19.06	0.83	(0.78 , 0.87)	****
at 24 months						
Importance of Wild Greens		**10.82**	**16.13**	**0.67**	**(0.63 , 0.71)**	********
by Area	Urban	17.18	16.61	1.03	(0.79 , 1.35)	N.S.
	Rural	10.72	16.09	0.67	(0.63 , 0.71)	****
by Terrain	Hills	6.24	5.94	1.05	(0.81 , 1.36)	N.S.
	Terai	13.98	17.48	0.80	(0.75 , 0.85)	****

For key refer to Table 3.2.

Table 3.10 Stunting by Mothers Knowing Importance of Wild Greens at 12- and 24-Month Exams

at 12 months		Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Importance of Wild Greens		64.95	51.24	1.27	(1.24, 1.29)	****
at 24 months						
Importance of Wild Greens		62.32	49.13	1.27	(1.24, 1.30)	****
by Terrain	Hills	73.78	71.95	1.03	(0.98, 1.07)	N.S.
	Terai	54.48	46.10	1.18	(1.15, 1.22)	****

For key refer to Table 3.2.

Risk of Bitot's Spots and Xerophthalmia/ Nutrition Education: Maternal Literacy

Maternal literacy was an uncommon attribute in the study area. Mothers who were literate were different in many characteristics, including economic status and caste. At the start of the study, however, educated mothers had reduced risk only for Bitot's spots. Literacy did reduce risk for corneal Xerophthalmia, but not significantly at the 12-month exam. However; at the 24-month exam, maternal literary was associated with an even greater reduction of risk for Bitot's spots, and literate mothers had no cases of corneal Xerophthalmia. Literate mothers were more receptive to or better able to understand behavior changes being promoted by the study. Refer to Appendix C.

At the 12-month exam, maternal literacy was associated with decreased risk for Bitot's spots across all major population parameters. The reduction of risk was greatest among children of literate mothers in the capsule distribution and symptomatic treatment cohorts. It also seems to have a more significant effect among children with normal nutritional status. At the 24-month exam, maternal literacy increases its effect on Bitot's Spot risk reduction, and at this time no literate mothers have children who develop corneal Xerophthalmia.

Risk of Wasting and Stunting/ Nutrition Education: Maternal Literacy

Of all the activities undertaken, the impact of maternal literacy appeared to be the greatest on all aspects of nutritional status.

At the 12-month and 24-month exam literate mothers had less wasted and taller

children. At both examinations it appeared to be more significant for mothers in the terai than for mothers in hills. The reduction of stunting was seen across all interventions.

Table 3.11 Wasting by Maternal Literacy at 12- and 24-Month Exams

at 12 months		Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Maternal Literacy		**10.88**	**13.73**	**0.79**	**(0.72 , 0.87)**	********
by Area	Urban	11.39	10.86	1.05	(0.76 , 1.45)	N.S.
	Rural	10.03	13.76	0.73	(0.66 , 0.81)	****
by Terrain	Hills	6.28	5.83	1.08	(0.86 , 1.35)	N.S.
	Terai	11.96	17.81	0.67	(0.61 , 0.74)	****
at 24 months		**Wasting of participants**	**Wasting of Non-participants**	**Relative Risk**	**(95% CI)**	**Chi Square p-value**
Maternal Literacy		**9.89**	**12.28**	**0.80**	**(0.74 , 0.88)**	********
by Terrain	Hills	7.44	6.04	1.23	(1.03 , 1.47)	**
	Terai	11.33	15.50	0.73	(0.66 , 0.81)	****

Table 3.12 Stunting by Maternal Literacy at 12- and 24-Month Exams

at 12 months	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Maternal Literacy	**56.45**	**61.42**	**0.92**	**(0.89 , 0.95)**	********
at 24 months					
Maternal Literacy	**54.97**	**60.13**	**0.91**	**(0.89 , 0.94)**	********

For key refer to Table 3.2.

Of all the program activities, maternal education appeared to have the greatest overall effect on the health status. It is important to note that at baseline nutrition education was not significantly associated with reduced risk. Over the course of the Project, educated mothers were the first to be influenced by the nutritional education promotion material. It was their receptivity to Project messages that appears to have influenced the nutritional status rather than education on its own being a major contributing factor.

In the maternal literacy programs, the information used in teaching was all organized around maternal and child nutritional issues, disease management case studies and household sanitation information. They were relevant to the lives of the mothers attending the courses, and whether they were able to read or not they were exposed to the messages in the maternal literacy courses.

Risk of Wasting and Stunting/ Growth Monitoring

Although limited in application, mothers participating in growth monitoring activities had children who were at lower risk for stunting and higher risk for wasting at the 12-month exam. By the 24-month exam, they were at neither higher risk for stunting nor wasting. This activity needs more promotion and training for growth monitoring. It has been suggested that more attractive and durable growth monitoring cards for the mothers would further facilitate their participation and support.

Initially, the terai had high levels of wasting. However, at the 12-month exam, the growth monitoring program appeared to be particularly effective in reducing wasting in the terai. Growth monitoring in a time of adequate caloric availability appears to be effective in reducing risk for wasting. Its association with risk for stunting at the 12-month exam is no longer seen at the 24-month exam (Appendix C).

Impact on Serum Vitamin A

Blood sample were taken from a sub-sample of children located in 10 villages close to the road so that samples could be prepared for analysis and frozen within 24 hours after they had been collected. The blood serum vitamin A levels were estimated using high pressure liquid chromatography in Kathmandu. The equipment belongs to the Agricultural Food Laboratory, but the project did assist with training and supplies during the time that samples needed to be analyzed. In addition the equipment was utilized to look at beta-carotene content found in common foods of Nepal.

During baseline exam 710 blood samples were collected, at the 12 month exam 655, were collected and at the 24 month exam 819 blood samples were collected. Approximately 213 of the bloods were collected all three years from the same children. All of the interventions had increase in serum vitamin A levels. The largest increase was for the Primary Health Care activity between baseline and the 12 month exam, however, the mean level had reduced somewhat by the 24 month exam. All the levels of increase were significant. It is interesting to note that while PHC and nutrition education had the highest level of increase for serum vitamin A levels, the capsules had the largest impact on Bitot's spots and mortality risk.

Table 3.13

Mean Serum Vitamin A Levels at Baseline, 12 and 24 month exam by Intervention
(micro-grams per deci-liter)

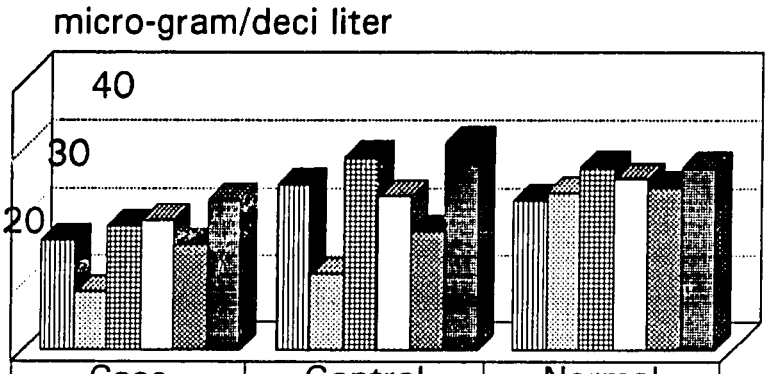
Intervention	Baseline exam	12 month exam	24 month exam	Number
Vitamin A Capsule Distribution	21.3	25.2***	25.6***	70
Primary Health Care	21.8	29.7***	27.6***	83
Nutrition Education	19.3	22.4**	24.9***	66

* < .1 * < .05 *** < .01 **** < .001

Serum vitamin A was significantly lower in the cases than in controls or normal at baseline, the 12 and 24 months exam. At the 12 month exam, cases and controls under 60 months of age had extremely low levels of serum vitamin A. It appears in figure 3.21 that among the normal population that serum vitamin A levels improved between the baseline assessment and the 24 month exam for all children, those under 60 months as well as those over 60 months. It would also appear that for the normal population that children older than 60 months have higher mean levels of serum vitamin A than children younger than 60 months except for the 24 month exam.

Figure_3.21

Serum Vitamin A by Clinical Status

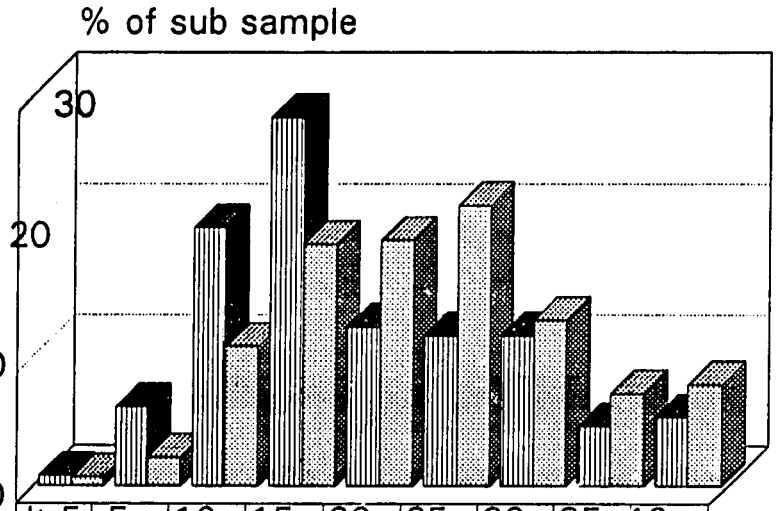


	Case	Control	Normal
6-60 mon @ base	16.4	24.7	22.4
6-60 mon @ 12	8.7	11.4	23.5
6-60 mon @ 24	18.5	28.7	27.3
60-120 mon @ base	19.4	23	25.5
60-120 mon @ 12	15.7	17.8	24.3
60-120 mon @ 24	22.5	30.8	27.2

The median serum vitamin A levels are higher than those seen in Indonesia during the 1978 Helen Keller national prevalence survey[45], during the more recent MSG fortification work[46], or during the Eastern Island Nutritional Survey that was carried out in 1991 in four provinces in the Eastern islands of Indonesia.[47] Even though the level of serum vitamin is higher, the prevalence of Bitot's spots and corneal xerophthalmia are also higher.

Figure_3.22

Serum Vitamin A by Age at Baseline



	lt 5	5 -	10 -	15 -	20 -	25 -	30 -	35 -	40 +
6-60 mon @ base	0.8	6.1	19.8	28.2	12.2	11.5	11.5	4.6	5.3
60-120 mon @ base	0.7	2.2	10.7	18.5	18.8	21.5	12.7	7.1	7.8

In Nepal as in most places in the world, their is a marked difference of risk by age. Among the normal population, the median value for children younger than 60 months and those older than 60 months is only 1-3 micro-gram. However among cases, you children appear to have much lower levels of serum vitamin A than cases among older children. For both age groups there is a difference between case and control.

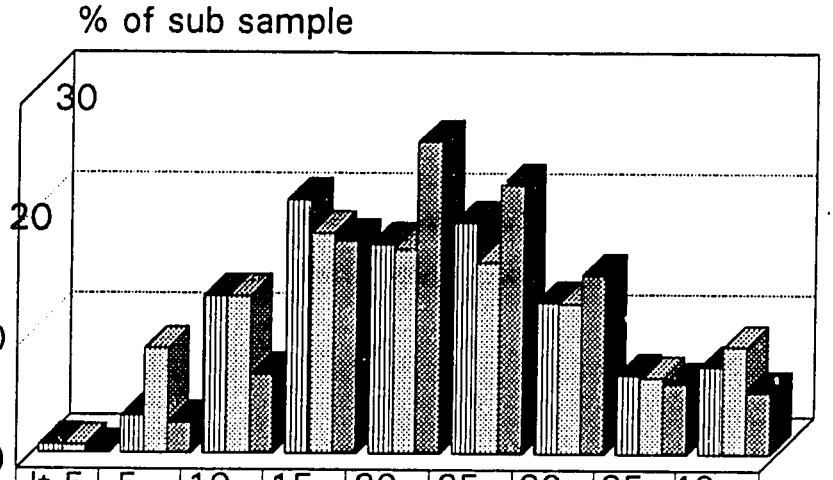
The distribution of serum vitamin A levels among age cohorts shows that younger children generally have lower levels of serum vitamin A than children older than 60 months at baseline. However, it should be pointed out, that the highest levels of risk for new Bitot's spots and corneal destruction was found among children older than 60 months.

While the mean level of serum vitamin appears to have risen steadily for children younger than 60 months in the study, it has fluctuated somewhat for the older children. When the distribution of serum vitamin A levels is considered for all three years, it appears that the percentage of children under 10 micro-grams/deci liter increased at the 12 month exam and then decreased dramatically by the 24 month exam.

It should be noted that serum vitamin A is not a good measure of vitamin A nutriture within a population, and the relative dose response (RDR) and modified relative dose response are much better methods for assessing vitamin A adequacy within a population. However, several points can be made. Cases tend to have lower levels of serum vitamin A than do matched controls, or randomly selected normal populations. Children under 60 months have lower levels of serum vitamin than to children over 60 months, and the difference between cases and matched controls is generally higher for the younger children. The year the Bitot's spots rate made the greatest drop (at the 12 month exam), there was an increase in the percentage of the population less than 20 micro-grams per deci-liter. The biggest improvement in serum vitamin A was seen in the interventions with the least reduction of risk for Bitot's spots.

Figure 3.23

Serum Vitamin A at Baseline, 12 and 24 months



	lt 5	5 -	10 -	15 -	20 -	25 -	30 -	35 -	40 +
baseline	0.7	3.1	12.9	20.9	17.2	19	12.4	6.5	7.2
12 month exam	0.6	8.6	12.9	18.1	16.8	15.7	12.3	6.3	8.8
24 month exam	0.1	2.5	6.5	17.5	25.7	22.1	14.7	5.8	5.1

Impact on Mortality

Mortality reduction was not a primary consideration in the study design, and no comprehensive information was collected at baseline, although it appeared that risk of mortality was not different among interventions cohorts at baseline based on mothers reported experience with mortality. All children in the sites were censused at baseline, and unfortunately some of the children died between the first, second, and third

examinations. When a child on the household registry was reported dead at a subsequent examination, a verbal autopsy was conducted. Difference in mortality rates by intervention groups are shown in Table 3.14. At 12 months their was no significant difference between the mortality experience of the different interventions and the control group. However, between the 12 and 24 month exam mortality risk increased among children within the control group, while it decreased among children in the interventions. By the second year, this difference is significant between the symptomatic treatment group and the capsule distribution, nutrition education cohorts, and primary health care cohorts. The age cohorts with the most significant reduction are children that were infants at the previous exam, and children over the age of 60 months. It would appear that the effect of the vitamin A programs on mortality is greater in the older age children and among the children under 60 months.

Table 3.14
Mortality Risk among Intervention Cohorts

Intervention Group	age group	at 12 month exam			at 24 month exam		
		Dead	Exam	Rate 10,000	Dead	Exam	Rate 10,000
Capsules Cohort	all ages	80	12,674	63.1	63	12,323	51.1****
	0-1 year	16	1,140	140.4	16	1,147	130.8**
	1-2 year	24	1,274	188.4	16	1,138	140.6
	2-5 year	23	3,995	58.2	25	3,854	64.9
	5-10 years	17	6,305	27.0	7	6,184	11.3**
Primary Health Care Cohort	all ages	102	13,287	76.8	89	13,119	67.8**
	0-1 year	21	1,215	172.8	16	1,223	130.8**
	1-2 year	29	1,444	200.8	27	1,256	215.0
	2-5 year	29	4,297	67.5	35	4,186	83.6
	5-10 years	23	6,333	36.3	11	6,454	17.0
Nutrition Education Cohort	all ages	90	13,593	66.2	75	13,038	57.5***
	0-1 year	21	1,266	165.9	16	1,249	128.1
	1-2 year	25	1,398	178.8	22	1,243	177
	2-5 year	27	4,254	63.5	28	4,138	67.7
	5-10 years	17	6,675	25.5	9	6,408	14.0**
Symptomatic Treatment (control)	all ages	106	12,813	82.7	115	12,817	89.7
	0-1 year	30	1,325	226.4	29	1,194	242.9
	1-2 year	27	1,360	198.5	26	1,310	198.5
	2-5 year	28	4,134	67.7	41	4,174	98.2
	5-10 years	21	5,994	35.0	19	6,139	30.9

* < .1 ** < .05 *** < .01 **** < .001

Worm Loads

An analysis of the sub-sample's stool was also performed at each exam. This peculiar procedure became more accepted by village mothers and team members alike over the life of the project. A Lab technician would travel and prepare a few of the slides during the central exam period. The Kato thick smear was performed and a complete slide reading done. The study was interested in ascertaining the relationship of ***Ascaris lumbricoides*** (roundworm) egg density with risk for xerophthalmia, and to check that the universal deworming was reducing not only the prevalence, but the worm load as well within the children of the community. In addition several other species of enteric nematodes are of interest in the etiology of vitamin A deficiency, particularly ***Anclyostoma duodenale*** (hookworm), and its association with anemia.

As can be seen, high worm loads with both parasites were associated with risk at baseline, as well as at the 12 month and 24 month exams. More interesting is that the controls tended to have lower egg counts than the normal children. Given the fact that the control was from the same neighborhood (or potential high risk cluster site), and would have the same risk of exposure to contaminated soil, it would appear to be an important risk difference.

Table 3.15

Parasite	Case	Control	Normal
Roundworm baseline	197.8	37.2	61.6
Roundworm @ 12 months	107.8	49.2	60.52
Roundworm @ 24 months	198.1	89.3	91.2
Hookworm baseline	11.8	1.8	15.2
Hookworm @ 12 month	.6	4.2	4.0
Hookworm @ 24 month	6.9	0	4.3

While roundworm was always observed to be a risk factor for xerophthalmia, hookworm was only a risk factor for two of the three observations. The worm load for roundworm climbed in both the controls and normal population over the study, suggesting that perhaps deworming was not reducing the worm load.

The following table documents prevalence among the three active interventions and as can be seen the prevalence of hook worm went down in the PHC and NutEd cohort where mebendazole was distributed, while the prevalence of roundworm infestation stayed the same.

Table 3.16 Per cent of sub-population infested.

Parasite	Capsules	Primary Health Care	Nutrition Education
Roundworm baseline	39.7 %	58.0 %	55.6 %
Roundworm @ 12 months	36.7 %	36.1 %	37 %
Roundworm @ 24 months	51.3 %	50.9 %	49.4 %
Hookworm baseline	21.8 %	31.9 %	20.8 %
Hookworm @ 12 month	8.9 %	.9 %	3.3 %
Hookworm @ 24 month	5.3 %	4.0 %	1.7 %

It appears that semi-annual deworming was only marginally successful in reducing worm load or prevalence of worm infestation through the semi-annual distribution of mebendazole. This could be one of the reasons that the deworming did not appear to have a significant impact on xerophthalmia risk, mortality risk, or nutritional status. In areas where the fecal environment is not contained, then semi-annual deworming seems to have little effect on the dynamics and magnitude of the intestinal nematode situation.

---

40 Invertnational Vitamin A Consultative Group (1978) Guidelines to the control of "Vitamin A deficiency and Xerophtalmia. New York.

41 Tarwotjo, Tilden et al. (1983) "Interactions of community nutritional status and xerophthalmia in Indonesia." American Journal of Clinical Nutrition, 37:645-651.

42 Community Systems Foundation, Eastern Island Nutritional Assessment

43 Government of Indonesia (19780) Nutrition Blindness: Controling Xerophthalmia in Indonesia. GOI, HKI. Jakarta.

44 Pant, C.R., Gorstein, Particicaption papaer.

45 Sommer, 1982. Nutritional Blindness, Oxford University Press.

46 Muhilal et.al., 1986. "A Pioneering Project for Combating Vitamin A Deficiency and Zerophthalmia with MSG Fortified with Vitamin A." Nutritional Research Report. Center for the Research and Development of Nutrition, Agency for the research and Development of Health. Indonesia.

47 Center for Research and Development in Nutrition, Nutrition Directorate Ministry of Health Republic of Indonesia, 1991. "Eastern Islands Micro nutrient Deficiency Prevalence Study." Technical assistance from CSF, 1130 Hill Street, Ann Arbor, MI 48104 USA.

Chapter 4 Cost of Establishing a National Program

4.1 Background for Program Cost Determination

The objective of the cost analysis was to determine the incremental costs of alternative interventions aimed at reducing Vitamin A deficiencies in children 10 years of age or younger. Incremental costs are costs that occur as a result of the intervention and are added on to already existing health service costs. While the primary objective is to facilitate budget estimates of future vitamin A deficiency control activities in Nepal, a secondary purpose is to compare the costs and effectiveness of alternative approaches to controlling vitamin A deficiency.

In all areas studied, both control and experimental, vitamin A capsules were given to children with eye signs or symptoms. Expenses in these interventions covered mass distribution of capsules with intensified efforts to control childhood infectious diseases; or mass capsule distribution with nutrition education and diet modification; or mass capsule distribution alone.

Sources of Funds

Funds from UNICEF/JNSP and DISVI went to the Social Services National Coordinating Council; then from the Council to the Nepal Netra Jyoti Sangh (NNJS), the non-governmental agency responsible for blindness care in Nepal. Most of the resources used in the experimental interventions were purchased by NNJS and distributed to the intervention areas. Some funds from NNJS supported orientation and training of teachers and agricultural extension workers in the diet modification alternative.

To generate monetary cost estimates of the inputs for each intervention category, accounts of transfers and unit prices of physical resources and personnel were recorded. Since NNJS was purchasing the goods and services to be distributed to the interventions, it seemed reasonable to use their accounts of expenditures on programmatic inputs as the primary source of unit prices. The quantities delivered to each intervention were recorded.

Initial and replacement training expenditures and production of trained workers for each intervention were reported by NNJS. The intervention director reported the numbers of each type of worker assigned initially or as replacement for each intervention director. Records of money paid by the field office for supplies and salaries were recorded.

Cost Categories

In general, the categorization of cost elements is consistent with those published in the Asia/Near East Bureau (ANE Bureau) "Guidance for Costing of Health Service Delivery Projects," submitted to the ANE Bureau of the Agency for International Development by the Resources for Child Health Project (Resources for Child Health Project, 1987). One difference between this Project's accounting and that outlined in "Guidance" is the separation of one-time costs into fixed and variable costs. The fixed costs are those which are incurred at the outset and do not change as programs proceed.

Many general costs, such as program development, or salary of the ophthalmic assistant who supervises all of the sites for a particular intervention, cannot be allocated to specific sites. Program management costs incurred by NNJS for the Vitamin A Project as a whole are reported without being allocated to a specific intervention.

Costs were recorded separately for

1) each intervention,
2) Project management not specific to individual interventions.

For each of these cost centers, costs were developed for

1) program development and testing
2) one-time initial investment expenditures
3) recurring operating expenditures.

Expenditures measured included: baseline surveys and implementation planning; initial expenditures for training, stocks of supplies, vehicles and spare parts; other equipment, facilities, assessment and other start-up activities; recurring operating expenditures for monitoring, consumption of supplies and utilities, pay and allowances; incentive pay, personnel travel; transportation and storage of commodities; replacement training; and maintenance and repair of equipment and facilities.

Cost Comparisons

Alternative interventions were compared measuring total incremental costs by health improvement, rather than cost-effectiveness ratios. Levels of effectiveness are masked when ratios are used. For example, if in the control (zero incremental cost) areas eye signs were to decrease only a trivial amount over time, the ratio of effectiveness/cost would be infinite.

Sequencing Cost Analysis Activities

The initial step was to establish record-keeping for the development of unit prices and the transfers of resources to intervention areas. Current accounting

procedures were reviewed so that cost-accounting requirements imposed as few new categories and concepts as possible. Following this, discussions were held with the supervisors of each intervention area to set up record-keeping of resources received. Forms and procedures were developed on the basis of these discussions.

Reporting of the required resource and cost information was regularly made to the evaluation group. The evaluation group in Nepal was responsible for:

1. collecting and reviewing reports on NNJS expenditures and physical resources;

2. developing unit prices from these reports;

3. collecting and reviewing reports from NNJS and area supervisors on resource transfers;

4. collecting reports from NNJS on transfers of resources or money to health workers or health posts;

5. reporting food expenditure information from surveys.

Reports for each intervention area were taken to the University of Michigan for cost analysis to develop comparable incremental costs of interventions.

4.2 Projected Budgets for Possible National Program Implementation

An important part of the results of the study consist of projected budgets for national implementation of vitamin A deficiency reduction programs (not to be confused with the actual budget for three years of prototype programs). Budget estimates for projected vitamin A control programs were based on data collected during the operation of this project using actual expenditures and the estimated value of in-kind donations. We compare the costs of interventions in this study to aid in the design of a national program. Detailed data on expenses, as well as records of personnel training and utilization, were recorded throughout the evaluation period to aid in evaluating the intervention alternatives.

Due to travel and transport difficulties in Nepal as well as constraints on human resources and finances, personnel at all levels worked on more than one intervention. Data was collected, analyzed and evaluated to determine the required physical resources, (personnel, equipment, and supplies, both as capital stock and for operations) for each of the four types of intervention which were studied. To review, the types of interventions considered were:

1. Capsule distribution twice per year
2. Capsule distribution 3 times per year
3. Primary health care package (includes capsule distribution)
4. Nutrition education package (includes PHC without capsule)

The seasonality of xerophthalmia suggests a fifth alternative--delivery of only one capsule per year during critical months by existing village health workers (vaccinators) as an addition to their immunization work. Costs have been estimated for such a program, although no field evaluation has been done, and data on the effect of this alternative are not available. A sixth alternative, conducting adult literacy programs, is also considered. After baseline assessment, maternal literacy rates of 6% were found in the Nutrition Education Area, so a previously developed adult literacy program was implemented there.

From project records and analyses for each intervention, specifications for a national vitamin A deficiency control program were determined. Levels of analysis included central and district-level administration and the delivery of specified intervention services and commodities to the children under 10 years of age in rural villages.

Expenditures were recorded, then divided by the quantities procured to derive unit prices. Where feasible, UNICEF prices were substituted for local procurement, in order to minimize outlays. Where, as in the case of vitamin A, supplies were donated, market prices plus freight charges were obtained from the suppliers. Rupees were converted to US dollars at the rate of 35:1, the approximate average exchange rate at the time of the expenditures.

Cost estimates were developed for future initial investment requirements and for operations over a period of five years. They are presented in 1990 U.S. dollars, with no adjustments for time (discounting) nor for future changes in prices. It was assumed that annual operating costs for a given intervention would not change over time. The effects of altering certain assumptions on the costs of interventions will also be noted.

Administrative Costs

Projected budgets will include the cost of operating central and field offices (equipment and operating costs: the salary of the staff, per diem, fuel and local transport costs). In addition to office expenses, costs will include assessment and

monitoring, producing information on vitamin A deficiency prevalence in five new districts every year and monitoring of implementation in another five districts per year.

Investments already made while in the initial stage of the Project are not included in estimates for future nation-wide programs.

Central Costs

The main task of the Kathmandu office is to coordinate the efforts of ministries, non-governmental organizations (NGOs) and donor agencies in their effort to control vitamin A deficiency in Nepal. The central office provides guidelines for implementation and supervision for training and other activities in the field. It is the responsibility of this office to assure a regular flow of supplies to the field offices and to provide feedback to the government and the donors about the implementation of the program.

The person in charge of the central office during nation-wide implementation of vitamin A deficiency control programs is the National Coordinator. The coordinator, an ophthalmologist, is assisted by an ophthalmic assistant or training coordinator, one bilingual secretary, one accountant, one graphic artist, one audio-visual technician, one driver and other auxiliary staff. The office will be equipped with one car, one computer with laser printer, one photocopy machine, one fax machine, audio-visual equipment, one motorbike, one bicycle, furniture, and office supplies.

Table 4.1 presents an estimate of the annual operating costs for the central administration of a national vitamin A program. This is based on costs incurred during 1990 for the Project's Kathmandu office, less those for technical assistance in the evaluation of the interventions.

TABLE 4.1
ANNUAL OPERATING COSTS FOR CENTRAL ADMINISTRATION OF A NATIONAL VITAMIN A PROGRAM
(U.S. dollars)

Staff	Cost
Physician (Ophthalmologist)	$3,989
Ophthalmic Assistant	1,481
Secretary	1,282
Accountant	1,111
Graphic artist	969
Audio-Visual Technician	969
Assistant	655
Night guard	655
Driver	655
Consultants	313
Other:	
Fuel	427
Electricity	313
Telephone/FAX	940
Mail/Telex	142
Rent	3,761
Stationery	1,795
Vehicle maintenance	1,225
Insurance	256
Total	**$20,940**

District costs

At district level small offices can be established in one room with a storage facility. The District Supervisor, preferably an ophthalmic assistant, will be responsible for these offices, assisted by one office assistant and one accountant/store keeper. The district office also requires its own transportation in order to assure timely distribution of drugs and proper supervision. Two or more districts, implementing the same strategy, could be supervised by a single field office, reducing the costs. Estimates of the investment and operating costs at district level are shown in Table 4.2.

The projected district budget is estimated separately for central administration, which is not expected to vary with the number of districts covered or the type of intervention selected. District-level supervision is expected to vary with the number of districts phased in, but not by the type of intervention.

TABLE 4.2
ANNUAL OPERATING COSTS FOR A DISTRICT OFFICE
(U.S. dollars)

Staff:	Cost
1 ophthalmic assistant	$1,485
1 office assistant	828
1 accountant/store keeper	1,114
1 driver	657
1 assistant	343
Other:	
stationery	171
fuel	514
vehicle maintenance	1,282
electricity	342
communications	342
rent	684
insurance	257
Total Annual Operating Cost	**$8,019**

Initial Investment (U.S. dollars)

Item	Cost
1 car	19,000
2 typewriters	500
1 bicycle	100
office furniture	300
training	1,500
Total Initial Investment	**$21,400**

Five Year Cost: 5(8,019) + 21,400 = $61,495

Assessment and Monitoring Costs

A national program for vitamin A deficiency control will require an appropriate monitoring system. Its purpose should be to assess effectiveness in the districts where the interventions are being implemented and whether the implementation is proceeding according to plan. In addition, the prevalence of xerophthalmia in other districts of the

country must be assessed in order to determine priority areas for interventions on a national level. During the assessment in new districts, data on the availability of primary health care facilities, transportation and accessibility will be collected to assist policy makers in the formulation of more detailed plans and budget estimates.

Assessment costs have been derived from evaluation costs during the study. The assessment of prevalence is conducted during the peak season for xerophthalmia (April to June), thus reducing the size of the sub-sample required for each district. The same staff conducting the assessment will collect data for monitoring the implementation during the low season for xerophthalmia (July to March).

The staff will use the office facilities already in place to run the national program. At the central level the data entry will take place in the Kathmandu office, where the computers and the data-entry staff is based. The assessment team will need transportation facilities (two cars and drivers) and will spend most of the time in the field. The staff presently trained and working for the study evaluation will be sufficient to enumerate and visit from 80,000 to 100,000 children per year. The assessment staff could, in the course of a year, assess approximately five districts and monitor program performance in another five districts. (See Table 4.3.)

TABLE 4.3
ANNUAL OPERATING COSTS FOR ASSESSMENT AND MONITORING
(U.S. dollars)

ITEM	COST
Salaries:	
5 team leaders	$10,000
10 anthropometrists	12,000
5 administrators	6,000
20 enumerators	20,000
2 drivers	1,000
Data entry supervisor	1,000
3 data entry clerks	2,000
Other expenses:	
Per diem	$23,000
Fuel	1,000
Maintenance	1,000
Training:	13,000
Supplies:	8,000
Miscellaneous	1,000
Total operating costs	**$99,000**

Technical Assistance

The cost of technical assistance is not part of the field budget. Nor does it include the cost of assistance provided to the Government of Nepal and donors in the selection of the most appropriate intervention or combination of interventions for implementation, sample selection, data management and analysis, etc. These activities do not appear in the budget because they have already been provided and paid for. Besides, a disproportionate amount of resources were devoted to technical assistance during the experimental stage of the Project. Monitoring and assessment for the national program will require fewer resources.

Intervention Costs

In this category all the costs specific to each intervention have been listed. Included are: differing amounts of supplies and equipment; supervision costs, and training, which will be shorter for Capsule Distribution (CD), and longer for Primary Health Care (PHC) and Nutrition Education (NE). Unit costs of training are specified as per day per person, plus training materials and refreshments. Unit costs are multiplied for the number of days and number of participants for total costs. Costs for training materials will be different for each intervention. Participants in capsule distribution will receive a manual with relatively fewer pages and only one poster, while primary health care and nutrition education will have a manual with more pages, two posters and other materials. Together with first training and refresher training, is added the cost of annual replacement training (to train new community health volunteers in case of drop-out, estimated at 20% per year).

The cost of another intervention, one which was not tested during this project, is also projected. This intervention consists of distributing vitamin A mega-dose capsules once a year, delivered by vaccinators (VHWs) in association with the extended program of immunization already in place, and with limited training and supervision.

The Ministry of Health in Nepal has already implemented limited primary health care services on a national scale. Two of its components, the Extended Program of Immunization (EPI) and the Oral Rehydration Therapy (ORT) programs, registered an increase in coverage in the intervention cohorts. EPI coverage increased in all the interventions approximately 10%, while the oral rehydration salt utilization increased between 10% to 30% in different interventions. The incremental cost for these two programs has been calculated and included under intervention costs.

This study was designed for implementation primarily in villages and other rural areas, with the delivery of service by the network of health volunteers already in place in rural areas under the primary health care program of the Ministry of Health. There are no VHWs or CHVs in urban areas, so they could not be enlisted to implement programs there. In addition, the prevalence of xerophthalmia is low in urban areas and in sites less than two hours walking distance from district hospitals. These factors

indicate limiting the new vitamin A deficiency prevention strategies to rural areas.

The Adult Literacy Program is presently implemented only in few districts of the country and was included during the study in all the nutrition education areas. Its cost has been included with other costs of the nutrition education intervention.

The possibility that different programs will be implemented in different areas in order to meet local requirements must be taken into account. Therefore, the cost was calculated for each intervention to cover one district for five years, including training, medicines, other supplies and education materials. Capsule distribution at different dosage frequencies was considered as separate interventions. Costs were also calculated for mass distribution of vitamin A mega-dose dose capsules before the peak season for Xerophthalmia (April to June), using the existing full time staff of the health posts (VHWs).

While the population in districts in the experimental project averaged about 200,000 each, districts in Nepal varied in the 1981 census from a low of 7,021 (Manang) to a high of 534,692 (Morang). Table 4.4 shows the distribution of districts according to size class. Table 4.5 shows the number of districts in each of the three ecological zones, classified by terrain.

TABLE 4.4
DISTRIBUTION OF DISTRICT SIZE GROUPS, 1981

Size of District	Number of Districts
<50,000	6
50,000-99,999	9
100,000-199,999	28
100,000-299,999	18
300,000-399,999	10
400,000-499,999	3
>499,999	1

TABLE 4.5
DISTRIBUTION OF DISTRICT TERRAIN GROUPS, 1981

Terrain	Number of Districts	% of Population
Mountain	6	9
Hill	50	48
Terai	19	43

For the purpose of this budget, intervention costs were calculated assuming populations of 100,000, 250,000, and 400,000 per district. The program will target children below 120 months, about 33% of the total population in Nepal. These estimates assume that percentage of children for each district.

Capsule Distribution (Once per year)

The study registered a seasonal distribution of xerophthalmia cases, with more than 90% of them detected during April, May and June. Many factors contribute to this effect. It is from April to June that most of the diarrhea cases occur. This is also the most dry period during the year in Nepal, with limited production of vegetables, and the last months before the new harvest. By this time of year, the household food stock is depleted in most cases.

It is thus possible to control Vitamin A deficiency in Nepal with the delivery of a single mega-dose vitamin A capsule to protect the child during the three months when xerophthalmia risk is highest. This alternative would make it possible to reach the greatest number of beneficiaries since, besides considerations of cost, the program structure would be simpler.

Such a program, with only one contact with the children per year, can be delivered though the full-time salaried staff of the Ministry of Health rather than using the community health volunteers. The most appropriate staff would be the Village Health Worker (the vaccinator--also delivering the extended program of immunization). Each VHW visits the five villages she supervises at least once per month, and during the month of March, can deliver mega-dose vitamin A capsules to all children below ten years of age. This activity will probably have the added benefit of reinforcing coverage for the extended program of immunization.

Costs for training and training materials for this program would be very low. There would be no need for replacement training since the program would be delivered by permanent staff. Supervision would be provided by the Health Posts without additional supervision from the Vitamin A Project staff. A district office would not even be required. Moreover, if this strategy is implemented on a national scale, the same considerations apply to the central office. Extended program of immunization coverage may increase, but without community health volunteers' participation (the primary distributors of ORS), the coverage for oral rehydration therapy is not expected to rise.

In appendix E, Table E4.1 presents estimates of the initial investment and annual operating costs of delivering capsules once per year in a district of approximately 200,000 population. The total five-year cost of delivering a single capsule per district adds approximately U.S. $ 27,000 to the cost of primary health care services.

Semi-Annual Capsule Distribution

The community health volunteers in this intervention received only mega-dose vitamin A capsules and a small amount of paracetamol and oral rehydration salt packets as an incentive. Other supplies required are; scissors for opening the capsules for children less than one year old, registers, and pens to list the children in the village.

Initial training lasted 3 days, and refresher training one day annually will suffice. Community health volunteers will receive one manual and one poster during training 4 or 5 copies of the "Amrit" monthly newsletter for distribution in the village. "Amrit" appears to be an effective and low cost way to increase coverage and participation in the program.

Supervision costs include one visit by the district supervisor in each village every 6 months. The costs of supervision from the central office (National Coordinator) was listed under administrative costs, and we assume that those costs will not change between interventions.

In appendix E, Table E4.2 presents estimates of the requirements semi-annual capsule distribution to the children of a district of about 200,000 people. Total costs for a five year period are estimated at U.S. $85,000.00.

Capsule Distribution (3 times per year)

This budget differs from semi-annual capsule distribution in the costs of capsules and supervision. With distribution of capsules every four months, the amount needed will be 50% higher than every six months. If Project staff participate in the distribution, no other costs will be incurred.

In appendix E, Table E4.3 presents the initial investment and annual operating costs of delivering capsules three times a year to a district population of about 200,000. The total five-year budget requirement is approximately U.S. $110,000.00.

Primary Health Care

Compared with capsule distribution, this intervention results in higher costs in training, materials and medicines. The amount of supervision required is similar to the intervention of capsules three times a year.

Initial training will require 8 days and refresher training can be held for 3 days annually. The training materials will include one manual, two posters (capsule distribution and primary health care), one dosage chart for Co-trimoxazole and

paracetamol for each community health volunteer.

Village health workers and community health volunteers in this intervention will receive more supplies than those participating in capsule distribution alone: more medicines, mega-dose vitamin A capsules for semi-annual distribution, Mabendazole for deworming, Co-trimoxazole, paracetamol and oral rehydration salt packets. Supervisors will visit intervention sites every four months. Villages in this intervention will receive the monthly newsletter "Amrit".

In appendix E, Table E4.4 presents estimates of initial investment and annual operating budgets for the Primary Health Care intervention. Total five-year budget requirements amount to approximately U.S. $223,000.

Nutrition Education

This intervention is the most costly of the study, because more supplies, educational materials and supervision are required. Among all the activities tested in the trial interventions, the adult literacy component of this intervention was the most expensive. Initial training in nutrition education lasts ten days, with refresher training lasting five days. Community health volunteers in this intervention received a complete set of educational materials, including posters, flip-charts, a scale and growth charts for growth monitoring, improved seeds to promote kitchen-gardening, and more oral rehydration salts packets to meet increased demand.

Supervision is required every three months during growth-monitoring sessions and mothers' meetings. An estimated 4 visits for village per year is to be conducted by the district office. Participants in this intervention will receive the monthly newsletter "AMRIT" with an increased number of pages for additional information and nutrition messages.

During the past year of field implementation 100 literacy centers were established in the nutrition education area, 2000 mothers attended the classes and more than 1000 became literate. During the second year other mothers attended literacy classes and newly literate mothers attended post-literacy courses focusing on nutritional subjects.

The classes were implemented according to a field-tested model jointly developed by the Ministry of Education and UNICEF Kathmandu. Because of limited resources, the Project restricted the attendance to mothers rather than all the adults in the village.

A hypothetical budget to implement adult literacy classes (Appendix E, Table E4.5) for all mothers in a village has been prepared according UNICEF guidelines (with exchange rate of Rps. 3500 = U.S. $100.00) to run one center for six months. This projected amount is consistent with the costs of running literacy centers monitored

by the Project. Budget items include training, books, other supplies, salaries and supervision. Calculations have been made based on an average of 400 centers per district, one center for each community health volunteer (each serving 500 people/150 children.)

Note that Table E4.5 in Appendix E presents details of the local costs in rupees of adult literacy class operations for January-February 1991. The total cost of operating the centers in one district amount to Rps. 1,222,000, or about U.S. $ 35,000.00, and 16% of the mothers became literate. Classes appear to be an important factor for motivating villagers to participate in the program activities and thus increase the level of coverage.

Adult literacy activities are included in the budget for nutrition education. These activities are considered together in comparing the effects of the five interventions. Table E4.6 in Appendix E presents a summary of the investment and annual operating costs of nutrition education. The five-year cost of the program in one district is about U.S. $413,000.00.

Intervention Cost Summary

Table 4.6 summarizes the start-up and operating costs of the alternative vitamin A interventions in a terai or hill country district with a population of about 200,000.

TABLE 4.6
COSTS OF STARTING AND OPERATING ALTERNATIVE VITAMIN A INTERVENTIONS IN A TERAI OR HILL COUNTRY DISTRICT
(in U.S. dollars)

Intervention	Initial Investment	Annual Operating Cost	Total 5-year cost
Capsules 1 x yr.	2,000	5,000	26,000
Capsules 2 x yr.	10,000	15,000	83,000
Capsules 3 x yr.	10,000	20,000	108,000
Primary health care	18,000	40,000	218,000
Nutrition Education	33,000	47,000	263,000
Nutrition Education and Adult Literacy	33,000	82,000	435,000

While there is little difference in the relative costs of different interventions in different size districts, Table 4.7 shows estimates adjusted for size variations. The number of community health volunteers, supplies of vitamin A and pharmaceuticals were assumed to be proportional to population.

TABLE 4.7
ADJUSTMENT FOR SIZE: 5 YEARS OF OPERATIONS
(in U.S. dollars)

	District Population:		
Intervention	**100,000**	**200,000**	**400,000**
Capsules 1 x yr.	13,000	26,000	52,000
Capsules 2 x yr.	50,000	83,000	140,000
Capsules 3 x yr.	79,000	108,000	162,000
Primary Health Care	130,000	218,000	445,000
Nutrition Education	158,000	265,000	541,000
Nutrition Education and Adult Literacy	352,000	435,000	556,000

It was also assumed that cost of maintaining equipment would be twice as high in a mountain district as in the terai or hills. The estimated 5 year cost of a district office for mountain district would rise from U.S. $ 66,000 to U.S. $ 76,000.

Other National Programs

Expanded Program of Immunization (EPI)

Analysis of the immunization status of children under two years old, after one year of field activities, shows a 10% increase in coverage as compared to the symptomatic treatment cohort. The increase may be attributable to improved rapport between the community health volunteers and the health post staff. Increased supervision is probably the most important cause, as the Project does not promote EPI in capsule distribution areas. An increase in EPI coverage should be considered as an ancillary benefit in evaluating vitamin A deficiency control programs.

The extended program of immunization is organized in Nepal with vaccination sessions taking place on a fixed day every month in each village, while all children visiting health posts receive immunizations, if needed, whenever the visit takes place.

The 10% increase in vaccination coverage registered during the study was not the result of an increase in the number of sessions, which still are conducted once per month per village, but rather by an increase in number of children per session. There

is no increase in expenditure for salary, per-diem, or supervision. One EPI vaccinator in Nepal covers an average population of 5,000 people with 220 children (3.59% of total population) below the age of one year. For those 220 children (the target group for the EPI), vaccinators are expected to conduct about 60 sessions per year. The expected number of children per vaccination session is approximately 4, but each vial (Diphtheria, Polio, Measles) contains 20 doses and once opened, must to be used the same day. Therefore, increased coverage for the extended program of immunization could reduce the waste of vaccine with no incremental cost at all for the Government of Nepal.

Oral Rehydration Therapy

The demand for, and utilization of, oral rehydration salts also increased in the intervention cohorts, as compared to the symptomatic treatment cohort. Nutrition education registered the greatest improvement, capsule distribution the lowest. The data of the second survey recorded that in the symptomatic treatment area 40% of the children having diarrhea used oral rehydration salts, compared with 50% in capsule distribution, 60% in primary health care and 70% in nutrition education areas.

According to the Nepal Public Health Office guidelines, the community health volunteers are supposed to receive an initial stock of oral rehydration salt packets during the training and get additional supplies from the health post. It may be more efficient to distribute ORS packets to meet the increased demand directly to community health volunteers. An additional stock of oral rehydration salts packets will also be needed for the health posts.

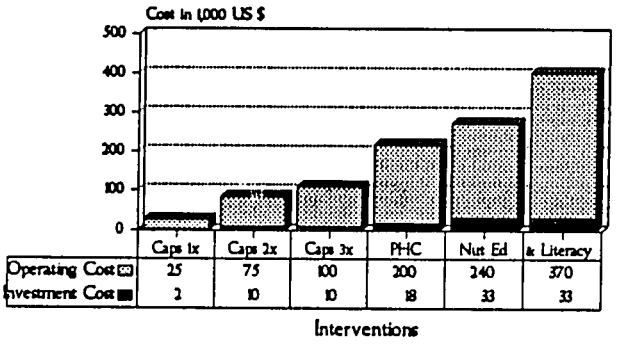
4.3 Summary

Costs of the various interventions increase 15-fold from the cheapest alternative to the most expensive. Even the most expensive intervention, however, can be delivered for about $6.00 per child in a five year period or about $1.20 per child per year.

Figure 4.1 shows the five-year costs of six different approaches to controlling vitamin A deficiency. Three of these interventions also target social factors that influence the vitamin A status of children. Figure 4.2 demonstrates the different cost factors in the annual costs of running the programs.

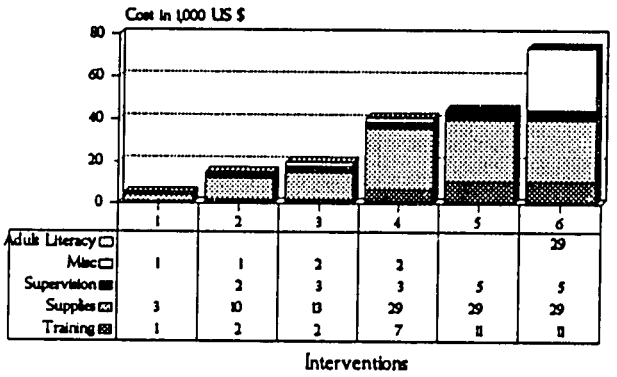
Figure 4.1

Cost of Alternative
Programs Average District Five Year Cost



The investment cost is low for all the approaches, and particularly low for the capsule distribution program. Recurrent costs increase with primary health care and nutrition education because of the cost of the supplies; for instance, deworming, ORS packets, and Co-Trimoxazole. Nutrition education also requires more supervision and educational and training materials. The most expensive component of all the interventions, however, is adult literacy.

Figure 4.2
Cost Components of Recurrent Expenditure



One more factor should be taken into consideration in evaluating these programs, that is, opportunity cost, the "cost" of not undertaking a more effective alternative. In putting money in a bank, for instance, one would not invest at 5% if one could also just as easily invest at 7%. Likewise in health programs, if the cost is not prohibitively high, the ideal program has the greatest effect per dollar invested.

All the alternative strategies are cost-effective investments in treating the effects of vitamin A deficiency, with the valuable added benefits of improved childhood health and reduced mortality. In areas where the vitamin A deficiency is severely endemic, several strategies might be used in concert. In areas where it is less of a threat, a less expensive alternative could be utilized.

CHAPTER 5 Discussion and Conclusions

We have reviewed the findings and characteristics indicating the impact of the Project's activities. Risk for both xerophthalmia and malnutrition among children was reduced for children participating in the Project activities. This information is important for establishing a national vitamin A deficiency control policy in Nepal, as well as to those interested in controlling vitamin A deficiency elsewhere in the world. The development of the national program discussed here is a confirmation of study hypotheses.

Confirmation of Study Hypotheses

The study hypotheses are: (1) Children of all ages participating in any of three vitamin A deficiency control programs will have a significant reduction in the prevalence of Bitot's spots. (2) Communities with children participating in the combined capsule distribution and infection control intervention will sustain a greater level of community participation in project activities than those villages where only capsules are delivered. (3) Children participating in nutrition education activities whose mothers have understood the messages (and altered their child's feeding behavior) will have a significant reduction in Bitot's spots and sustain a greater improvement in nutritional status than those mothers who have not changed their child's feeding behavior.

Program Participation and Bitot's Spot Reduction

Children of all ages participating in any of the three vitamin A deficiency control programs had a significant reduction in the prevalence of Bitot's spots. At the beginning of the Project, there was doubt that children older than 60 months would respond to vitamin A supplementation. Non-responsive Bitot's spots are reported to be more frequent among older children. However, most community-based studies done in the last decade used 60 months as the upper age boundary for inclusion in each study. Thus, detailed information on the effect of vitamin A supplementation on older children was lacking.

During the preliminary assessment and field testing for the fortification of MSG with vitamin A in Indonesia, in 1984, entry-level school children were included in some of the pilot testing clinical exams and information collection exercises. The results consistently showed an elevated risk for Bitot's spots in school-aged children over pre-school aged children. Intervention was also associated with reduction of risk in both age groups. In the formal survey, however, exams were focused on the traditional target population of pre-school children and mothers.

The experimental design of the Nepal Vitamin A Child Survival Project included children 60-120 months as part of the study population. Risk for Bitot's spots and wasting was significantly reduced in all intervention cohorts, within all age groups. This improvement of health status was seen both years despite adverse agricultural conditions in the study area from the 12- to the 24-month exam.

A significant reduction of risk for xerophthalmia, wasting, and mortality was greater among the older children than the younger ones, although both age cohorts seem to have significant levels of health benefit from participating in Project activities. The reduction in risk for reported mortality in children aged 60 to 120 months was greater at the 24 month exam than that of the children under 60 months. At both exams the impact on risk for Bitot's spots and wasting was significant.

In Indonesia, with well-documented community vitamin A dynamics, risk for corneal xerophthalmia and wasting are seldom seen in post-weaning children. In Nepal, risk for corneal xerophthalmia increases in the post-weaning ages. Peak risk for both Bitot's spots and wasting is in the 60-120 month age cohort. After vitamin A deficiency-reduction programs, children 60-120 months old exhibit the greatest reduction in new Bitot's spots. Older children have as much or more to gain from inclusion in vitamin A programs.

While children of all ages benefited from inclusion in vitamin A deficiency control programs, not all nutritional status categories benefited equally. Children with low body mass and adiposity appeared not to benefit from participating in intervention activities. The effects of chronic food shortage and a recent history of disease seem to reduce the effectiveness of capsule distribution and other public health interventions.

Programs appeared to reduce risk most during the peak prevalence months of May and June, and did not affect risk as much during the lower prevalence months of July, August and September. The effect of the programs, like the risk, appears to be seasonal, but not across age groups.

When a logistic model is used to predict risk for the different wards within the study population, one finds that level of risk for xerophthalmia within a ward at any exam can be predicted by agricultural patterns, maternal literacy, and household sanitation better than by coverage with any program activities. This reduction of risk between individuals in high-risk sites does not extend into a reduction of background risk. In other words, the ecological and socio-economic environment producing xerophthalmia risk in the study area dominated risk determination throughout the study period.

Participation in the Project appeared to reduced risk for children with xerophthalmia, but community-level risk for xerophthalmia appears to be only influenced by maternal education activities. Additionally, price support mechanisms in millet producing areas appear to have the potential to significantly reduce

xerophthalmia risk in the study areas. Improving household sanitation might also be an important way to reduce risk.

Until the government can install social safety nets for millet-producing areas, effectively promote women's literacy, and improve household sanitation, delivering capsules to high-risk populations appears to be an effective initial phase with an expected outcome of a significant reduction in risk of xerophthalmia. Nutrition education messages are associated with reduced risk of xerophthalmia and of wasting. A modified nutrition education program with capsules available to high-risk wards may be another effective way to control vitamin A deficiency in Nepal.

Despite the variations in risk reduction for Bitot's spots seen by nutritional status and season, there was a significant reduction of risk among all ages. Our first hypothesis, that all participating children will show decreased prevalence of Bitot's spots, is true for Nepal.

Increased Program Participation in Combined Intervention Sites

Communities with children participating in the combined capsule distribution and infection control intervention sustained a greater level of community participation than those villages where only capsules are delivered. The inclusion of selected primary health care components with the vitamin A capsule distribution program did increase participation rates for the capsule. Additionally, more wards had higher levels of participation when the primary health care activities and the capsules were delivered together.

The inclusion of the capsule into primary health care packages increased participation in primary health care activities. In comparing the difference in tactics between the nutrition education and primary health care cohorts, one sees that PHC relies on the mega-dose capsule for dietary supplementation, while nutrition education relies on messages to mothers to improve dietary supplementation. Other activities such as deworming, co-trimoxazole therapy for acute respiratory infection, promoting oral rehydration therapy for severe diarrhea, and immunization are the same in both intervention cohorts. In the nutrition education cohort, the utilization of deworming was consistently lower than in the primary health care cohort, suggesting that the capsule alone increases coverage of deworming in that cohort.

The second hypothesis is also true, that the primary health care package of activities maintains mothers' interest better than the capsule alone or the selected public health activities with nutrition education. The improvement in participation is slight for the capsule and moderate for primary health care activities.

The Vitamin A Child Survival Project has very high participation rates sustained throughout the Project. The exact package of activities within interventions influenced participation rates among mothers. Other factors responsible for the high rates of

participation include the thorough initial training, annual retraining, effective logistics and supervision, and the annual monitoring of 10% of participating mothers. Should the exact activities be replicated without training, reliable logistics and supervision, or monitoring, much lower rates of participation should be expected.

However, there is more than participation rates to consider when evaluating the appropriateness of selected primary health care activities as approaches to control vitamin A deficiency. Other important factors include their impact on the dynamics of community vitamin A nutrition. At the beginning of the study, it was assumed by many of the team members developing the Project that primary health care would have the greatest impact on both xerophthalmia rates and children's nutritional status. However, at the 12 month exam, it was found that in the PHC cohort the risks for Bitot's spots, corneal eye signs, mortality and wasting were higher than among children in either the capsule distribution or nutrition education cohorts.

The nutrition education cohort had all the activities (plus some) found in the primary health care intervention except for capsule distribution. It appears that the selected primary health care activities better reduce Bitot's spots risk in the absence of the capsule, and the capsule performs much better in the absence of primary health care activities. Combining these two activities diminishes the potential effectiveness of both approaches to controlling vitamin A deficiency.

At the individual risk level, different activities bundled as the primary health package can be considered separately. Immunization was always associated with decreased risk for Bitot's spots and wasting. Treatment of diarrhea with oral rehydration therapy was generally positive, but deworming and treatment of ARI with co-trimoxazole had a mixed response; at times statistically reducing risk for Bitot's spots; at times increasing risk. More importantly, ORT and co-tri appear to have some negative consequences on children's nutritional status, increasing risk for wasting. However, the combined deworming capsule program was the only activity having a significant effect on reduction of risk for corneal eye signs, suggesting that this approach is beneficial for the control of nutrition blindness.

We must conclude that information generated by this study requires further evaluation and monitoring as it continues to be utilized by the government of Nepal. Reduced impact among cohorts with high rates of utilization is not due to inaccurate measurement, nor does it appear to be due to randomization error. It is seen across health status measures including Bitot's spots, risk for wasting, risk for mortality and risk for severe morbidity. The children in the combined primary health care and capsule cohorts showed less improvement in health status measures (other than nutrition blindness) over the life of the project than either the capsule cohort or the nutrition education messages combined with the primary health care activities.

The study suggests that deworming plus capsule programs are probably inappropriate as a vitamin A deficiency control strategy for Nepal, even though it is a

popular activity that has high rates of participation where it is offered. It should not be expected to have a significant impact on either the risk for xerophthalmia, or the risk for wasting in Nepal under the present level of caloric availability.

Effective Nutrition Education is the Most Beneficial Intervention

Children participating in the nutrition education intervention whose mothers understood the messages (and altered their child's feeding behavior) had a significant reduction in Bitot's spots and sustained a greater improvement in nutritional status than mothers who had not changed their child's feeding behavior.

This hypothesis is also supported by the results. Dietary and feeding habits, as reported by mothers, were significantly associated with decreased risk for both Bitot's spots and wasting. Information programs reduce risk. The hypothesis assumes that the only measurable effects of nutrition education are changes in the qualities and quantities of vitamin A-rich foods in children's diet (practice). However, in the study it was found that mothers' knowledge alone of vitamin A had some type of protective effect, and if the mother could identify which foods had vitamin A, risk was even further reduced. The quantity of vegetables served children in the nutrition education cohort was also shown to be greater than in the other intervention cohorts during the third monitoring.

There are larger nutritional issues at play besides vegetable consumption. The study area has severe household food security problems. The magnitude of the problem varies from year to year depending on rainfall patterns and the availability of fertilizer. Risk for xerophthalmia and mortality showed a strong relationship to nutritional status, which had a strong association with agricultural patterns and crops produced in the ward. The increased risk of wasting and xerophthalmia seen in areas growing millet requires further exploration. Introduction of crop diversity might have a significant impact on the health status of the children in these sites.

The ability of nutrition education programs to change mother's behavior is predicated on mothers being able to both receive messages and act on them. The nutrition education program not only faced problems with reduced resources for mothers in addressing dietary needs, but also very low rates of maternal literacy. Mothers need to be literate and informed. At the beginning of the study, literate mothers did not have good information, and their children had the same risk for wasting as those of non-literate mothers. By the end of the study, children of literate mothers had the lowest risk for xerophthalmia and wasting. The importance of literacy to improved health status was clear by the 12-month exam, and continued to be important at the 24-month exam.

Literacy programs disseminated nutrition and disease management information to the community. Literacy training materials, developed for educating mothers, contained materials using nutritional and public health messages. A newsletter was

distributed as a part of the literacy programs that allowed mothers to exchange ideas on child care, feeding and disease management.

This Project demonstrated that vegetable consumption can be influenced by community nutrition programs, and that increased consumption reduces risk. The results indicate that those background rates of maternal literacy not only affect risk, but have an affect on the impact of the nutrition education program. To an even greater degree, the risks of a community for xerophthalmia and wasting both appear to have strong association with agricultural patterns and household sanitation levels.

Program impact can be enhanced by improving maternal literacy rates. Sound development policy should also emphasize nutrition consequences for populations growing specific crops. Agricultural programs in crop diversification, better crop production, and better marketing and price support could also play an important role in the control of vitamin A deficiency. These measures should enhance the effect of the diet modification program.

Cost Effectiveness Analysis

The cost-effectiveness of vitamin deficiency control programs can be compared in an analysis with other activities dedicated to control vitamin A deficiency. The interventions that reduce specific types of risk can be compared to determine relative cost-effectiveness. They can also be compared to other alternative investments the ministry of health might make in either health promotion or disease treatment.

Cost-effectiveness is an approach whereby health promotion and disease prevention programs can be compared by some indicator of effectiveness such as health status and disease prevention. The effect of the alternative programs on the indicators at fixed budgetary levels then allows one to compare preferred programs and alternatives. In equal cost comparisons of different programs, the program that produced the lowest death rate or greatest reduction in disease prevention would be selected.

Another approach is to compare the cost to reach a specified level of effect. Again, it is assumed that the activity that produces an adequate impact reduction at the least cost would be the most reasonable policy to endorse.

Historically, cost-effectiveness analyses as applied toward vitamin A deficiency searched for approaches to buy the most "blindness reduction" at specific budgetary levels. Researchers have generally found that a mega-dose capsule distribution program produces the highest levels of benefits at the lowest budgetary levels. It is relatively inexpensive and effective therapy for the reduction of xerophthalmia, and appears to reduce risk for wasting.

The program also found that capsule distribution was both inexpensive and had the greatest effect on Bitot's spot reduction. While nutrition education had potential for greatest effect on nutritional status improvement, it was also more expensive, so that at moderate resource levels, it can be expected that the nutrition education program will outperform capsules to yield better nutritional status or a lower rate of Bitot's spots.

Choice should not be based on Bitot's spots alone. In the past several years, the effectiveness of vitamin A deficiency control programs on reducing child mortality risk has gained wide acceptance. The use of child mortality as an indicator rather than Bitot's spots allows comparison of the different vitamin A activities, not only to each other, but across a wider spectrum of public health interventions that also affect mortality risk. It is important to know how improving vitamin A nutrition compares with other investments to improve health status, such as improving medical care, reducing drug costs, improving traditional birth attendants, or improving primary health care.

A district-specific approach to cost-effectiveness analyses considered the cost and impact of the alternative interventions tested in the program. Considering an average district in the hills or terai having 200,000 people, one expects to find approximately 60,000 children, of whom 780 (if we assume average risk at baseline) might have Bitot's spots if examined during May through September. District-level cost has already been shown in chapter 4, reduction of risk for Bitot's spots in chapter 2, and reduction of risk for wasting in chapter 3. The information from those chapters are summarized in the following table:

Table 5.1 Project Activities, Costs and Risk Reduction Measurements

District Wide Program	5 year cost	Prevalence of Bitot's Spots	Prevalence of Wasted Children	Deaths last 12 months
no intervention	0	780	12000	540
Capsules	85,000	273	9840	308
Primary Health Care	218,000	468	11880	420
Nutrition Education	258,000	312	7920	323
Maternal literacy	145,000	78	9360	270

After having implemented any alternative or a maternal literacy program in all sites at baseline, one could return in five years to subsequently measure the children's health status. Using average risk for Bitot's spots, wasting, and mortality, along with the relative risk information, we project the number of expected cases at the end of five years with other factors influencing xerophthalmia constant.

After five years, one would expect to find the largest reduction of Bitot's spots

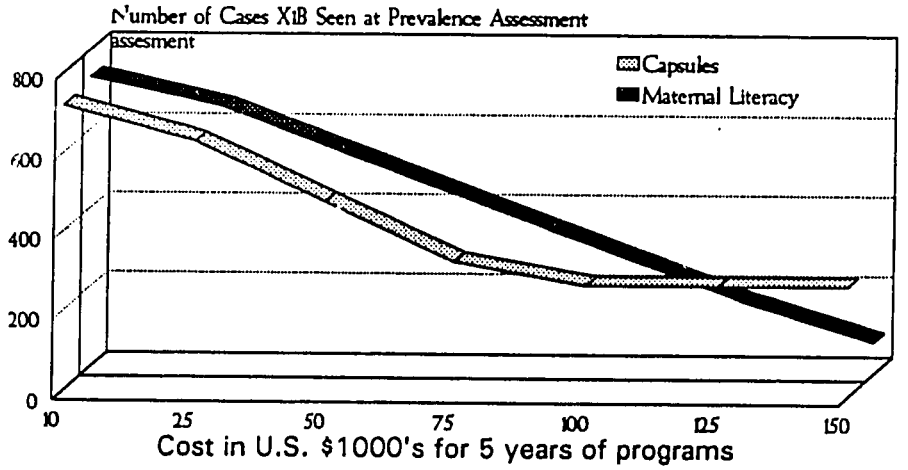
and mortality where maternal literacy programs were implemented. If one could replicate the experience found in the Vitamin A Child Survival Project, the greatest reduction in child wasting would be among the nutrition education cohort.

When considering the effect of a constrained budget, capsule distribution is the least expensive program, at about U.S. $85,000.00. This is about U.S. $17,000.00 per year per district, or less than $0.42 for five years per person ($1.41 per child for 5 years of coverage. While this is less than the cost of one vehicle, it may be more than a district could afford. At the same level of expenditure, the maternal literacy program could have only been extended to 59% of the population, and the number of Bitot's spots in the district prevalence assessment would be 369, which as can be seen in Figure 5.1, is more than would be seen in the capsule cohort. The maternal literacy program trails behind capsule distribution programs until U.S. $105,000.00 is spent per district over five years.

Figure 5.1 Bitot's Spots Found After Five Years at Different Levels of Funding

Bitot's Spots Found After FiveYears at Different Levels of Funding

For Caspule Distribution and Maternal Literacy

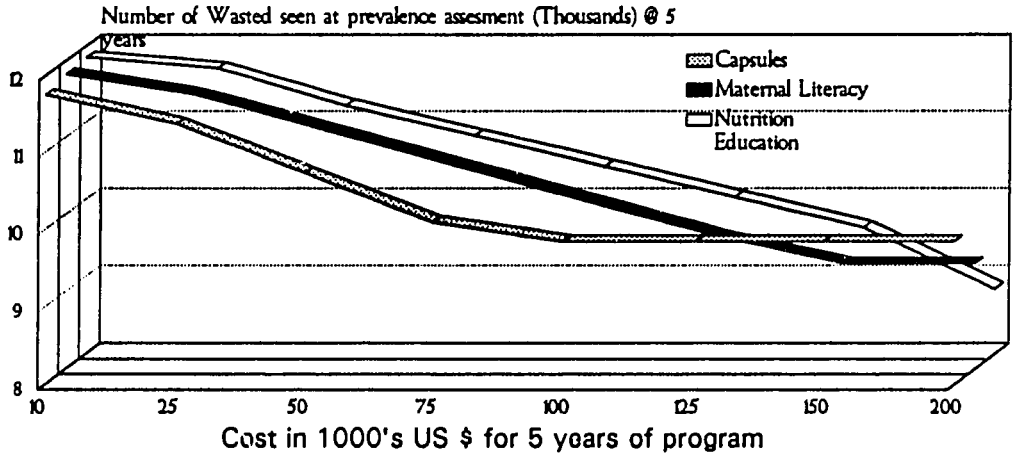


The capsule distribution program continues to be more cost-effective for Bitot's spot reduction until it reaches it's maximum potential. After that point its effect on health status cannot increase, even with additional resources. For the same cost, the capsule distribution program reaches 100% of the children, whereas the maternal literacy program is only taking place in 59% of the sites. Yet, the programs are approximately equal in terms of impact on Bitot's spot prevalence. If resources above U.S. $150,000 for five years per district were made available, then maternal literacy becomes more cost-effective in reduction of Bitot's spots than the capsule program, the primary health care program, or the Nutrition Education program in terms of Bitot's spots risk reduction.

Figure 5.2 Projected Levels of Wasting Reduction in Different Interventions

Bitot's spots found after five years at Different levels of funding

For Caspule Nutrition Education and Maternal Literacy



Another measure of health status used was wasting. The nutrition education intervention had the largest overall reduction on risk of wasting. Of three alternatives for reducing wasting, it is also the most expensive. If we consider the number of wasted children in a district at a prevalence assessment done after five years, nutrition education with maternal literacy only becomes a cost-effective intervention if more than U.S. $105,000.00 is spent for the district over five years. If less than that amount is spent, then the capsule distribution program will have a more significant impact on wasting reduction. At funding levels between $105,000.00 and $145,000.00, the maternal literacy program has the greatest impact on health status. Above funding levels of $145,000.00, nutrition education activities would have the most significant impact on health status. Again, primary health care activities would not be considered, because they produce less reduction in child wasting than the capsule intervention, and at higher cost.

Which of the field-tested activities is more cost-effective, then, depends very much on the resources available to invest in program activities. At budgets of less than $17,000.00 per district per year, the optimal choice is capsule distribution to reduce Bitot's spots and child wasting. If more funds become available, then maternal literacy becomes the most cost-effective investment.

Analysis of mortality reduction reveals several other important issues. During the course of this Project, as well as in two other projects, vitamin A supplementation had a significant impact on the reduction of mortality risk. This study had the advantage of considering the mortality risk for children based on maternal literacy. The impact of capsules on mortality risk is less than might be expected from a program that could increase literacy rates. The capsule is a cheaper method of preventing deaths, but is limited to the biological response of dietary supplementation, which

appears to be less than can be achieved by introducing maternal literacy.

Table 5.2 Projected Levels of Mortality Reduction in Different Interventions

District Wide Program	5 year cost	Annual Deaths	5 Years Deaths Prevented	Cost Per Death Averted
no intervention	0	540		
capsules	85,000	308	1165	$ 73.1
Primary Health Care	218,000	420	600	$ 363.3
Nutrition Education	258,000	322	1090	$ 237.2
Maternal literacy	145,000	270	1350	$ 107.4

Perhaps more important is the fact that all of the approaches are relatively inexpensive on a cost-per-death-avoided basis. The literature suggests very few health promotional activities that can prevent a death for under $100.00. Only vertically-delivered immunization programs, of all the potential community health activities, might compare with the least effective intervention fielded by the study; the primary health care intervention. This suggests that in future government allocations to reduce mortality, the Project's activities define the frontier of efficiency for a given investment level. If the government could effectively deliver any vitamin A programs, it would get more for its money in terms of reduction in mortality than any alternative investment it could make.

Vitamin A programs cannot be delivered in the absence of a basic health care delivery system. However, budgetary priorities based on trying to achieve maximal impact for each dollar spent would contain a vitamin A component. Perhaps funding several approaches to controlling vitamin A deficiency might do more for the overall health status of the population than expanding resources on less productive health activities.

The control of vitamin A deficiency is very cost-effective in Nepal. Of the three formal interventions, and the maternal literacy program, it appears that maternal literacy might have the highest level of health benefits; higher than capsule distribution or primary health care, given that the content of the training material will be messages related to appropriate dietary practices, disease recognition and management, and how to better manage household sanitation. Literacy programs not utilizing appropriate nutrition education materials would not have the effect seen in this Project.

Conclusions: Project Organization and Delivery

In 1986, WHO, UNICEF and USAID initiated activities that led to the development and implementation of the Vitamin A Deficiency Control Project in the seven districts of Nepal considered to have moderate to high risk for xerophthalmia.

The government's village health workers (VHWs) and community health volunteers (CHVs) implemented the program at the community level. The staff of the Ministry of Health was involved in system management, logistics of supplies, and staff supervision. The research Project also assisted in the training of VHWs, CHVs and their supervisors, development of training materials and community instructional materials, maintaining a constant supply of materials to health posts, and monitoring 10% of participating mothers to ensure program effectiveness. In addition, the Project did extensive evaluation of costs, maternal participation levels, and health status of children in study areas.

A major focus of the Project during the implementation of the three interventions was the integration the Vitamin A deficiency control activities into ongoing national programs, thus reducing costs, making the program replicable on a wider scale and sustainable in the future. Due to the low level of staffing and motivation for most of the government staff, and the inherent inefficiency of the community health volunteers program, the Project provided input whenever it was necessary, supporting the primary health care network in its weakest points. This approach was successful. The three interventions were effective and coverage for all the primary health care activities increased in the intervention areas.

The Project provided support to the district offices:

1) Organization and funding of training for both community health volunteers and adult literacy teachers.

2) Production and distribution of educational materials.

3) Procurement and distribution of medicines.

4) Additional supervision in the form of monitoring.

District health offices of the Ministry of Health in the seven Project districts were able to implement the program and achieve significant levels of health improvement among children whose mothers participated in the program. The district health office demonstrated the capacity to act on project-generated information concerning district- and sub-district-level issues.

The interventions are not viable for replication in urban areas, and different strategies have to be adopted to cover the population living in towns. There is a high percentage of children attending primary schools in urban as compared to rural areas. These structures should be utilized and the Ministry of Education should be involved for the delivery of Vitamin A deficiency control activities to the urban sector of the population. Utilization of primary schools is also recommended because of the high prevalence of ocular signs in the age group 5 to 10 years.

The three interventions are all replicable on a national scale in rural areas, but without improvement of the primary health care system, they may not be effective or may have a limited impact. It is also important to realize that program success depends in part on a strong evaluation component. No national program can be successful unless an assessment is conducted prior to implementation and regular monitoring performed in the area where the implementation is already started. Continuing evaluation of the Project will ensure, as much as is possible, that expansion of any of these programs to a national scale will proceed effectively and efficiently.

The Project demonstrated that all activities are affordable, and they are all associated to varying degrees with reduced risk for xerophthalmia. Two activities hold much promise for the control of vitamin A deficiency in Nepal: (1) the capsule distribution program, because it is cheap and relatively effective, and (2) the nutrition education/maternal literacy program, because the profound effect it makes on reducing risk for xerophthalmia, malnutrition, and risk for mortality on the communities where effectively delivered.

Although they are costly, public health activities are well accepted by mothers and make a contribution to the improvement of community vitamin A nutrition, which primarily is demonstrated by reduced risk for corneal eye signs. However, the effect of program interventions on community nutrition depend on caloric availability. In times of caloric adequacy, primary health care appears to facilitate higher rates of child growth. In times of caloric insufficiency, the nutritional status of children utilizing deworming and co-trimoxazole therapy is not helped, and may be harmed instead.

The availability of adequate calories at the household level, therefore, is fundamental to the successful utilization of the primary health care activities. Some type of social caloric safety net must be provided to rural children to reduce the overall background risk for xerophthalmia in these areas.

A social caloric safety net could take several forms. The basic problem is the cyclic nature of rainfall in this area. A period of time when rains are late or reduced will be followed by a few years of good rainfall. The irony is that areas where xerophthalmia is the most endemic (Bara, Parsa) are also areas of fertile soil. In times of high agricultural output, the market surplus is absorbed by India. In times of caloric deficit, there is no buffer food stock, and grain merchants and tenant landlords speculate, exacerbating the problem. The result is, during hard times, increased price for grains, decreased availability to lower class populations, and increased risk for wasting and xerophthalmia.

Another type of caloric safety net may be to provide jobs for the rural poor by encouraging manufacturing, mining, or assembly activities in areas where there have been chronic periodic agricultural disruptions. Children of households having income available from outside activities did not have xerophthalmia. Even when harvests of

household farms are poor due to bad weather, food can be purchased. The government could insure jobs by implementing labor-intensive jobs programs, like public works projects, and expanding them during times of poor agricultural output.

It is interesting to note that in areas where millet is grown there is an increased risk for xerophthalmia and wasting, while areas that grow sugar are at decreased risk. By considering these crops, maternal literacy rates, and sanitation levels one can fairly accurately predict the risk of Bitot's spots within a ward. This suggests that the long-term control of vitamin A deficiency lies more in reducing the impact of the climate and markets on caloric availability, improving maternal literacy, rural housing and sanitation levels, than in delivering dietary supplements.

The Ministry of Health does have the capacity to reduce xerophthalmia and blindness, improve nutritional status, and reduce childhood mortality, if it promotes the control of vitamin A deficiency. It has the manpower and the capability. This problem is too important to the health of the children of Nepal to delegate to some international donor organization. If done effectively, it can be the most cost-effective investment the Government of Nepal could make in promoting children's health.

The findings of this study extend beyond Nepal in their significance. Non-responsive Bitot's spots were a significant portion of the total number of Bitot's spots seen by the 24 month exam. It is not clear whether these are seasonal manifestations, or lesions that occur all year. Children with non-responsive, "recidivist" Bitot's spots generally were taller and thinner at each age with very low body fat and muscle. Bitot's spots' presence was detected in both pre-school and school-age cohorts, but participation in a Project activity was often more effective in risk reduction for xerophthalmia, wasting and mortality among the children over 60 months of age. School-aged children could be accessed through school health programs. Maternal nutrition education messages can also be reinforced by educating children with the same messages at school. A stronger collaboration between education and health officials might also be cost-effective, not only in Nepal, but in other countries with endemic vitamin A deficiency.

When this study was initiated, there was no maternal literacy component. It was added when the low levels of literacy were documented at baseline. Subsequently, with training materials saturated with health and nutrition information, it appeared to be one of the most cost-effective activities in the reduction of xerophthalmia, wasting and mortality. It appears that sectors outside of health, such as agriculture and education, have a potentially more significant role to play in the control of vitamin A deficiency in Nepal.

The most discouraging aspect of the study was the program's lack of effect on risk for corneal xerophthalmia, which is a constant menace to children in all interventions. At the 12-month exam, children in the primary health care cohort seemed to receive some protection related to deworming. From the baseline

examination to the 12 month exam, rates of corneal xerophthalmia decreased in the intervention cohorts. The rates of Bitot's spots decreased again from the 12- to the 24-month exam, but the rates of corneal xerophthalmia increased. While this is understandable, given the increase in background risk, it points to a very significant problem in blindness prevention. It appears that the reduction of risk for Bitot's spots is not always associated with the reduction of risk for corneal xerophthalmia. Child mortality risk among all intervention cohorts steadily declined from baseline through the 12 and 24 month exam, while child mortality risk increased in the symptomatic treatment cohort. While Bitot's spots and mortality became less threatening, the risk of corneal eye signs increased.

The most encouraging aspect of the study was that the children in the study population who participated in the interventions did not deteriorate in overall nutritional status (height for age and weight for height) from the 12- to the 24-month exam. There were agricultural problems, and even though the children showed subtle effects of food shortages such as deterioration of skin fold thicknesses and upper mid arm circumferences, in general they remained well nourished, healthy and alive.

The importance of vitamin A for Nepal should not be underestimated, even though it has never been a major priority for the Ministry of Health. In the 1980 national blindness survey done by the Seva Foundation and Nepal Netra Jyoti Sangh, xerophthalmia was designated as a cause of blindness of secondary importance. As such, it took almost a decade to develop a pilot vitamin A deficiency control program. It should be understood by now that vitamin A deficiency's effect on blindness are of secondary importance to its effect on promoting good overall child health. Vitamin A deficiency increases risk of wasting, it increases risk of severe disease and of death, and occasionally, because of it, children go blind.

LITERATURE CITED

Ash, L.R. and Orihel, T.C. (1987). Parasites: A Guide to Laboratory Procedures and Identification. ASCP Press, Chicago.

American Foundation for the Overseas Blind, (1975). "An Evaluation of the Vitamin A Deficiency Prevention Pilot Project in Indonesia." American Foundation for the Overseas Blind, New York.

Arroyave, G.,Aguilar, J.R., Flores, M., and Guzman, M.A. (1979). "Evaluation of Sugar Fortification with Vitamin A at the National Level," PAHO Publ. No. 384. Pan Am. Health Organ., Washington, D.C..

Bagchi, K., Halder, K., Chowdhury, S., (1959). "Study of Bitot's Spots with special reference to protein malnutrition." Journal of the Indian Medical Association, 33:401-407.

Baksu, T., (1979). "Vitamin A and cancer of epithelial origin." Journal of Human Nutrition, 33:24-31.

Blackfan, K., Wolback, B., (1933). "Vitamin A deficiency in infants." The Journal of Pediatrics, 5:679-706.

Bloch, C., (1924). "Clinical investigation of xerophthalmia and dystrophy in infants and young children." Journal of Hygiene, 29:283-304.

Bradley, D.J., White, G.F., and White, A.U., (1972). Drawers of Water; domestic water use in East Africa. University of Chicago Press.

Brink, E., Perera, D., Broske, S., Cash, R., Smith, J., Sauberlich, H., Bashor, M., (1979). "Vitamin A status of children in Sri Lanka." American Journal of Clinical Nutrition, 32:84-91.

Brown, K., Gaffar, A., Alamgir, S., (1979). "Xerophthalmia, protein-calorie malnutrition, and infections in children." The Journal of Pediatrics, 95:651-656.

Brownrigg, L., (1985). "Home Gardening in International Development: What the Literature Shows." The League for International Food Education, Washington, D.C..

Brubacher, G., (1976). "Early signs of deficiencies of Fat- Soluble Vitamins" Biblthca Nutrition Diets, 23:51-60.

Campos, F., Flores, H., Underwood, B., (1987). "Effect of an infection on vitamin A status of children as measured by the relative dose response." American Journal of Clincial Nutrition, 46:91-94.

Chen, L., Huq, E., Huffman, S., (1981). "A prospective study of the risk of diarrheal diseases according to the nutritiional status of children." American Journal of Epidemiology, 114:284- 292.

Clugston, Dulberg, Pandav, Tilden, (1987). "The Prevalence and Control of Iodine Deficiency Disorders (IDD) in the South East Asia Region." In The Prevention and Control Iodine Deficiency Disorders. edited by Hetzel, B., Dunn, J., and Stanbury, J. Elsevier; Amsterdam.

Cohen, N., Rahman, H., Spraque, J., Jalil, M., Leemhuis, E., Mitra, M., (1985). "Prevalence and determinants of nutritional blindness in

Bangladesh." World Health Statistical Quarterly, 38:317-329.

Cohen, N.; Rahman, H.; Leemhuis de Regt., E.; Sprague, J.; Mitra, M., (1986). "Blinding Malnutrition in rural Bangladesh." Journal of Tropical Pediatrics. 32:73-78.

Cort, W., Schapiro, L., Stoll, N., (1929). "A study of reinfection after Treatment with Hookworm and Ascaris in two villages in Panama." American Journal of Hygiene, 10:614.

Fajans, P. and Sudiman, H., (1983). "The Indonesian National Family Nutrition Improvement Programme." (UPGK), Submitted to UNICEF Jakarta.

Farthing, M., Mata, Urrutia, J., Kronmal, R., (1986). "Natural history of Giardia infection of infants and children in rural Guatemala and its impact on physical growth." American Journal of Clinical Nutrition, 43:395-405.

Fiksel, M., (1986). "A Strategy for Xerophthalmia Control in Nepal." JNSP Coordination Unit, Kathmandu Nepal.

Gopalan, C., Venkatachalam, P., Bhavani, B., (1960). "Studies of Vitamin A Deficiency in Children." American Journal of Clinical Nutrition, 8;833-840.

Government of Indonesia, (1980). "Nutritional Blindness Prevention Project: Characterization of Vitamin A Deficiency and Xerophthalmia in the Design of Effective Intervention Program: Final Report." Jakarta, July.

Helen Keller International, (1985). "Bangladesh Nutritional Blindness Study: Key Results." Dhaka.

Helen Keller International, (1985). "Bangladesh Nutritional Blindness Study: Nutritional Findings." Dhaka.

Helen Keller International, (1986). " Bangladesh Nutritional Blindness Study: Risk Factors." Dhaka.

International Vitamin A Consultative Group (IVACG) (1977). "Guidelines for the Eradication of Vitamin A Deficiency and Xerophthalmia." Nutrition Foundation, New York.

International Vitamin A Consultative Group (IVACG) (1982). "Biochemical Methodology for the Assessment of Vitamin A Status. Nutrition Foundation, New York.

Jayarajan, P., Reddy, V., Mohanram, M., (1980). "Effect of dietary fat on absorption of Beta-carotene from green leafy vegetables in children." Indian Journal of Medical Research, January, 71:53-56.

Krishnan, S., Bhyanb, U., Talwar, G., Ramalingaswami, V., (1974). "Effect of Vitamin A and Protein-Calorie Undernutrition on Immune Responses." Immunology, 27:383-392.

Kusin, J., Sinaga, P., Smit, E., (1980). "Vitamin A status of preschool children in Suka Village, North Sumatra after an Oral Massive Dose." Preceedings of the Meeting on Vitamin A Deficiency and Xerophthalmia, Jakarta, October.

Kutty, P.; Mohanram, M.; Vinodini, R.,(1981). "Humeral Immune Response

in Vitamin A Deficient children." Acta Vitaminol Enzymol. 3:231-235.

Manoff International Inc. (1985). Guide to mass media and support materials for nutrition education in developing countries. Authors, M. Griffiths et.al., International Nutrition Communication Service, Newton, Mass..

Martorell, R., Yarbrough, C., Yarbrough S., Klein R., (1980). "The impact of ordinary illnesses on the dietary intakes of malnourished children." The American Journal of Clinical Nutrition, 33:345-350.

McLaren, D., Shirajian, E., Tchalian, M. Khoury, G., (1965). "Xerophthalmia in Jordan." American Journal of Clincial Nutrition, 17:117-130.

Mejia, L., Pineda, O., Noriega, J., Benitez, J., Falla, G., (1984). "Significane of postprandial blood concentrations of retinol, retinol-binding protein, and carotenoids when assessing the vitamin A status of children." American Journal of Clinical Nutrition, 39:63-65.

Milton, R.; Reddy, V., Naidu, A., (1987). "Mild vitamin A deficiency and childhood morbidity: an Indian experience." American Journal of Clinical Nutrition, 46:827-829.

Muhilal, et.al. (1986). "A Pioneering Project for Combatting Vitamin A Deficiency and Zerophthalmia with MSG Fortified with Vitamin A." Nutritional Research Report. Center for the Research and Development of Nutrition, Agency for the Research and Development of Health. Indonesia.

Muhilal,(1984). "Highlight of Current Studies: Considerations for Program Intervention." Preceedings of the Fourth Asian Nutrition Conference: Human Nutrition Better Nutrition Better Life; Aksornsmai Press, Bankok, Thailand.

New ERA (1986). A Baseline Survey for the Joint Nutrition Support Program; Kathmandu, Nepal.

Ooman, H.A.P.C., (1974). Xerophthalmia in Indonesia. In "Vitamin A Deficiency and Blindness Prevention." American Foundation for the Overseas Blind, New York.

Pereira, S., Begum, A., (1969). "Prevention of Vitamin A Deficiency." American Journal of Clinical Nutrition, 22:858- 862.

Peto, R., Doll, R., Buckley, J., Sporn, M., (1981). "Can dietary beta-carotene materially reduce human cancer rates?" Nature, 290:201-208.

Pinnock, C., Douglas, R., Badcock, N., (1986). "Vitamin A status in children who are prone to respiratory tract infection." Austrial Paediartric Journal, 22:95-99.

Reddy, V., Raghuramulu, N., Arujiyoti, Shivaprakash, M., Underwood, B., (1986). "Absorption of vitamin A by children with diarrhea during treatment with oral rehydration salt solution." Bulletin of the World Health Organization, 64:721- 724.

Resources for Child Health Project, (1987). "ANE Bureau Guidance for Costing of Health Service Delivery Projects." John Snow International, October.

Rodger, F., Saiduzzafar, H., Grover, D., Fazal, A., (1963). "A reappraisal of the ocular lesion know as Bitot's spot." British Journal of Nutrition, 17:475-485.

SEVA Foundation, (1988). The Epidemiology of Blindness in Nepal: Report of the 1981 Nepal Blindness Survey. Edited by G. Brilliant.

Sinha, D., Bang, F., (1973). "Seasonal variation in signs of vitamin A deficiency in rural West Bengal children." Lancet, August 4:228-231.

Sivakumar, B., Reddy, V., (1975). "Absorption of Vitamin A in Children with Ascariasis." Journal Tropical Medical Hygiene, 78:114-115.

Solon, F.S., Popkin,B.M., Fernandez, T.L., and Latham, M.C. (1978). "Vitamin A Deficiency in the Philippines: A study of xerophthalmia in Cebu." American Journal of Clinical Nutrition: 31,360-368.

Sommer, A; Emram, N.; Tjakrasudjatma, S., (1980). "Clinical Characteristics of Vitamin A Responsive and Nonresponsive Bitot's Spots." American Journal of Ophthalmol. 90:160-171 (1980).

Sommer, A., Muhilal, Tarwotjo, I., (1982). "Protein Deficiency and Treatment of Xerophthalmia." Arche Ophthalmol, 100:785-787.

Sommer, A., (1982). Nutritional Blindness, Oxford Press.

Sommer, A., Husaaini, G., Tarwotjo, I., Susanto, D., (1983). "Increased mortality in children with mild vitamin A deficiency." Lancet, September 10:585-588.

Sommer, A., Katz, J., Tarwotjo, I., (1984). "Increased risk of respiratory disease and diarrhea in children with preesixting mild vitamin A deficiency." American Journal of Clinical Nutrition, 40:1090-1095.

Sommer, A. Tarwotjo et al, (1986). "Impact of vitamin A supplementation on childhood mortality." Lancet, May 18.

Swaminathan, M, Susheela, T., Thimmayamma, V., (1970). "Field Prophylactic Trial with a Single Annual Oral Massive Dose of Vitamin A." American Journal of Clinical Nutrition, 23:119-122.

Tarwotjo, I., Tilden, R., Satibi, L., Nendrawati, H.; (1986). "Vitamin A Deficiency Control in Indonesia." In The Control of Vitamin A Deficiency. Academic Press Inc..

Tarwotjo, I., Sommer, A., Soegiharto, T., Susanto, D., Muhilal, (1985). "Dietary practices and xerophthalmia among Indonesian children." American Journal of Clincal Nutrition, 35:574-581.

Tarwotjo, I., Tilden, R., Pettiss, S., Sommer, A., Soedibjo, A., Hussaini, G., Sulistijo, J., Nendrawati, H., (1983). "Interactions of community nutritional status and xerophthalmia in Indonesia." American Journal of Clinical Nutrition, 37:645- 651.

Tarwotjo, I., Sommer, A., Tilden, R., (1980). "The Epidemiology of Vitamin A Deficiency and Xerophthalmia in Indonesia." Proceedings of the Meeting of Vitamin A Deficiency and Xerophthalmia in Jakarta.

Tilden, R., (1985-A). "Assignment Report: Vitamin A deficiency in Southeast Asia, A regional Strategy for Control through Primary Health Care."

Tilden, R., et.al. (1985-B) The Ecology of Vitamin A in Nepal. Department of

Epidemiology, The University of Michigan in Ann Arbor.

Upadhyay, M., Gurung, B., Pillai, K., Nepal, B., (1985). "Xerophthalmia among Nepalese Children." American Journal of Epidemiology, 121:71-77.

Vijayaraghavan, K., Rao, P., Sarma, R., Reddy, V., (1984). "Impact of massive doses of vitamin A on incidence of Nutritional Blindness." Lancet, July 21: 149-151.

Wald, N., Idle, M., Boreham, J., (1980). "Low Serum Vitamin A and Subsequesnt Risk of Cancer." Lancet, October 18: 813-815.

Whittpen, J.; Tseng, S.; Sommer, A.(1986). "Detection of Early Xerophthalmia by Impression Cytology." Archives of Ophthalmology. 104:237-239.

Wolback, B., Howe, P., (1925). "Tissue changes following deprivation of fat-soluble A vitamin." Journal of Experimental Medicine, pp.753-777.

Wolback, B., Howe, P., (1932). "Epithelial Repair in Recovery from Vitamin A Deficiency." Journal of Experimental Medicine, pp.511-523.

World Bank, (1988). "World Development Report 1988." Oxford University Press.

World Health Organization, (1982-A). "Control of Vitamin A Deficiency and Xerophthalmia." WHO Technical Report of a Joint WHO/UNICEF/USAID/Helen Keller International/IVACG Meeting,Report #672.

World Health Organization, (1982-B). "Blindness in Nepal." WHO Statistical Quarterly.

World Health Organization, (1987). "Prevention and control of intestinal parasitic infections." Report of a WHO Expert Committee. WHO Technical Report Series No. 749; Geneva.

Appendix A: Background Determinants for Health Status in the Study Area

Logistic regression was performed on community-level data collected through the survey, as well as household and individual-level data that had been collected at the ward level. Dependent variables were organized by specific categories and a step-wise regression performed for all the variables in that category. Significant variables from each of the categories were then put into a second stepwise regression, to examine community patterns useful in targeting prevention and therapy activities.

Dependent variables consisted of all primary health status measures used in this study. Nutritional status measures were used as independent variable categories in the logistic regression for Xerophthalmia and Mortality. Dependent variables and their codes are shown below.

Table A1
Dependent Variables and Specification of Binary Codes

Variable	Binary Codes
Bitot's Spot	*Binary code 0 for non-risk wards (prevalence X1B=0) and 1 for wards with risk (prevalence X1B>0)*
Corneal Xerosis	*Binary code 0 for non-risk wards (prevalence X2-X3B=0) and 1 for wards with risk (prevalence X2-X3B>0)*
Death Rate	*Binary code 0 for non-risk wards (no death) and 1 for wards with risk of mortality (number of death>0)*
Underweight	*Binary code 0 for mn_waz > - 2.0 and as 1 for mn_waz < - 2.0*
Stunting	*Binary code 0 for mn_haz > - 2.0 and as 1 for mn_haz < - 2.0*
Wasting	*Binary code 0 for mn_whz > - 14 and as 1 for mn_whz < - 14*

Groups of Independent Variables

Dependent variables were categorized by risk based on community-level indicators, household-level indicators, or individual indicators. In general, while the dependent variables were either 0 or 1 to define risk, most individual and household variables were based on proportions of totals falling into specific categories, or in the case of nutritional status, as means. Many ward-level development agriculture and epidemic information was binary (yes or no). Some wards had vastly different rates of risk. This analysis was done to look at factors associated with these levels of risk at each exam period, not the difference in risk from one exam to the next. If the latter were the objective, one would probably consider different approaches to categorization.

Categories chosen are viewed as potential community characteristics useful in program targeting. To improve overall program efficiency, training and supervision could be increased in "higher-risk" areas based on knowledge about the distribution of risk among this sample. We will consider what grouping of significant high-risk variables might be used in the identification of potential high-risk areas.

Table A2 Categories of Candidate Independent Variables to Predict Risk in High-Risk Wards

Category	Measure
1. Community Development	a. The availability of health post b. The availability of VHW c. The availability of CHV d. The availability of Primary School e. The availability of Road f. The availability of transportation g. The availability of electricity h. The availability of market
2. Community Agriculture	a. The types of foods grown b. The type of staple foods c. The availability of staple food d. The availability of fruit e. The availability of vegetables
3. Epidemic in the last year	a. Measles b. GI c. Diarrhea d. Acute respiratory infection e. Malaria f. Meningitis.
4. Ward Economic	a. The availability of credit program b. The availability of bank programs c. The number of shops
5. Other Government Projects	a. Drinking Water b. Latrine program c. Woman's development program d. JNSP e. Adult literacy program f. Village participation
6. Household characteristics and Household wealth	a. Number of HH with own house b. Have own land c. Type of house d. Caste e. Maternal literacy rate

	f. Income generated outside household.
7. Sanitation	a. The availability of water b. The availability of latrine c. Drainage problem d. Washing hands before eating.

8. Vitamin A Child Survival Project	a. Vitamin A Capsule distribution b. Deworming tablets, c. ORS with diarrhea d. Co-trimoxazole treatment e. Mothers have heard of vitamin A f. Mothers who know which food has Vit. A
9. Mean Nutritional Status	a. WAZ b. HAZ c. WHZ

A series of logistic regressions were performed for each dependent variable (just the variable in each category) to search for association between the dependent variable and variables in that category. Variables within categories that demonstrated a statistically significant association with risk for the dependent variable were then incorporated into a second logistic regression that considered the strength of only the most significant variables among the categories. This process was continued for all the dependent variables until patterns of risk were derived for each of the dependent variables. The risks for many of the dependent variables are correlated, with high-risk wards for xerophthalmia, being high-risk wards for wasting and mortality. The patterns of risk seen for one dependent variable is often seen for another dependent variable.

Several rules govern subsequent tables. All variables are listed, and if the variable has a coefficient then it was significant in the intra category regression for that dependent variable. If there is no number, perhaps it was significant in the category, but not when compared to variables outside the category. Numbers in bold face were selected into the intra-category model for 2 or more years. These variables most consistently were associated with risk between wards. After reviewing the variables that occur most often with each dependent variable, we will compare risk across indicators of health status to look for factors that are common to all the measure of poor health that were used in the study.

Regression coefficients measure how well changes in one variable correspond to changes in others. Increases in values are associated with higher levels of predictability of one variable for another. Significance levels of .05 were used. The number of cases in this analysis is limited to the number of wards where censuses were done at all three measurements (395). The regression coefficients also contain signs with a (-) sign indicating an inverse relationship. In a logistic regression; however, we are looking at predicting risk for being a high-risk site. If the sign is positive, then as high death rate, xerophthalmia, and wasting rates increase, a higher percentage of children, mothers or households are found in that category. Sites with high rates of Bitot's spots, corneal xerophthalmia, and mortality are worse off than villages without, so variables with negative slopes have lower risk and are therefore better off.

Bitot's Spots

The majority of significant risk predictors for Bitot's spots are in the community agriculture and household socio-economic status categories. All categories had some risk at baseline, however, the bold-faced variables were significant on the second-order regressions. Ward development and economic structure also affect risk, where wards with markets have less risk. This trend is observed during all three exams, suggesting that economic activity is associated with lower risk. This is not what was found in the province of Aceh in 1982-84[48], where increased risk was found near areas of economic activity.

Community agricultural patterns also help define ward-level risk. Children in wards that grow millet are at exceptionally high risk for Bitot's spots, with those in wards growing corn also at risk. Wards growing sugar, mango and pulses are at decreased risk for Bitot's spots, with sugar-growing areas showing reduced risk at all three examinations, even though these sites are located in the higher-risk terai area.

History of an epidemic of some type of disease was always associated with decreased risk of Bitot's spots, but these associations were never picked out as dominant when comparing between categories in the intra-category analysis. A history of being the site of government projects was also associated with reduced risk, but it too proved unimportant in the Second-Level regression.

The composition of the socio-economic status of the households in the site also played an important role in the determination of ward-level risk. Wards where most families owned their own houses were at increased risk at baseline and at the third year. Wards where many households owned livestock were at decreased risk all three years. Maternal literacy rates were also associated with decreased risk for Bitot's spots, and in wards where household members had incomes generated from outside activities, there was also less risk for Bitot's spots at baseline and the 12-month examination. In wards where xerophthalmia occurred, fewer of the households had latrines, and at baseline more of them had drainage problems.

Table A3 Bitot's Spot First-Level Regression Summary

Factor	Year 1 r^2	Year 2 r^2	Year 3 r^2
Community Development			
The availability of health post			
The availability of VHW			
The availability of CHV		.1407	
The availability of Primary School			
The availability of Road			
The availability of transportation			
The availability of electricity			
The availability of market	**-.3832**	**-.3297**	**-.2557**
Community Agriculture			
The types of foods grown			

Millet	**.2004**	**.2995**	**.2195**
Maize	**.0951**	**.0844**	**.0741**
Barley			
Pulses		**-.1123**	**-.0992**
Papaya			.1122
Sugar	**-.0860**	**-.2132**	**-.1124**
Mango	**-.1548**		**-.1265**
Rice		.0848	
The type of staple foods			
The availability of staple food			
The availability of fruit			
The availability of vegetables			
Epidemic in the last 3 years			
Measles		-.0800	
Diarrhea			-.0867
Acute respiratory infection	-.0745		
Malaria			
Meningitis			
Ward Economic			
The availability of credit			
The availability of bank programs			
The number of shops			
Market in Ward	**-.0402**		**-.0913**
Other Government Projects			
Drinking Water			
Latrine program	-.0555		
Woman's development program			
JNSP		-.0877	
Adult literacy program			
Village participation			
Household characteristics and Household wealth			
Household Garden	.2382		
Number of HH with own house	**.2395**		**.1636**
Have own land			
Livestock	**-.2508**	**-.0685**	**-.1585**
Type of house			
Caste	.0922		
Maternal literacy rate	**-.2000**	**-.2376**	**-.1127**
Percent Puccha House		.0954	
Percent Kacha House			
Income generated outside household.	**-.0907**	**-.1563**	
Sanitation			
The availability of water			
The availability of latrine,	**-.1003**	**-.1552**	**-.1661**
Drainage problem	.2067		
Washing hands before eating.		-.1121	
Vitamin A Child Survival Project			
Vitamin A Capsule distribution		-.0663	
Deworming tablets			
ORS with diarrhea			
Co-trimoxazole treatment			.0856

Mothers have heard of vitamin A			-.1030
Mothers who know which foods have vitamin A		-.1816	
Mean Nutritional Status			
WAZ	-.1837		
HAZ	.3657		
WHZ		-.2225	-.2524

As one would hope, the interventions had no relationships to patterns of risk found at baseline. At the 12-month exam high coverage with the capsule and maternal knowledge of vitamin A were associated with decreased risk for Bitot's spots. By the third year, the education factor of hearing about vitamin A was significantly associated with reduced risk, but the capsules weren't. Furthermore, at the 24-month exam, wards where a higher percentage of mothers reported utilizing co-trimoxazole therapy for acute respiratory infection had higher risk for Bitot's spots, which was also found to be true on the individual-level analysis.

None of the program participation variables were ever selected as significant in the intra-category analysis. This suggests that at all three exams, ward economic activity, agricultural patterns, and household economic characteristics were more important in defining risk for Bitot's spots than were the Project activities.

Ward-level wasting rates were closely and significantly linked with risk for Bitot's spots at the 12- and 24-month exams. One might successfully focus supervision and retraining on CHWs for areas growing millet, or in areas with low literacy rates, or where few people have the opportunity for outside employment, and be able to target the impact of the program to areas with consistently-high risk for Bitot's spots.

Corneal Xerophthalmia

Corneal xerophthalmia risk was associated with fewer predictor variables and categories than Bitot's spots risk. The strongest overall risk for corneal xerophthalmia was found among individual nutritional status characteristics. Risk for corneal xerophthalmia was only associated with wasting at baseline and at the 24-month exam. At 12 months, it was associated with children's height, as it was again at the 24-month exam, suggesting that corneal cases were more likely to occur in areas where the children were taller in stature, and wasted, which has also been seen in other analyses.

High-risk wards for corneal xerophthalmia were likely to have drainage problems at baseline and again at the 12-month exam, but by 24 months, the availability of latrines appeared to be a more significant predictor of risk at the ward level. The only Project parameter that appeared to have any effect on corneal eye signs was the nutrition education component. Characteristics of household wealth, while associated with risk, were always less important than nutritional parameters, community agriculture, and sanitation factors. Household characteristics vary from

year to year in terms of reduced risk. At baseline, households with outside income had reduced risk of corneal xerophthalmia. By the 12-month exam, ownership of livestock became associated with reduced risk, and by the 24-month exam, the availability of a household garden was associated with reduced risk.

The agricultural component of risk suggests that the cultivation of millet and mustard are associated with increased risk for corneal eye signs, as is the cultivation of oranges. The cultivation of sugar; however, is associated with decreased risk.

Targeting areas based on corneal eye signs would again suggest that areas of millet production deserve extra supervision and training of CHVs and VHWs, and that areas with malnourished, tall children have an elevated risk, perhaps requiring food supplementation.

Table A4 Corneal Xerophthalmia

Factor	Year 1	Year 2	Year 3
Community Development			
The availability of health post			
The availability of VHW			
The availability of CHV	-.2964		
The availability of Primary School			
The availability of Road			
The availability of transportation			
The availability of electricity			
The availability of market			
Community Agriculture			
The types of foods grown			
Millet		**.1071**	**.1647**
Mustard	.1273		
Maize			
Barley			
Orange	.0923		
Pulses			
Papaya			
Sugar	**-.2070**	**-.1659**	
Mango			
Rice			
The type of staple foods			
The availability of staple food			
The availability of fruit			
The availability of vegetables			
Epidemic in the last 3 years			
Measles			
Diarrhea			
acute respiratory infection			
Malaria			
Meningitis			
Ward Economic			
The availability of credit			

The availability of bank programs			
The number of shops			
Market in Ward			
Other Government Projects			
Drinking Water			
Latrine program			
Woman's development program			
JNSP			
adult literacy program			
Village participation			
Household characteristics and Household wealth			
Household Garden			-.1230
Number of HH with own house			
Have own land			
Livestock		-.1737	
Type of house			
Caste			
Maternal literacy rate			
Percent Puccha House			
Percent Kacha House			
Income generated outside household	-.1422		
Income generated from land			
Sanitation			
The availability of water			
The availability of latrine			-.1175
Drainage problem	.1750	.0927	
Washing hands before eating			
Vitamin A Child Survival Project			
Vitamin A Capsule distribution			
Deworming tablets			
ORS with diarrhea			
Co-trimoxazole treatment			
Mothers have heard of vitamin A			-.1726
Mothers who know which foods have vitamin A			
Mean Nutritional Status			
WAZ			
HAZ		.2718	.1279
WHZ	-.24[illegible]		-.1654

An interesting aspect of xerophthalmia risk is that Bitot's spot risk is more widespread and appears to have a larger web of risk with low employment opportunity, poverty, low levels of maternal literacy, poor sanitation, and millet or corn production occurring where Bitot's spots are more likely to be seen.

Risk for corneal xerophthalmia, while still elevated in areas growing millet, and infrequently seen in areas growing sugar, is much less associated with household variables. Maternal literacy, which is so important in determining risk for Bitot's

spots, appeared to have no importance at all for risk of corneal xerophthalmia. Each year, one of the household socio-economic variables was associated with lower risk for corneal xerophthalmia, but each year household drainage problems were even more significantly associated with this risk. Corneal xerophthalmia tended to be of increased risk in wards with more wasted children, and/or tall children.

The nutritional combination of being tall and emaciated as a xerophthalmia risk pattern is not so inconsistent with the seasonality of xerophthalmia seen in West Java, prior to its control, which manifests a post-harvest seasonality and was also associated with a growth spurt that depleted meager vitamin A stores.

Of more concern is the fact that at the 12-month and 24-month exam, only two program activity variables were significant in predicting risk for xerophthalmia, and one of those consisted of increased risk for Bitot's spots from participating in primary health care acute respiratory infection therapy. The capsule reduced risk at the 12-month exam, as did being a mother that knew which foods had vitamin A. By the 24-month exam only mothers hearing about vitamin A was still associated with reduced risk for both the Bitot's spots and corneal xerophthalmia.

Community corneal xerophthalmia risk was unaffected by any program activity except for nutrition education. Moreover, the only way to reduce risk for corneal xerophthalmia appears to be to effectively reduce the amounts of wasting in the community. That will only be possible by improving household food security. The results for both Bitot's spots and corneal xerophthalmia suggest that the risk for xerophthalmia cannot be eliminated solely by vitamin A deficiency control programs. At best, these programs reduce risk for individuals living in these high-risk areas, but the determination of high risk for a locality is associated with the agricultural and economic situation, not with participation rates in any of the Project activities.

Communities at Risk for Low-Weight Children

Control of child wasting and growth failure appears to be the preferred approach to controlling corneal xerophthalmia. This section reviews factors influencing community risk for different types of under-nutrition and growth failure. Three attributes of community nutritional status are reviewed. The first to be reviewed will be the characteristics that differentiate sites with low mean weight for age levels (< -2 S.D.) as compared to those with higher levels.

We find a risk pattern where three community characteristics define all the measurable risk: (1) maternal literacy rate, (2) household sanitary facility rate, and (3) whether or not the ward had a passable road. These factors all worked in favor of increased weight for age status in the community. Few factors were associated with increased risk for underweight children on the community level, except growing mangos at the 24-month exam, and drinking water projects at baseline.

Household characteristics (other than maternal literacy) affecting weight-for-age included employment outside the household, which seemed to be associated with less risk of being underweight, and household gardens, cash crops, and drainage problems that were associated with increased risk.

Table A5 Underweight: First-Level Regression Summary

Factor	Year 1	Year 2	Year 3
Community Development			
The availability of health post			
The availability of VHW			
The availability of CHV			
The availability of Primary School	-.2629		
The availability of a Road		**-.2744**	**-.1817**
The availability of transportation			
The availability of electricity			
The availability of market			
Community Agriculture			
The types of foods grown			
Millet		-.1531	
Mustard			
Maize			
Barley			
Orange			-.1069
Pulses			
Papaya			
Potato			-.0992
Sugar			
Mango			.0689
Rice		-.0789	
The type of staple foods			
The availability of staple food			
The availability of fruit			
The availability of vegetables			
Epidemic in the last 3 years			
Measles			
Diarrhea		-.0822	
Acute respiratory infection			
Malaria			
Meningitis			
Ward Economic			
The availability of credit			
The availability of bank programs			
The number of shops			
Market in Ward			
Other Government Projects			
Drinking Water	.1248		
Latrine program			
Woman's development program			
JNSP			

Adult literacy program Village participation			
Household characteristics and Household wealth			
Household Garden	.1153		
Number of HH with own house			
Have own land			
Livestock			
Type of house			
Caste			-.0651
Maternal literacy rate	**-.1488**	**-.0720**	**-.1490**
Percent Puccha House			
Percent Kacha House			
Income generated outside household	-.1880		
Income generated from land		.1286	
Sanitation			
The availability of water			
The availability of latrine		**-.0700**	**-.1040**
Drainage problem	.1712		
Washing hands before eating			
Vitamin A Child Survival Project			
Vitamin A Capsule distribution			
Deworming tablets			
ORS with diarrhea			
Co-trimoxazole treatment			
Mothers have heard of vitamin A			
Mothers who know which foods have vitamin A			

The effect (or lack thereof) of the programs in determining whether a community will be at risk points to a major problem with most government prevention and control programs. Programs can be effective in reducing risk between individuals, but not in preventing the root causes of problems.

Stunting (Height for Age)

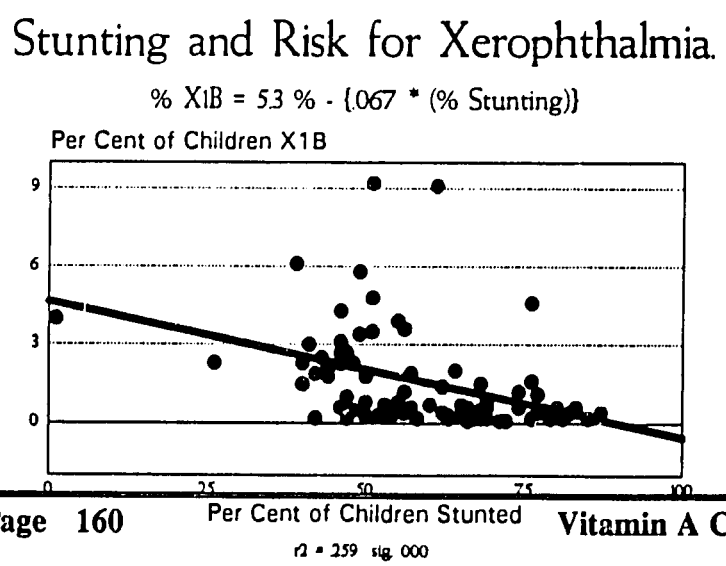


Figure A1

The difficulty with risk for stunting is that there is no indication that stunting is associated with any negative risk measured by xerophthalmia, wasting and mortality. Stunted children with good body mass seemed, if anything, to be at an advantage for reduced risk of

xerophthalmia and mortality. A stunted child appears to be at lower risk for xerophthalmia and wasting. Therefore, sites with higher rates of stunting have lower rates of xerophthalmia as can be seen in Table A6. The significance of the relationship between stunted population and low risk for xerophthalmia appears to be strongest at baseline, but two years of program activity do not much reduce its strength of association or significance. It undoubtedly reflects risk differences between hill and terai children. While hill children are much more likely to be stunted, and terai children are more like to be wasted, it might also be interpreted as indicating that smaller children are more adapted to the hazards of growing in calorie-scarce Nepal.

Table A6 Rates of Stunting and Xerophthalmia

examination	r^2	sig.
baseline	.225885	.0000
12-month	.21062	.0000
24-month	.12610	.0003

High risk for stunting then is associated with low risk for xerophthalmia. The risk of stunting was associated with various community agriculture and household characteristics, and unfortunately, some program activities.

Community barley production was associated with increased risk of stunting, while millet cultivation was associated with decreased risk of stunting. Orange and papaya production where associated with decreased rates of stunting, while sugar and mango were not so significant.

Selected household characteristics were also associated with decreased risk for stunting, with livestock ownership and maternal literacy rates associated with increased risk. Households with outside incomes also had much higher rates of stunting. The availability of water was associated with decreased rates of stunting, while the availability of latrines was associated in the second year with increased rates of stunting.

Table A7 Stunting: First-Level Regression Summary

Factor	Year 1 r^2	Year 2 r^2	Year 3 r^2
Community Development			
The availability of health post			
The availability of VHW			
The availability of CHV			
The availability of Primary School			
The availability of Road			
The availability of transportation	-.2401		
The availability of electricity			
The availability of market			

Community Agriculture			
The types of foods grown			
Barley	.1384	.0737	.1369
Millet	-.2799	-.3142	-.1918
Mustard			
Maize			-.0692
Barley			
Orange	-.0819		-.0928
Papaya	-.1112	-.1581	
Sugar	.1574	.1291	
Mango	.1216	.1396	.1284
The type of staple foods			
The availability of staple food			
The availability of fruit			
The availability of vegetables			
Epidemic in the last 3 years			
Measles			
Diarrhea			.0623
Acute respiratory infection			
Malaria			
Meningitis			
Ward Economic			
The availability of credit			
The availability of bank programs			
The number of shops			
Market in Ward			
Other Government Projects			
Drinking Water			
Latrine program			
Woman's development program			
JNSP			
Adult literacy program			
Village participation			
Household characteristics and Household wealth			
Household Garden		.2604	
Number of HH with own house	-.2932		
Have own land			
Livestock	.3207	.1217	
Type of house			
Caste		-.0656	-.0727
Maternal literacy rate	.1229		.0902
Percent Puccha House			
Percent Kacha House			
Income generated outside household.	.0949	.1297	
Income generated from land		.0761	
Sanitation			
The availability of water		-.1670	
The availability of latrine		.1131	
Drainage problem			
Washing hands before eating.		.1085	

Vitamin A Child Survival Project			
Vitamin A Capsule distribution			
Deworming tablets			-.0230
ORS with diarrhea			
Co-trimoxazole treatment		**.0897**	**-.0998**
Mothers have heard of vitamin A		-.1007	
Mothers who know which foods have vitamin A		**-.1963**	**.1415**

Two Project activities that over both measurements affected the risk for stunting were co-trimoxazole treatment and "mothers being able to correctly identify which foods contained vitamin A." In the first year, co-trimoxazole treatment is associated with increased risk for stunting, while in the second it is associated with decreased risk. Mothers knowing which foods have vitamin A also has this cross over. At the 12-month exam, knowledgeable mothers are associated with a decreased risk of stunting, while at the 24-month they are associated with increased risk of stunting.

What is unclear about stunting is not why it occurs, but why when there is reduced caloric availability in areas, that a policy maker would want to prioritize small children for nutrition improvement programs to control stunting. Weight gain and body mass gain are associated with decreased risk of xerophthalmia. Tall children in this environment are sometimes wasted if they suffered from growth faltering due to disease or limited caloric availability. Inducing linear growth in the absence of caloric availability increases the risk of wasting, as we will see in the next section.

The use of stunting for program targeting is that in populations with high proportions of stunted children, xerophthalmia will be less of a problem than in populations with rapidly growing children.

Wasting (Weight for Height)

Many wards had means of < 1.4 S.D. weight-for-height (WHZ) scores. These wards were considered "wasted." More variables in the community socio-economic status and household categories are associated with risk for wasting. They included agricultural patterns, a history of diarrhea or measles epidemics, the presence of markets, whether households had livestock, maternal literacy, and household income generated from household or outside activities.

Wasting, unlike stunting, is associated with increased risk for xerophthalmia and increased risk of mortality. As discussed, the relationship between xerophthalmia and wasting is the opposite of the relationship between xerophthalmia and stunting.

Areas where barley was grown were less likely to be "wasted" at all exams. Areas where millet was grown were more likely to be wasted, as were areas growing maize and oranges. Areas growing sugar were at decreased risk for wasting. A history

of recent diarrhea epidemics at baseline and the 24-month exam were associated with decreased risk of wasting (suggesting wasted children in these sites may have died during these epidemics). Areas that had markets were less likely to have high levels of wasting.

In areas where large numbers of households had livestock or literate mothers a lower risk for wasting was found. Areas with income opportunities from crops or free time were also much less wasted.

Table A8 Wasting: First-Level Regression Summary

Factor	Year 1 r^2	Year 2 r^2	Year 3 r^2
Community Development			
The availability of health post			
The availability of VHW			
The availability of CHV			
The availability of Primary School			
The availability of Road			
The availability of transportation		.1701	
The availability of electricity			
The availability of market	*-.3960*		
Community Agriculture			
The types of foods grown			
Barley	**-.0746**	**-.1552**	**-.1990**
Millet	**.2196**	**.3104**	**.3630**
Mustard			
Maize	**.0617**		**.1181**
Barley			
Orange	**.1871**	**.0837**	
Papaya			
Sugar	**-.1147**	**-.2041**	**-.1369**
Mango			
The type of staple foods			
The availability of staple food			
The availability of fruit			
The availability of vegetables			
Epidemic in the last 3 years			
Measles		-.0898	
Diarrhea	**-.0649**		**-.1261**
Acute respiratory infection			
Malaria			
Meningitis			
Ward Economic			
The availability of credit			
The availability of bank programs			
The number of shops			
Market in Ward	**-.1491**		**-.1554**
Other Government Projects			
Drinking Water			
Latrine program			
Woman's development program			

JNSP			-.0692
Adult literacy program			
Village participation	.0992		
Household characteristics and Household wealth			
Household Garden		-.0793	
Number of HH with own house	.2286		
Have own land			
Livestock	**-.1955**	**-.1237**	
Type of house			
Caste	**.0853**		**.0728**
Maternal literacy rate		**-.1864**	**-.2210**
Percent Puccha House		.0788	
Percent Kacha House			
Income generated outside household.	**-.2365**	**-.1547**	
Income generated from land	**-.0693**	**-.1503**	
Sanitation			
The availability of water		.1631	.1345
The availability of latrine		-.2272	-.2103
Drainage problem			
Washing hands before eating.			
Vitamin A Child Survival Project			
Vitamin A Capsule distribution		-.1082	
Deworming tablets		.0447	
ORS with diarrhea			
Co-trimoxazole treatment			.1667
Mothers have heard of vitamin A			
Mothers who know which foods have vitamin A			

The availability of water is associated with increased risk for wasting at the 12- and 24-month exams. However, latrines are associated with a decreased risk of wasting, suggesting that perhaps they are seldom found together.

The capsule distribution program appears to reduce risk for wasting at the 12-month exam, but is not at the same level of predictor as household livestock. Deworming tablets also appear to be associated with increased risk for wasting at the 12-month exam, as acute respiratory infection therapy appears to be at the 24-month exam. The fact that public health activities are associated with increases in risk for wasting indicates that perhaps these services should not be universally distributed through village health workers and community health volunteers.

Wasting moreover, is primarily affected by adverse agricultural economics, disease, low household assets and poor sanitation. An effective program to control wasting should help increase the value of crops in areas of high risk (in our Project, millet), or engage in activities that improve family welfare and sources of agricultural production.

To target programs to reduce wasting, one could go to millet growing areas, where households did not grow livestock, and no jobs were available, and mothers were not literate, and find high areas of risk that could benefit from some type of safety net. A safety net is a social mechanism to help those who, for whatever reason, can not thrive in the market system. For the control of xerophthalmia, it would appear that safety nets that improve the nutritional status of children might be especially effective in reducing risk of xerophthalmia.

Mortality

Child mortality varied between wards, and many wards reported no deaths at the 12- and 24-month exams. Those that did, lacked the strong association with agricultural patterns seen when xerophthalmia or wasting were the dependent variables. The mortality analysis is inconsistent over time, except for adult literacy programs. It is hoped that the positive slope means district officers are targeting the programs in areas of high risk. Areas where large numbers of households have gardens are also associated with increased risk for mortality. Areas with latrines, or where it is common practice to wash hands before eating, have a much lower death rate. Yet no program variable has an association with high mortality risk sites for more than one year.

Table A9 Death Rate: First-Level Regression Summary

Factor	Year 1	Year 2	Year 3
Community Development			
The availability of health post			
The availability of VHW			
The availability of CHV			
The availability of Primary School			
The availability of Road			
The availability of transportation	.2210		
The availability of electricity			
The availability of market			
Community Agriculture			
The types of foods grown			
Millet			
Mustard			
Maize			
Barley			
Orange			
Pulses			
Papaya			-.0690
Sugar			
Mango			
Rice			
The type of staple foods			
The availability of staple food			

The availability of fruit			
The availability of vegetables			
Epidemic in the last 3 years			
Measles			
Diarrhea			
Acute respiratory infection			
Malaria			
Meningitis	-.0636		
Ward Economic			
The availability of credit			
The availability of bank programs			
The number of shops			
Market in Ward			
Other Government Projects			
Drinking Water			
Latrine program			
Woman's development program			
JNSP			-.0718
Adult literacy program	**.0916**		**.0735**
Village participation			
Household characteristics and Household wealth			
Household Garden	**.1848**	**.1562**	
Number of HH with own house			
Have own land			
Livestock			
Type of house			
Caste			
Maternal literacy rate		**-.0601**	**-.1122**
Percent Puccha House			
Percent Kacha House			
Income generated outside household			
Income generated from land			
Sanitation			
The availability of water			
The availability of latrine		-.1219	-.1855
Drainage problem	.1786		
Washing hands before eating		-.2033	-.2261
Vitamin A Child Survival Project			
Vitamin A Capsule distribution			
Deworming tablets			
ORS with diarrhea			
Co-trimoxazole treatment			
Mothers have heard of vitamin A		-.0721	
Mothers who know which foods have vitamin A			.0936
Mean Nutritional Status			
WAZ			
HAZ			
WHZ			

Of the community characteristics, some are consistently associated with risk. The following table shows different variables and the number of years that they were either significantly associated with risk or lack of risk in an intra-category analysis. A star is given for each year that is was in the intra-category analysis and the direction of risk is shown in the parenthesis.

Areas where millet is grown have higher risk for Bitot's spots and higher levels of wasting. Children from these areas are taller at every age. Children from areas where sugar is grown have few Bitot's spots, less corneal xerophthalmia, less wasting but are shorter.

Household socio-economic characteristics are also important for determining areas at high risk for different health problems. Household gardens are consistently associated with increased risk for Bitot's spots, corneal xerophthalmia, higher death rates, and taller children. In areas where mothers are literate there is less xerophthalmia, less death, and less wasting.

Household sanitation levels are also strongly associated with risk. Bitot's spots, corneal xerophthalmia, and death are all less common in the presence of latrines and where people practice hand washing. The risk for corneal xerophthalmia and low weight are both increased if there is a drainage problem in the ward. Tall and wasted children have more corneal xerophthalmia and Bitot's spots than short children, or children with adequate body mass.

Project activities' impact on risk reduction for the health problems considered was low. At the ward level, risk was a function of agricultural patterns and household assets (including education). Programs that are oriented toward reducing the impact of the dependent health variables might be more effective if addressed toward the correcting community agricultural problems leading to these risks, or toward helping households achieve a balance with their caloric assets, or better yet, by supplying a safety net to help communities maintain caloric adequacy.

Table A10 Summary: Second-Level Regression

Factor	Bitot's Spots R	Corneal Xero R	Death Rate R	Low Weight R	Low Height R	Wasting R
Community Development						
The availability of health post						
The availability of VHW						
The availability of CHV						
The availability of Primary School						
The availability of Road				* (-)		
The availability of transportation						
The availability of electricity						

The availability of market						* (-)
Community Agriculture						
The types of foods grown						
Barley					*** (+)	** (-)
Millet	* (+)			*(-)	*** (-)	** (+)
Mustard		* (+)				
Maize	* (-)					
Pulses	* (-)					
Orange					* (-)	
Papaya			* (-)		* (-)	
Sugar	** (-)	** (-)			** (+)	* (-)
Mango	* (-)				* (+)	
Rice				*(-)		
The type of staple foods						
The availability of staple food						
The availability of fruit						
The availability of vegetables						
Epidemic in the last 3 years						
Measles	* (-)					* (-)
Diarrhea				* (-)		
Acute respiratory infection						
Malaria						
Meningitis			* (-)			
Ward Economic						
The availability of credit						
The availability of bank programs						
The number of shops						
Market in Ward						** (-)
Other Government Projects						
Drinking Water						
Latrine program						
Woman's development program						
JNSP	* (-)		* (-)			
Adult literacy program			* (+)			
Village participation						* (+)
Household characteristics and Household wealth						
Household Garden	* (+)	* (+)	* (+)		* (+)	* (-)
Number of HH with own house						
Have own land						
Livestock	*(-)				* (+)	
Type of house						
Caste				* (-)		* (+)
Maternal literacy rate	**(-)		** (-)	** (-)		** (-)
Percent Puccha House						
Percent Kacha House						
Income generated outside household				* (-)		
Income generated from land	* (-)					
Sanitation						
The availability of water						
The availability of latrine	* (-)		*(-)			

Drainage problem		*(+)		* (+)		
Washing hands before eating						
Vitamin A Child Survival Project						
Vitamin A Capsule distribution						
Deworming tablets						
ORS with diarrhea						
Co-trimoxazole treatment					* (+)	
Mothers have heard of vitamin A		* (-)				
Mothers who know which foods have vitamin A					* (+)	
Nutrition						
Mean WAZ	* (-)					
Mean HAZ	* (+)	* (+)				
Mean WHZ	* (-)	* (-)				

48 *Aceh final report*

Appendix B: Distribution of Anthropometric Indicators by Age, Sex and Intervention

Table 4.3.29 : Distribution of Anthropometric Indicators by Age, Sex and Intervention - *Baseline*

Age Group	Intervention	N	Weight-for-Height < -2 SD	Weight-for-Height Mean (SD)	Height-for-Age < -2 SD	Height-for-Age Mean (SD)	Weight-for-Age < -2 SD	Weight-for-Age Mean (SD)	TS (mm) Mean (SD)	MUAC (cm) Mean (SD)	Fat (mm2) Mean (SD)	Muscle (mm2) Mean (SD)
0-1 Year	Total	4345	12.0	-0.46 (1.29)	42.0	-1.67 (1.51)	39.4	-1.63 (1.32)	6.86 (1.94)	12.75 (1.16)	405 (123)	897 (177)
	Boys	2223	12.2	-0.45 (1.32)	43.6	-1.71 (1.53)	39.2	-1.63 (1.30)	7.00 (1.99)	12.92 (1.16)	418 (127)	917 (175)
	Girls	2122	11.7	-0.47 (1.28)	40.2	-1.64 (1.49)	39.5	-1.64 (1.34)	6.71 (1.89)	12.58 (1.13)	391 (117)	875 (175)
	Caps	1053	13.0	-0.42 (1.39)	38.1	-1.58 (1.51)	37.1	-1.52 (1.37)	6.73 (1.87)	12.74 (1.23)	397 (123)	904 (189)
	Caps and PHC	1057	10.6	-0.42 (1.24)	44.1	-1.75 (1.47)	39.5	-1.65 (1.29)	7.17 (1.99)	12.76 (1.17)	422 (127)	881 (174)
	PHC and Nut. Ed	1069	12.5	-0.52 (1.28)	42.1	-1.68 (1.49)	40.1	-1.69 (1.24)	6.65 (1.78)	12.79 (1.09)	395 (113)	914 (169)
	Symptomatic	1166	11.7	-0.48 (1.28)	43.3	-1.68 (1.56)	40.5	-1.67 (1.37)	6.91 (2.08)	12.75 (1.14)	408 (128)	891 (173)
1-5 Year	Total	21105	29.0	-1.35 (1.13)	64.6	-2.46 (1.56)	70.6	-2.56 (1.16)	6.90 (1.80)	13.48 (1.09)	429 (121)	1023 (184)
	Boys	10731	29.8	-1.37 (1.13)	64.1	-2.43 (1.52)	70.5	-2.54 (1.13)	6.82 (1.76)	13.57 (1.06)	427 (118)	1043 (182)
	Girls	10374	28.1	-1.33 (1.13)	65.2	-2.48 (1.59)	70.8	-2.59 (1.18)	6.99 (1.84)	13.39 (1.11)	431 (123)	1001 (184)
	Caps	5010	28.0	-1.33 (1.12)	63.5	-2.41 (1.51)	69.0	-2.50 (1.12)	6.86 (1.75)	13.55 (1.08)	429 (119)	1039 (183)
	Caps and PHC	5485	26.2	-1.26 (1.13)	64.5	-2.47 (1.54)	69.1	-2.53 (1.18)	7.08 (1.82)	13.40 (1.08)	436 (121)	999 (180)
	PHC and Nut. Ed	5422	30.4	-1.38 (1.14)	63.5	-2.42 (1.57)	70.7	-2.56 (1.14)	6.73 (1.71)	13.49 (1.08)	420 (115)	1035 (183)
	Symptomatic	5188	31.3	-1.42 (1.11)	67.0	-2.52 (1.59)	73.6	-2.64 (1.19)	6.93 (1.91)	13.47 (1.09)	430 (126)	1020 (189)
5-10 Year	Total	26126	26.7	-1.34 (1.04)	58.8	-2.23 (1.45)	65.0	-2.29 (0.94)	6.00 (1.64)	14.64 (1.18)	409 (114)	1299 (242)
	Boys	13523	28.0	-1.40 (1.03)	60.6	-2.28 (1.49)	68.7	-2.37 (0.94)	5.74 (1.52)	14.65 (1.17)	393 (105)	1314 (242)
	Girls	12603	25.2	-1.28 (1.04)	57.0	-2.18 (1.41)	61.1	-2.20 (0.91)	6.28 (1.71)	14.63 (1.19)	426 (120)	1280 (240)
	Caps	6541	22.3	-1.25 (0.98)	62.6	-2.35 (1.36)	66.0	-2.31 (0.91)	6.04 (1.62)	14.68 (1.16)	413 (114)	1305 (234)
	Caps and PHC	6484	26.0	-1.29 (1.09)	59.1	-2.22 (1.46)	64.1	-2.29 (0.95)	6.12 (1.69)	14.55 (1.18)	415 (116)	1276 (241)
	PHC and Nut. Ed	6785	28.6	-1.38 (1.05)	56.6	-2.14 (1.44)	63.8	-2.26 (0.93)	5.77 (1.51)	14.62 (1.17)	394 (106)	1307 (240)
	Symptomatic	6316	29.7	-1.43 (1.02)	56.9	-2.19 (1.54)	66.0	-2.30 (0.96)	6.07 (1.71)	14.72 (1.21)	416 (117)	1309 (250)

- *First year evaluation*

Age Group	Intervention	N	Weight-for-Height < -2 SD	Weight-for-Height Mean (SD)	Height-for-Age < -2 SD	Height-for-Age Mean (SD)	Weight-for-Age < -2 SD	Weight-for-Age Mean (SD)	TS (mm) Mean (SD)	MUAC (cm) Mean (SD)	Fat (mm2) Mean (SD)	Muscle (mm2) Mean (SD)
	Total	3537	6.1	-0.31 (1.13)	49.4	-1.97 (1.23)	39.6	-1.69 (1.21)	7.51 (2.16)	12.75 (1.26)	4.36 (1.26)	8.65 (2.31)
	Boys	1808	7.0	-0.35 (1.15)	51.7	-2.01 (1.25)	40.5	-1.70 (1.21)	7.56 (2.14)	12.89 (1.19)	4.43 (1.26)	8.84 (2.22)
	Girls	1729	5.1	-0.27 (1.13)	47.3	-1.94 (1.22)	38.6	-1.68 (1.21)	7.46 (2.18)	12.61 (1.30)	4.30 (1.25)	8.44 (2.40)
0-1 Year	Caps	769	3.7	-0.21 (1.04)	42.7	-1.77 (1.17)	35.0	-1.52 (1.23)	7.90 (2.22)	12.78 (1.12)	4.57 (1.31)	8.42 (1.85)
	Caps and PHC	885	7.3	-0.39 (1.15)	48.4	-1.97 (1.24)	40.1	-1.74 (1.19)	7.90 (2.32)	12.86 (1.29)	4.57 (1.31)	8.67 (2.53)
	PHC and Nut. Ed	907	7.8	-0.40 (1.17)	50.9	-2.03 (1.18)	40.6	-1.74 (1.23)	7.12 (1.84)	12.73 (1.31)	4.15 (1.10)	8.85 (2.41)
	Symptomatic	976	5.2	-0.24 (1.15)	54.4	-2.08 (1.31)	41.7	-1.73 (1.19)	7.23 (2.12)	12.65 (1.24)	4.21 (1.24)	8.57 (2.26)
	Total	20756	14.4	-1.09 (0.89)	65.1	-2.43 (1.46)	64.1	-2.30 (1.03)	7.49 (2.02)	13.31 (1.07)	4.56 (1.29)	9.56 (1.80)
	Boys	10542	15.1	-1.12 (0.88)	63.4	-2.39 (1.43)	62.8	-2.27 (1.01)	7.40 (2.01)	13.39 (1.04)	4.54 (1.29)	9.76 (1.78)
	Girls	10214	13.7	-1.07 (0.90)	66.9	-2.49 (1.48)	65.5	-2.34 (1.05)	7.58 (2.04)	13.22 (1.08)	4.58 (1.30)	9.35 (1.79)
	Caps	4878	12.9	-1.03 (0.90)	61.7	-2.34 (1.41)	60.4	-2.21 (1.01)	7.65 (2.12)	13.41 (1.06)	4.67 (1.35)	9.65 (1.78)
1-5 Year	Caps and PHC	5443	13.2	-1.09 (0.87)	64.0	-2.40 (1.46)	63.1	-2.26 (1.02)	7.81 (2.05)	13.35 (1.06)	4.73 (1.29)	9.49 (1.85)
	PHC and Nut. Ed	5277	16.4	-1.13 (0.91)	67.9	-2.52 (1.44)	66.7	-2.38 (1.01)	7.27 (1.81)	13.22 (1.06)	4.40 (1.18)	9.55 (1.73)
	Symptomatic	5158	15.1	-1.11 (0.89)	66.6	-2.49 (1.50)	66.1	-2.35 (1.06)	7.22 (2.06)	13.24 (1.08)	4.42 (1.31)	9.57 (1.82)
	Total	25043	13.3	-1.07 (0.84)	56.6	-2.16 (1.34)	56.4	-2.08 (0.87)	6.32 (1.86)	14.49 (1.14)	4.25 (1.26)	12.50 (2.36)
	Boys	12823	14.3	-1.13 (0.84)	59.0	-2.24 (1.37)	60.9	-2.17 (0.88)	6.07 (1.79)	14.48 (1.12)	4.09 (1.21)	12.63 (2.34)
	Girls	12220	12.1	-1.02 (0.86)	54.0	-2.10 (1.29)	51.7	-1.99 (0.86)	6.59 (1.90)	14.51 (1.16)	4.43 (1.30)	12.37 (2.36)
	Caps	6113	11.1	-1.02 (0.83)	58.0	-2.23 (1.24)	57.0	-2.09 (0.83)	6.63 (2.03)	14.57 (1.14)	4.46 (1.38)	12.47 (2.35)
5-10 Year	Caps and PHC	6476	12.6	-1.06 (0.84)	55.6	-2.12 (1.36)	55.0	-2.04 (0.90)	6.50 (1.91)	14.52 (1.14)	4.36 (1.27)	12.45 (2.41)
	PHC and Nut. Ed	6432	15.5	-1.13 (0.85)	57.3	-2.19 (1.31)	56.2	-2.12 (0.85)	5.93 (1.52)	14.39 (1.13)	3.97 (1.04)	12.57 (2.31)
	Symptomatic	6022	13.8	-1.08 (0.86)	55.5	-2.13 (1.41)	55.6	-2.06 (0.91)	6.24 (1.88)	14.49 (1.15)	4.23 (1.28)	12.52 (2.35)

Table4.3.29 : Distribution of Anthropometric Indicators by Age and Intervention
- Second year evaluation

Age Group	Intervention	N	Weight-for-Height < -2 SD	Weight-for-Height Mean (SD)	Height-for-Age < -2 SD	Height-for-Age Mean (SD)	Weight-for-Age < -2 SD	Weight-for-Age Mean (SD)	TS (mm) Mean (SD)	MUAC (cm) Mean (SD)	Fat (mm2) Mean (SD)	Muscle (mm2) Mean (SD)
	Total	3403	4.1	-0.31 (1.00)	52.4	-2.06 (1.15)	39.8	-1.72 (1.11)	7.31 (1.66)	12.43 (1.06	4.16 (1.05)	8.21 (1.62)
	Boys	1699	4.5	-0.34 (0.99)	54.5	-2.12 (1.18)	39.7	-1.71 (1.12)	7.41 (1.67)	12.60 (1.05)	4.27 (1.07)	8.43 (1.63)
	Girls	1704	3.7	-0.29 (1.00)	50.2	-2.00 (1.10)	40.0	-1.74 (1.10)	7.21 (1.65)	12.25 (1.04)	4.04 (1.03)	7.98 (1.60)
0-1 Year	Caps	823	4.8	-0.31 (1.02)	50.5	-2.06 (1.14)	41.3	-1.76 (1.07)	7.32 (1.58)	12.49 (1.07)	4.18 (1.01)	8.30 (1.64)
	Caps and PHC	845	3.6	-0.24 (1.04)	56.6	-2.13 (1.17)	39.9	-1.73 (1.15)	7.49 (1.74)	12.43 (1.04)	4.25 (1.10)	8.10 (1.51)
	PHC and Nut. Ed	877	3.6	-0.37 (0.96)	49.4	-1.98 (1.17)	38.1	-1.67 (1.11)	7.19 (1.68)	12.47 (1.12)	4.09 (1.06)	8.36 (1.86)
	Symptomatic	858	4.3	-0.34 (0.97)	53.0	-2.08 (1.13)	40.1	-1.74 (1.11)	7.24 (1.63)	12.34(1.00)	4.10 (1.05)	8.09 (1.43)
	Total	20617	12.5	-1.07 (0.84)	65.6	-2.46 (1.37)	63.7	-2.29 (0.96)	7.30 (1.71)	13.17 (1.06)	4.41 (1.14)	9.48 (1.72)
	Boys	10466	13.0	-1.[illegible] (0.85)	64.4	-2.41 (1.35)	62.7	-2.25 (0.94)	7.19 (1.65)	13.25 (1.04)	4.37 (1.11)	9.66 (1.70)
	Girls	10151	12.0	-1.05 (0.83)	66.9	-2.50 (1.38)	64.6	-2.32 (0.96)	7.41 (1.76)	13.09 (1.08)	4.44 (1.17)	9.27 (1.72)
	Caps	4796	11.6	-1.01 (0.85)	63.5	-2.38 (1.31)	59.4	-2.20 (0.94)	7.41 (1.67)	13.25 (1.06)	4.49 (1.14)	9.53 (1.69)
1-5 Year	Caps and PHC	5333	11.6	-1.05 (0.85)	65.6	-2.45 (1.40)	63.2	-2.28 (0.96)	7.41 (1.77)	13.17 (1.07)	4.46 (1.17)	9.39 (1.72)
	PHC and Nut. Ed	5143	12.9	-1.09 (0.83)	66.2	-2.47 (1.36)	64.7	-2.31 (0.94)	7.23 (1.72)	13.21 (1.06)	4.38 (1.13)	9.56 (1.79)
	Symptomatic	5345	14.0	-1.12 (0.84)	67.1	-2.52 (1.38)	66.9	-2.36 (0.98)	7.15 (1.65)	13.09 (1.07)	4.30 (1.11)	9.39 (1.68)
	Total	25264	11.1	-1.04 (0.82)	54.4	-2.11 (1.25)	53.2	-2.02 (0.82)	6.04 (1.47)	14.38 (1.13)	4.05 (1.04)	12.46 (2.23)
	Boys	12918	12.2	-1.10 (0.81)	56.8	-2.18 (1.28)	58.1	-2.11 (0.82)	5.78 (1.37)	14.34 (1.10)	3.88 (0.96)	12.54 (2.22)
	Girls	12346	9.9	-0.97 (0.82)	51.8	-2.03 (1.23)	48.1	-1.92 (0.80)	6.31 (1.52)	14.42 (1.16)	4.23 (1.09)	12.38 (2.24)
	Caps	6116	9.8	-1.00 (0.80)	56.4	-2.18 (1.19)	54.0	-2.04 (0.80)	6.16 (1.50)	14.37 (1.13)	4.12 (1.07)	12.37 (2.21)
5-10 Year	Caps and PHC	6514	11.0	-1.02 (0.82)	53.5	-2.09 (1.26)	52.7	-1.99 (0.82)	6.13 (1.55)	14.39 (1.13)	4.11 (1.09)	12.43 (2.23)
	PHC and Nut. Ed	6339	12.1	-1.09 (0.80)	53.4	-2. 06 (1.25)	53.7	-2.02 (0.81)	5.98 (1.39)	14.40 (1.13)	4.01 (0.98)	12.54 (2.26)
	Symptomatic	6295	11.6	-1.04 (0.83)	54.3	-2.11 (1.31)	52.5	-2.02 (0.84)	5.88 (1.41)	14.36 (1.13)	3.95 (1.00)	12.52 (2.23)

Table 4.3.29 : Distribution of Anthropometric Indicators by Age and District
- *Baseline*

Age Group	District	N	Weight-for-Height < -2 SD	Weight-for-Height Mean (SD)	Height-for-Age < -2 SD	Height-for-Age Mean (SD)	Weight-for-Age < -2 SD	Weight-for-Age Mean (SD)	TS (mm) Mean (SD)	MUAC (cm) Mean (SD)	Fat (mm2) Mean (SD)	Muscle (mm2) Mean (SD)
0-1 Yr	Bara	515	5.2	-0.89 (1.21)	40.3	-1.55 (1.53)	47.8	-1.85 (1.38)	6.18 (1.69)	12.64 (1.12)	3.66 (1.13)	9.12 (1.60)
	Parsa	405	6.2	-0.84 (1.39)	45.3	-1.78 (1.56)	50.9	-2.00 (1.36)	7.73 (1.91)	12.76 (1.14)	4.52 (1.17)	8.48 (1.74)
	Makwanpur	346	3.5	-0.06 (1.45)	39.8	-1.58 (1.58)	29.6	-1.28 (1.32)	6.07 (1.87)	12.65 (1.25)	3.59 (1.19)	9.23 (1.86)
	Chitwan	520	3.8	- 0.52 (1.09)	29.1	-1.27 (1.37)	30.1	-1.34 (1.24)	6.12 (1.52)	12.95 (1.11)	3.71 (1.03)	9.71 (1.70)
	Nawalparasi	617	4.2	-0.54 (1.22)	40.2	-1.62 (1.49)	39.4	-1.67 (1.27)	7.26 (2.13)	12.77 (1.14)	4.26 (1.33)	8.80 (1.77)
	Palpa	303	1.3	0.01 (1.21)	55.8	-2.21 (1.34)	39.1	-1.66 (1.20)	6.99 (1.64)	12.66 (1.22)	4.09 (1.13)	8.69 (1.73)
	Tanahu	280	2.5	0.12 (1.16)	52.3	-1.99 (1.55)	33.3	-1.44 (1.26)	7.49 (1.84)	12.93 (1.12)	4.44 (1.23)	8.94 (1.70)
1-5 yr.	Bara	3384	15.6	-1.49 (1.12)	59.6	-2.27 (1.73)	70.3	-2.56 (1.25)	6.29 (1.58)	13.36 (1.08)	3.91 (1.08)	10.35 (1.80)
	Parsa	3687	20.2	-1.84 (1.12)	53.9	-2.06 (1.77)	76.1	-2.78 (1.25)	7.42 (1.84)	13.56 (1.11)	4.62 (1.25)	10.09 (1.85)
	Makwanpur	2294	5.5	-1.22 (1.09)	68.4	-2.59 (1.49)	70.0	-2.51 (1.14)	6.71 (1.83)	13.54 (1.08)	4.16 (1.21)	10.27 (1.83)
	Chitwan	3441	11.5	-1.29 (1.08)	59.3	-2.25 (1.37)	64.9	-2.36 (1.09)	6.21 (1.42)	13.64 (1.04)	3.96 (1.02)	10.98 (1.78)
	Nawalparasi	3934	13.0	-1.45 (1.07)	69.8	-2.65 (1.46)	76.1	-2.73 (1.11)	7.14 (1.90)	13.46 (1.10)	4.41 (1.24)	10.07 (1.95)
	Palpa	2219	8.8	-0.93 (1.03)	74.7	-2.84 (1.31)	66.6	-2.43 (1.03)	6.87 (1.60)	13.44 (1.11)	4.27 (1.14)	10.14 (1.70)
	Tanahu	2146	6.2	-0.73 (1.01)	75.2	-2.85 (1.36)	65.5	-2.38 (1.07)	7.56 (1.82)	13.40 (1.03)	4.63 (1.22)	9.70 (1.63)
5-10 yrs.	Bara	3981	14.2	-1.59 (1.01)	45.7	-1.83 (1.52)	60.8	-2.19 (1.03)	5.54 (1.45)	14.65 (1.24)	3.81 (1.04)	13.27 (2.43)
	Parsa	4429	20.5	-1.97 (0.98)	35.7	-1.35 (1.68)	59.2	-2.19 (1.14)	6.48 (1.84)	14.97 (1.25)	4.49 (1.28)	13.33 (2.60)
	Makwanpur	2713	3.6	-1.00 (0.94)	73.4	-2.71 (1.17)	69.0	-2.35 (0.84)	5.87 (1.57)	14.39 (1.11)	3.95 (1.09)	12.56 (2.24)
	Chitwan	4671	8.6	-1.24 (0.98)	59.5	-2.28 (1.21)	63.8	-2.27 (0.88)	5.50 (1.33)	14.77 (1.12)	3.81 (0.98)	13.55 (2.25)
	Nawalparasi	4925	10.7	-1.40 (0.97)	63.5	-2.43 (1.35)	70.2	-2.42 (0.88)	6.25 (1.68)	14.65 (1.16)	4.24 (1.12)	12.83 (2.48)
	Palpa	2733	8.2	-0.98 (0.91)	74.9	-2.75 (1.16)	69.7	-2.35 (0.78)	5.83 (1.43)	14.46 (1.13)	3.93 (1.01)	12.72 (2.30)
	Tanahu	2674	5.7	-0.74 (0.93)	75.6	-2.78 (1.18)	64.4	-2.27 (0.82)	6.36 (1.71)	14.40 (1.09)	4.26 (1.18)	12.32 (2.18)

Table 4.3.29 : Distribution of Anthropometric Indicators by Age and Intervention
- First year evaluation

Age Group	District	N	Weight-for-Height		Height-for-Age		Weight-for-Age		TS (mm)	MUAC (cm)	Fat (mm2)	Muscle (mm2)
			< -2 SD	Mean (SD)	< -2 SD	Mean (SD)	< -2 SD	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
0-1 Yr	Bara	479	11.5	-0.75 (1.08)	51.2	-2.05 (1.20)	50.1	-1.99 (1.17)	6.66 (1.79)	13.34 (1.41)	4.10 (1.13)	10.18 (2.69)
	Parsa	617	8.5	-0.62 (1.13)	48.8	-1.89 (1.31)	48.5	-1.95 (1.26)	8.03 (2.30)	12.19 (1.14)	4.43 (1.31)	7.36 (1.75)
	Makwanpur	274	2.2	0.06 (1.06)	55.8	-2.16 (1.09)	63.5	-1.63 (1.08)	6.96 (2.12)	13.10 (1.01)	4.18 (1.29)	9.52 (1.78)
	Chitwan	586	3.4	-0.10 (1.07)	44.9	-1.81 (1.23)	31.1	-1.49 (1.16)	6.92 (1.75)	12.89 (1.14)	4.15 (1.16)	9.14 (1.85)
	Nawalparasi	803	7.0	-0.36 (1.14)	44.2	-1.84 (1.24)	37.9	-1.66 (1.16)	8.23 (2.37)	12.64 (1.21)	4.66 (1.31)	8.05 (2.32)
	Palpa	411	1.1	0.04 (1.06)	52.9	-2.12 (1.18)	36.5	-1.51 (1.25)	7.50 (1.62)	12.44 (1.05)	4.27 (1.06)	8.08 (1.41)
	Tanahu	367	1.2	0.26 (0.97)	59.2	-2.27 (1.22)	33.8	-1.49 (1.28)	8.06 (2.24)	12.65 (1.09)	4.61 (1.36)	8.10 (1.64)
1-5 yr.	Bara	3425	20.4	-1.25 (0.93)	57.9	-2.22 (1.58)	63.6	-2.31 (1.12)	7.01 (1.80)	13.42 (1.03)	4.33 (1.22)	10.04 (1.66)
	Parsa	3809	21.6	-1.35 (0.87)	56.3	-2.09 (1.66)	63.1	-2.29 (1.18)	7.81 (2.25)	13.16 (1.16)	4.65 (1.42)	9.10 (1.89)
	Makwanpur	2219	8.5	-0.79 (0.90)	74.9	-2.74 (1.34)	62.2	-2.25 (0.99)	7.21 (1.99)	13.37 (1.01)	4.41 (1.27)	9.85 (1.74)
	Chitwan	3146	13.0	-1.07 (0.87)	60.7	-2.29 (1.26)	60.7	-2.19 (0.93)	7.00 (1.71)	13.55 (1.03)	4.44 (1.17)	10.23 (1.69)
	Nawalparasi	3875	16.2	-1.20 (0.84)	66.1	-2.49 (1.38)	70.0	-2.42 (0.96)	8.24 (2.15)	13.24 (1.05)	4.91 (1.33)	9.03 (1.79)
	Palpa	2091	6.6	-0.90 (0.80)	73.3	-2.74 (1.31)	65.8	-2.33 (0.95)	7.25 (1.55)	13.22 (1.05)	4.41 (1.10)	9.57 (1.56)
	Tanahu	2191	4.9	-0.71 (0.82)	78.2	-2.92 (1.26)	61.5	-2.29 (0.93)	7.61 (2.13)	13.20 (1.03)	4.57 (1.32)	9.31 (1.73)
5-10 yrs.	Bara	3780	18.8	-1.26 (0.86)	39.8	-1.68 (1.38)	53.2	-1.88 (0.96)	5.77 (1.43)	14.68 (1.17)	3.97 (1.04)	13.22 (2.33)
	Parsa	4480	20.2	-1.33 (0.81)	34.4	-1.42 (1.46)	56.6	-1.79 (1.01)	6.89 (2.24)	14.61 (1.25)	4.62 (1.50)	12.41 (2.62)
	Makwanpur	2485	6.3	-0.74 (0.83)	73.4	-2. 69 (1.13)	39.0	-2.19 (0.77)	6.07 (1.56)	14.30 (1.05)	4.04 (1.08)	12.28 (2.10)
	Chitwan	4223	11.8	-1.05 (0.82)	58.1	-2. 24 (1.10)	42.8	-2.12 (0.79)	5.91 (1.45)	14.67 (1.09)	4.09 (1.06)	13.10 (2.16)
	Nawalparasi	4804	14.9	-1.18 (0.83)	59.9	-2.29 (1.25)	36.8	-2.22 (0.81)	6.99 (2.11)	14.43 (1.08)	4.64 (1.38)	11.98 (2.35)
	Palpa	2650	7.8	-0.89 (0.79)	72.8	-2.69 (1.11)	34.1	-2.28 (0.75)	5.89 (1.41)	14.31 (1.10)	3.93 (1.00)	12.43 (2.17)
	Tanahu	2621	5.1	-0.74 (0.79)	77.2	-2.77 (1.07)	34.8	-2.25 (0.75)	6.25 (1.84)	14.22 (1.10)	4.13 (1.24)	12.01 (2.19)

Table 4.3.29 : Distribution of Anthropometric Indicators by Age and Intervention
- Second year evaluation

Age Group	District	N	Weight-for-Height		Height-for-Age		Weight-for-Age		TS (mm)	MUAC (cm)	Fat (mm2)	Muscle (mm2)
			< -2 SD	Mean (SD)	< -2 SD	Mean (SD)	< -2 SD	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
0-1 Yr	Bara	474	5.2	-0.54 (0.94)	54.8	-2.08 (1.18)	50.8	-2.01 (1.15)	7.29 (1.62)	12.24 (1.16)	4.09 (1.04)	7.91 (1.85)
	Parsa	528	6.2	-0.61 (0.99)	52.9	-2.09 (1.20)	44.9	-1.93 (1.12)	6.64 (1.77)	12.46 (0.99)	3.81 (1.06)	8.59 (1.61)
	Makwanpur	372	3.5	-0.13 (1.05)	47.1	-1.92 (1.11)	29.8	-1.54 (1.03)	7.71 (1.63)	12.32 (0.93)	4.31 (1.05)	7.82 (1.25)
	Chitwan	561	3.8	-0.33 (0.98)	39.6	-1.75 (1.07)	33.5	-1.51 (1.04)	7.47 (1.57)	12.50 (1.10)	4.25 (1.03)	8.24 (1.70)
	Nawalparasi	678	4.2	-0.29 (0.98)	53.7	-2.11 (1.16)	44.2	-1.82 (1.06)	7.57 (1.58)	12.31 (0.94)	4.26 (1.02)	7.86 (1.21)
	Palpa	411	1.3	-0.14 (0.95)	61.4	-2.31 (1.08)	37.7	-1.60 (1.17)	6.94 (1.59)	12.64 (1.14)	4.05 (1.07)	8.75 (1.74)
	Tanahu	379	2.5	0.05 (0.97)	65.3	-2.39 (1.13)	32.5	-1.52 (1.10)	7.34 (1.67)	12.78 (1.06)	4.29 (1.07)	8.79 (1.70)
1-5 yr.	Bara	3390	15.6	-1.18 (0.85)	60.5	-2.33 (1.53)	62.8	-2.30 (1.05)	7.42 (1.71)	12.88 (1.01)	4.37 (1.14)	8.88 (1.49)
	Parsa	3600	20.2	-1.34 (0.83)	58.3	-2.22 (1.51)	65.5	-2.36 (1.03)	6.58 (1.61)	13.67 (1.08)	4.07 (1.07)	10.21 (1.86)
	Makwanpur	2248	5.5	-0.77 (0.80)	73.8	-2.69 (1.28)	61.0	-2.20 (0.93)	7.97 (1.73)	13.03 (0.98)	4.71 (1.15)	8.81 (1.35)
	Chitwan	3218	11.5	-1.04 (0.82)	59.2	-2.24 (1.22)	58.3	-2.15 (0.90)	7.61 (1.69)	13.21 (1.04)	4.59 (1.13)	9.36 (1.64)
	Nawalparasi	4058	13.0	-1.15 (0.82)	66.8	-2.49 (1.28)	67.2	-2.36 (0.89)	7.43 (1.62)	13.08 (1.04)	4.46 (1.12)	9.23 (1.53)
	Palpa	2011	8.8	-0.99 (0.76)	72.7	-2.68 (1.28)	66.6	-2.34 (0.88)	6.89 (1.54)	13.44 (1.13)	4.27 (1.09)	10.17 (1.84)
	Tanahu	2092	6.2	-0.71 (0.82)	78.9	-2.87 (1.21)	63.2	-2.27 (0.94)	7.27 (1.69)	13.36 (1.07)	4.46 (1.14)	9.81 (1.73)
5-10 yrs.	Bara	4096	14.2	-1.17 (0.81)	41.5	-1.70 (1.39)	45.6	-1.84 (0.93)	6.00 (1.54)	14.17 (1.13)	3.97 (1.07)	12.08 (2.20)
	Parsa	4478	20.5	-1.35 (0.80)	36.9	-1.58 (1.34)	46.8	-1.88 (0.91)	5.76 (1.25)	14.73 (1.20)	3.98 (0.94)	13.31 (2.35)
	Makwanpur	2693	3.6	-0.67 (0.74)	69.2	-2.54 (1.09)	55.9	-2.07 (0.73)	6.42 (1.65)	14.09 (1.00)	4.19 (1.11)	11.66 (1.97)
	Chitwan	4271	8.6	-0.98 (0.79)	54.6	-2.12 (1.09)	50.6	-1.99 (0.77)	6.27 (1.61)	14.37 (1.11)	4.19 (1.14)	12.31 (2.19)
	Nawalparasi	4852	10.7	-1.09 (0.77)	56.6	-2.21 (1.18)	58.3	-2.12 (0.76)	5.91 (1.40)	14.31 (1.07)	3.95 (0.99)	12.39 (2.09)
	Palpa	2460	8.2	-0.94 (0.78)	68.3	-2.51 (1.07)	62.4	-2.21 (0.71)	6.06 (1.36)	14.57 (1.13)	4.12 (0.99)	12.81 (2.22)
	Tanahu	2414	5.7	-0.75 (0.80)	72.0	-2.63 (1.03)	60.2	-2.17 (0.70)	6.00 (1.34)	14.39 (1.09)	4.03 (0.96)	12.52 (2.14)

Appendix C: Relative Risk Tables from Chapter 3

Table C.1 New Cases (%) of Bitot's Spots by Activity Paricipation Following First Year of Implementation (12 Month Exam)

New cases (%) of Bitot's Spots by Activity Participation Following First Year of Implementation

Intervention Activities (First Year)		N	Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		45,503	42.18	0.30	0.67	0.45	(0.33 , 0.60)	****
Intervention	Capsule	10,999	83.37	0.17	0.66	0.27	(0.13 , 0.56)	****
	PHC & Caps	11,725	80.90	0.37	0.49	0.75	(0.38 , 1.48)	N.S.
	Nut Ed & PHC	11,670	3.36	0.51	0.35	1.48	(0.24 , 5.19) -	N.S.
	Sympt Treat	11,107	1.30	3.47	1.04	3.34	(1.22 , 7.93) -	***
Nutritional Status	Normal	14,089	42.91	0.46	0.86	0.54	(0.35 , 0.84)	***
	Stunted alone	23,099	42.72	0.18	0.53	0.34	(0.21 , 0.58)	****
	Wasted alone	2,665	38.95	0.58	0.55	1.04	(0.37 , 2.93)	N.S.
	Wasted & Stunted	3,055	37.64	0.43	0.89	0.49	(0.16 , 1.27) -	N.S.
Age of Child	1-5 years	20,002	42.70	0.30	0.65	0.47	(0.30 , 0.74)	****
	5-10 years	24,693	41.95	0.28	0.70	0.40	(0.27 , 0.61)	****
Sex of Child	Boys	23,229	41.41	0.31	0.76	0.41	(0.27 , 0.61)	****
	Girls	22,231	43.00	0.29	0.58	0.51	(0.33 , 0.79)	***
Area	Urban	1,438	50.49	0.00	0.28	0.00	(0.00 , 3.41) -	N.S.
	Rural	44,064	41.91	0.31	0.68	0.46	(0.34 , 0.62)	****
Terrain	Hills	15,773	38.24	0.00	0.12	0.00	(0.00 , 0.46) -	***
	Terrai	29,730	44.27	0.44	1.00	0.44	(0.33 , 0.60)	****
Received Mebendazole		45,489	49.30	0.47	0.56	0.85	(0.66 , 1.10)	N.S.
Intervention	Capsule	10,984	11.74	0.39	0.24	1.64	(0.55 , 4.11) -	N.S.
	PHC & Caps	11,727	86.96	0.36	0.59	0.62	(0.30 , 1.27)	N.S.
	Nut Ed & PHC	11,673	81.68	0.37	0.33	1.12	(0.50 , 2.52)	N.S.
	Sympt Treat	11,106	12.67	2.13	0.92	2.32	(1.54 , 3.50)	****
Nutritional Status	Normal	14,085	48.56	0.63	0.73	0.86	(0.58 , 1.28)	N.S.
	Stunted alone	23,090	50.10	0.34	0.43	0.79	(0.52 , 1.21)	N.S.
	Wasted alone	2,663	50.36	0.60	0.53	1.13	(0.41 , 3.10)	N.S.
	Wasted & Stunted	3,055	50.51	0.65	0.79	0.82	(0.35 , 1.88)	N.S.
Age of Child	1-5 years	19,992	48.71	0.52	0.48	1.10	(0.74 , 1.62)	N.S.
	5-10 years	24,689	49.74	0.43	0.61	0.70	(0.50 , 1.00)	**
Sex of Child	Boys	23,216	49.53	0.52	0.63	0.83	(0.59 , 1.16)	N.S.
	Girls	22,231	49.08	0.43	0.48	0.90	(0.61 , 1.33)	N.S.
Area	Urban	1,436	28.13	0.00	0.19	0.00	(0.00 , 8.87) -	N.S.
	Rural	44,053	49.99	0.48	0.57	0.84	(0.65 , 1.09)	N.S.
Terrain	Hills	15,768	51.13	0.07	0.08	0.96	(0.31 , 2.96)	N.S.
	Terrai	29,722	48.33	0.70	0.80	0.88	(0.68 , 1.14)	N.S.

			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Jeevan Jal		*16,474*	**56.16**	**0.65**	**0.84**	**0.77**	**(0.54 , 1.10)**	N.S.
Intervention	Capsule	*3,918*	53.75	0.28	0.33	0.86	(0.28 , 2.66)	N.S.
	PHC & Caps	*3,713*	62.73	0.52	0.94	0.55	(0.25 , 1.20)	N.S.
	Nut Ed & PHC	*4,161*	69.84	0.55	0.48	1.15	(0.45 , 2.94)	N.S.
	Sympt Treat	*4,683*	40.81	1.36	1.30	1.05	(0.63 , 1.73)	N.S.
Nutritional Status	Normal	*4,717*	58.32	0.69	1.42	0.48	(0.27 , 0.87)	**
	Stunted alone	*8,535*	54.99	0.68	0.60	1.14	(0.67 , 1.94)	N.S.
	Wasted alone	*955*	58.85	0.00	0.51	0.00	(0.00 , 2.43) ~	*
	Wasted & Stunted	*1,209*	56.08	0.74	1.32	0.56	(0.16 , 1.81) ~	N.S.
Age of Child	1-5 years	*8,576*	56.53	0.54	0.83	0.64	(0.38 , 1.08)	*
	5-10 years	*7,652*	55.55	0.80	0.88	0.91	(0.56 , 1.48)	N.S.
Sex of Child	Boys	*8,497*	56.31	0.61	0.84	0.73	(0.44 , 1.20)	N.S.
	Girls	*7,966*	55.99	0.70	0.86	0.81	(0.49 , 1.34)	N.S.
Area	Urban	*399*	77.44	0.32	1.11	0.29	(0.01 , 11.39) ~	N.S.
	Rural	*16,075*	55.63	0.66	0.84	0.78	(0.55 , 1.12)	N.S.
Terrain	Hills	*5,728*	52.90	0.17	0.22	0.74	(0.23 , 2.43)	N.S.
	Terrai	*10,745*	57.90	0.88	1.22	0.73	(0.50 , 1.05)	*
Received Cotrimoxazole		*13,795*	**21.28**	**0.44**	**0.62**	**0.72**	**(0.40 , 1.30)**	N.S.
Intervention	Capsule	*3,225*	13.80	0.00	0.40	0.00	(0.00 , 1.96) ~	N.S.
	PHC & Caps	*3,162*	26.34	0.48	0.47	1.02	(0.28 , 3.10) ~	N.S.
	Nut Ed & PHC	*3,634*	32.91	0.50	0.49	1.02	(0.38 , 2.71)	N.S.
	Sympt Treat	*3,775*	12.29	0.86	1.00	0.86	(0.26 , 2.27) ~	N.S.
Nutritional Status	Normal	*4,004*	21.15	0.24	0.73	0.32	(0.05 , 1.18) ~	N.S.
	Stunted alone	*7,165*	22.47	0.37	0.54	0.69	(0.29 , 1.66)	N.S.
	Wasted alone	*819*	16.85	0.72	0.44	1.64	(0.06 , 15.58) ~	N.S.
	Wasted & Stunted	*1,002*	20.26	0.49	0.50	0.98	(0.04 , 7.88) ~	N.S.
Age of Child	1-5 years	*6,992*	20.81	0.34	0.65	0.53	(0.21 , 1.27) ~	N.S.
	5-10 years	*6,620*	21.95	0.55	0.56	0.98	(0.45 , 2.14)	N.S.
Sex of Child	Boys	*7,118*	20.96	0.47	0.68	0.69	(0.31 , 1.55)	N.S.
	Girls	*6,665*	21.64	0.42	0.56	0.75	(0.31 , 1.80)	N.S.
Area	Urban	*304*	27.63	0.00	0.45	0.00	(0.00 , 49.76) ~	N.S.
	Rural	*13,491*	21.14	0.46	0.62	0.73	(0.41 , 1.33)	N.S.
Terrain	Hills	*4,774*	27.94	0.07	0.17	0.43	(0.02 , 2.91) ~	N.S.
	Terrai	*9,021*	17.77	0.75	0.82	0.91	(0.49 , 1.69)	N.S.

			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Child Fully Immunized		*4,595*	**64.87**	**0.13**	**0.25**	**0.54**	**(0.10 , 2.91)**	**N.S.**
Intervention	Capsule	*1,081*	68.73	0.00	0.00	NA	NA	NA
	PHC & Caps	*1,172*	67.83	0.00	0.27	0.00	(0.00 , 9.01)	N.S.
	Nut Ed & PHC	*1,121*	66.55	0.13	0.00	NA	(0.03 , ∞)	N.S.
	Sympt Treat	*1,219*	57.10	0.29	0.38	0.75	(0.08 , 7.23)	N.S.
Nutritional Status	Normal	*1,020*	70.39	0.00	0.33	0.00	(0.00 , 7.99)	N.S.
	Stunted alone	*2,484*	63.81	0.06	0.11	0.57	(0.02 , 22.13)	N.S.
	Wasted alone	*261*	68.58	0.00	0.00	NA	NA	NA
	Wasted & Stunted	*564*	61.52	0.58	0.46	1.25	(0.10 , 37.10)	N.S.
Age of Child	1-5 years	*4,595*	64.87	0.13	0.25	0.54	(0.12 , 2.40)	N.S.
	5-10 years	----	-----	-----	----	---	------ ------	NA
Sex of Child	Boys	*2,346*	66.45	0.13	0.13	1.01	(0.08 , 29.82)	N.S.
	Girls	*2,243*	63.26	0.07	0.24	0.29	(0.01 , 3.82)	N.S.
Area	Urban	*137*	78.10	0.00	0.00	NA	NA	NA
	Rural	*4,457*	64.46	0.14	0.25	0.55	(0.12 , 2.45)	N.S.
Terrain	Hills	*1,701*	59.55	0.00	0.00	NA	NA	NA
	Terrai	*2,894*	68.00	0.20	0.43	0.47	(0.11 , 2.09)	N.S.
Maternal Literacy		*39,466*	**10.59**	**0.14**	**0.56**	**0.25**	**(0.11 , 0.57)**	********
Intervention	Capsule	*9,597*	13.99	0.00	0.33	0.00	(0.00 , 0.72)	**
	PHC & Caps	*10,090*	10.89	0.18	0.43	0.42	(0.07 , 1.47)	N.S.
	Nut Ed & PHC	*10,170*	12.52	0.16	0.43	0.37	(0.06 , 1.29)	N.S.
	Sympt Treat	*9,609*	4.85	0.21	1.04	0.21	(0.01 , 1.04)	*
Nutritional Status	Normal	*12,259*	12.67	0.13	0.77	0.17	(0.03 , 0.57)	***
	Stunted alone	*20,219*	10.11	0.20	0.41	0.48	(0.15 , 1.20)	N.S.
	Wasted alone	*2,319*	8.62	0.00	0.57	0.00	(0.00 , 3.01)	N.S.
	Wasted & Stunted	*2,669*	8.95	0.00	0.82	0.00	(0.00 , 1.64)	N.S.
Age of Child	1-5 years	*17,438*	11.16	0.10	0.55	0.19	(0.03 , 0.63)	***
	5-10 years	*21,396*	10.27	0.18	0.57	0.32	(0.10 , 0.79)	**
Sex of Child	Boys	*20,154*	10.99	0.09	0.65	0.14	(0.02 , 0.46)	***
	Girls	*19,277*	10.17	0.20	0.47	0.43	(0.13 , 1.07)	*
Area	Urban	*1,287*	43.36	0.00	0.27	0.00	(0.00 , 4.54)	N.S.
	Rural	*38,178*	9.49	0.17	0.57	0.29	(0.13 , 0.66)	***
Terrain	Hills	*13,778*	9.86	0.07	0.09	0.83	(0.04 , 4.87)	N.S.
	Terrai	*25,688*	10.99	0.18	0.82	0.22	(0.08 , 0.48)	****

			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		*8,531*	**96.76**	**0.29**	**1.45**	**0.20**	**(0.07 , 0.67)**	****
Intervention	Capsule	*2,229*	94.89	0.09	0.88	0.11	(0.01 , 3.18)	**
	PHC & Caps	*2,607*	95.32	0.36	1.64	0.22	(0.05 , 1.50)	**
	Nut Ed & PHC	*3,355*	98.81	0.36	0.00	NA	(0.04 , ∞)	N.S.
	Sympt Treat	*342*	100.00	0.29	-	-	- -	-
Nutritional Status	Normal	*2,886*	96.50	0.25	1.98	0.13	(0.03 , 0.89)	***
	Stunted alone	*4,345*	97.42	0.17	0.00	NA	(0.05 , ∞)	N.S.
	Wasted alone	*449*	94.65	0.24	4.17	0.06	(0.00 , 2.21)	***
	Wasted & Stunted	*500*	96.00	1.46	0.00	NA	(0.07 , ∞)	N.S.
Age of Child	1-5 years	*3,805*	96.95	0.35	0.86	0.41	(0.07 , 8.80)	N.S.
	5-10 years	*4,640*	96.70	0.25	1.31	0.19	(0.05 , 1.24)	**
Sex of Child	Boys	*4,379*	97.08	0.26	0.78	0.33	(0.06 , 7.21)	N.S.
	Girls	*4,145*	96.43	0.33	1.35	0.24	(0.06 , 1.57)	N.S.
Area	Urban	*510*	99.61	0.20	0.00	NA	(0.00 , ∞)	N.S.
	Rural	*8,022*	96.58	0.30	1.46	0.20	(0.07 , 0.68)	***
Terrain	Hills	*2,937*	98.33	0.07	0.00	NA	(0.00 , ∞)	N.S.
	Terrai	*5,596*	95.93	0.41	1.75	0.23	(0.08 , 0.79)	<.01
Mother Knows All Correct Foods		*39,495*	**8.62**	**0.12**	**0.56**	**0.21**	**(0.08 , 0.57)**	****
Intervention	Capsule	*9,605*	10.10	0.21	0.28	0.74	(0.12 , 2.69)	N.S.
	PHC & Caps	*10,105*	6.83	0.00	0.44	0.00	(0.00 , 1.03)	*
	Nut Ed & PHC	*10,172*	15.75	0.06	0.46	0.14	(0.01 , 0.71)	**
	Sympt Treat	*9,610*	1.45	0.00	1.01	0.00	(0.00 , 2.16)	N.S.
Nutritional Status	Normal	*12,275*	9.34	0.00	0.76	0.00	(0.00 , 0.35)	***
	Stunted alone	*20,227*	9.06	0.05	0.41	0.13	(0.00 , 0.85)	**
	Wasted alone	*2,323*	5.64	0.00	0.55	0.00	(0.00 , 4.77)	N.S.
	Wasted & Stunted	*2,670*	6.70	1.12	0.72	1.55	(0.24 , 5.85)	N.S.
Age of Child	1-5 years	*17,448*	8.52	0.27	0.53	0.51	(0.16 , 1.28)	N.S.
	5-10 years	*21,415*	8.84	0.00	0.57	0.00	(0.00 , 0.28)	****
Sex of Child	Boys	*20,172*	8.58	0.23	0.63	0.37	(0.11 , 0.91)	**
	Girls	*19,289*	8.66	0.00	0.49	0.00	(0.00 , 0.37)	***
Area	Urban	*1,290*	18.84	0.41	0.10	4.31	(0.11 , 168.70)	N.S.
	Rural	*38,204*	8.27	0.06	0.57	0.11	(0.02 , 0.37)	****
Terrain	Hills	*13,785*	10.21	0.00	0.10	0.00	(0.00 , 2.49)	N.S.
	Terrai	*25,711*	7.76	0.20	0.80	0.25	(0.08 , 0.61)	***

			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		*39,378*	**92.15**	**0.51**	**0.68**	**0.75**	**(0.48 , 1.17)**	N.S.
Intervention	Capsule	*9,577*	93.05	0.26	0.60	0.43	(0.16 , 1.45) ~	N.S.
	PHC & Caps	*10,066*	89.46	0.42	0.38	1.12	(0.43 , 3.69) ~	N.S.
	Nut Ed & PHC	*10,142*	93.81	0.40	0.32	1.25	(0.36 , 7.75) ~	N.S.
	Sympt Treat	*9,594*	92.34	0.96	1.50	0.64	(0.34 , 1.20)	N.S.
Nutritional Status	Normal	*12,243*	92.04	0.63	1.33	0.47	(0.26 , 0.85)	**
	Stunted alone	*20,166*	92.57	0.39	0.33	1.16	(0.50 , 3.25) ~	N.S.
	Wasted alone	*2,317*	89.99	0.48	0.86	0.56	(0.13 , 3.74) ~	N.S.
	Wasted & Stunted	*2,662*	91.96	0.82	0.00	NA	(0.54 , ∞) ~	N.S.
Age of Child	1-5 years	*17,407*	92.84	0.50	0.56	0.89	(0.41 , 1.93)	N.S.
	5-10 years	*21,345*	91.75	0.51	0.79	0.64	(0.36 , 1.11)	N.S.
Sex of Child	Boys	*20,115*	92.28	0.58	0.77	0.75	(0.41 , 1.35)	N.S.
	Girls	*19,229*	92.04	0.44	0.59	0.74	(0.37 , 1.47)	N.S.
Area	Urban	*1,290*	92.95	0.17	0.00	NA	(0.00 , ∞) ~	N.S.
	Rural	*38,088*	92.13	0.52	0.70	0.74	(0.47 , 1.16)	N.S.
Terrain	Hills	*13,745*	92.41	0.09	0.10	0.90	(0.15 , 19.63) ~	N.S.
	Terrai	*25,634*	92.02	0.74	0.93	0.79	(0.50 , 1.27)	N.S.
Importance of Wild Greens		*39,431*	**69.90**	**0.31**	**1.01**	**0.31**	**(0.23 , 0.40)**	****
Intervention	Capsule	*9,586*	71.39	0.22	0.44	0.50	(0.23 , 1.07)	*
	PHC & Caps	*10,079*	72.86	0.27	0.77	0.35	(0.19 , 0.65)	****
	Nut Ed & PHC	*10,157*	70.88	0.18	0.91	0.20	(0.10 , 0.38)	****
	Sympt Treat	*9,608*	64.27	0.60	1.72	0.35	(0.23 , 0.52)	****
Nutritional Status	Normal	*12,246*	64.77	0.54	0.97	0.56	(0.36 , 0.85)	***
	Stunted alone	*20,207*	76.99	0.19	1.03	0.19	(0.12 , 0.29)	****
	Wasted alone	*2,321*	56.70	0.53	0.50	1.07	(0.33 , 3.69) ~	N.S.
	Wasted & Stunted	*2,665*	61.39	0.31	1.46	0.21	(0.07 , 0.55) ~	****
Age of Child	1-5 years	*21,377*	69.84	0.33	0.98	0.34	(0.23 , 0.49)	****
	5-10 years	*10,079*	72.86	0.27	0.77	0.35	(0.19 , 0.65)	****
Sex of Child	Boys	*20,143*	69.44	0.39	1.04	0.38	(0.26 , 0.54)	****
	Girls	*19,252*	70.41	0.22	0.97	0.23	(0.15 , 0.36)	****
Area	Urban	*1,285*	38.37	0.00	0.25	0.00	(0.00 , 5.58) ~	N.S.
	Rural	*38,145*	70.96	0.31	1.06	0.30	(0.23 , 0.39)	****
Terrain	Hills	*13,763*	91.34	0.09	0.08	1.04	(0.18 , 22.67) ~	N.S.
	Terrai	*25,668*	58.40	0.50	1.11	0.45	(0.34 , 0.60)	****

RR confidence intervals : Taylor series CI calculated ;
~ designates at least one cell count is < 5 - and mid-p exact CI is used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR1.XLS

Table C.2. New Cases (%) of Bitot's Spots by Activity Paricipation Following Second Year of Implementation (24 Month Exam)

New cases (%) of Bitot's Spots by Activity Participation Following Second Year of Implementation

Intervention Activities (Second Year)		N	Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		*44,016*	**45.23**	**0.23**	**0.39**	**0.59**	**(0.41 , 0.84)**	***
Intervention	Capsule	*10,455*	87.80	0.16	0.16	1.04	(0.27 , 6.75) *	N.S.
	PHC & Caps	*11,466*	89.20	0.24	0.16	1.51	(0.42 , 9.50) *	N.S.
	Nut Ed & PHC	*11,001*	2.22	0.41	0.33	1.26	(0.06 , 6.61) *	N.S.
	Sympt Treat	*11,094*	2.32	1.56	0.50	3.16	(0.97 , 8.08) *	**
Nutritional Status	Normal	*14,974*	45.79	0.29	0.48	0.61	(0.35 , 1.04)	*
	Stunted alone	*22,888*	45.78	0.11	0.31	0.36	(0.19 , 0.70)	***
	Wasted alone	*2,429*	43.64	0.47	0.37	1.29	(0.37 , 4.48)	N.S.
	Wasted & Stunted	*2,663*	41.76	0.36	0.45	0.80	(0.20 , 2.76) *	N.S.
Age of Child	1-5 years	*19,045*	44.78	0.22	0.33	0.67	(0.38 , 1.17)	N.S.
	5-10 years	*24,354*	45.69	0.22	0.43	0.52	(0.32 , 0.83)	***
Sex of Child	Boys	*22,431*	44.86	0.32	0.42	0.76	(0.49 , 1.17)	N.S.
	Girls	*21,502*	45.63	0.12	0.33	0.38	(0.20 , 0.72)	***
Area	Urban	*1,300*	56.92	0.00	0.18	0.00	(0.00 , 14.38) *	N.S.
	Rural	*42,717*	44.87	0.23	0.39	0.60	(0.42 , 0.86)	***
Terrain	Hills	*14,987*	40.97	0.03	0.10	0.32	(0.05 , 1.34) *	N.S.
	Terrai	*29,030*	47.43	0.31	0.56	0.55	(0.38 , 0.79)	***
Received Mebendazole		*44,013*	**50.67**	**0.30**	**0.33**	**0.89**	**(0.64 , 1.25)**	N.S.
Intervention	Capsule	*10,433*	10.90	0.26	0.16	1.64	(0.38 , 5.24) *	N.S.
	PHC & Caps	*11,466*	90.25	0.26	0.00	NA	(0.92 , ∞) *	*
	Nut Ed & PHC	*11,013*	86.43	0.33	0.33	0.97	(0.38 , 2.51)	N.S.
	Sympt Treat	*11,101*	11.68	0.39	0.53	0.73	(0.29 , 1.82)	N.S.
Nutritional Status	Normal	*14,975*	50.75	0.39	0.39	1.00	(0.60 , 1.67)	N.S.
	Stunted alone	*22,883*	50.45	0.20	0.25	0.81	(0.46 , 1.40)	N.S.
	Wasted alone	*2,428*	52.76	0.31	0.52	0.60	(0.15 , 2.18) *	N.S.
	Wasted & Stunted	*2,664*	50.83	0.44	0.38	1.16	(0.35 , 3.82)	N.S.
Age of Child	1-5 years	*19,034*	50.06	0.29	0.28	1.03	(0.61 , 1.76)	N.S.
	5-10 years	*24,261*	51.13	0.31	0.37	0.83	(0.53 , 1.27)	N.S.
Sex of Child	Boys	*22,373*	50.89	0.36	0.40	0.90	(0.59 , 1.38)	N.S.
	Girls	*21,508*	50.57	0.22	0.25	0.87	(0.50 , 1.51)	N.S.
Area	Urban	*1,298*	26.96	0.00	0.11	0.00	(0.00 , 51.46) *	N.S.
	Rural	*42,715*	51.39	0.30	0.34	0.88	(0.63 , 1.23)	N.S.
Terrain	Hills	*14,984*	51.52	0.05	0.10	0.54	(1.38 , 1.86) *	N.S.
	Terrai	*29,029*	50.23	0.43	0.45	0.94	(0.67 , 1.34)	N.S.

Intervention Activities (Second Year)			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Jeevan Jal		***13,196***	**61.15**	**0.35**	**0.45**	**0.77**	**(0.44 , 1.34)**	**N.S.**
Intervention	Capsule	*3,114*	55.65	0.06	0.07	0.80	(0.02 , 31.10) *	N.S.
	PHC & Caps	*3,753*	73.33	0.29	0.60	0.48	(0.17 , 1.40)	N.S.
	Nut Ed & PHC	*2,988*	70.48	0.24	0.68	0.35	(0.11 , 1.14)	*
	Sympt Treat	*3,342*	44.25	1.01	0.54	1.90	(0.85 , 4.24)	N.S.
Nutritional Status	Normal	*3,924*	64.76	0.51	0.58	0.88	(0.37 , 2.14)	N.S.
	Stunted alone	*7,305*	58.69	0.26	0.36	0.70	(0.30 , 1.62)	N.S.
	Wasted alone	*676*	64.79	0.23	0.42	0.54	(0.01 , 21.24) *	N.S.
	Wasted & Stunted	*1,006*	63.22	0.31	1.08	0.29	(0.04 , 1.64) *	N.S.
Age of Child	1-5 years	*7,517*	63.59	0.38	0.40	0.94	(0.44 , 1.99)	N.S.
	5-10 years	*5,584*	57.70	0.31	0.55	0.56	(0.25 , 1.29)	N.S.
Sex of Child	Boys	*6,805*	61.00	0.36	0.64	0.56	(0.28 , 1.13)	N.S.
	Girls	*6,367*	61.36	0.33	0.24	1.37	(0.52 , 3.60)	N.S.
Area	Urban	*226*	88.05	0.00	0.00	NA	NA NA	NA
	Rural	*12,971*	60.68	0.36	0.45	0.79	(0.45 , 1.37)	N.S.
Terrain	Hills	*4,497*	51.90	0.04	0.09	0.46	(0.02 , 6.09) *	N.S.
	Terrai	*8,699*	65.93	0.47	0.71	0.66	(0.37 , 1.17)	N.S.
Received Cotrimoxazole		***11,590***	**25.75**	**0.54**	**0.37**	**1.44**	**(0.79 , 2.64)**	**N.S.**
Intervention	Capsule	*2,784*	17.03	0.42	0.17	2.44	(0.31 , 13.80) *	N.S.
	PHC & Caps	*3,275*	35.79	0.26	0.43	0.60	(0.13 , 2.12) *	N.S.
	Nut Ed & PHC	*2,383*	39.99	0.52	0.42	1.25	(0.38 , 4.11)	N.S.
	Sympt Treat	*3,148*	12.23	1.56	0.47	3.35	(1.27 , 8.86)	***
Nutritional Status	Normal	*3,483*	27.36	0.73	0.51	1.43	(0.57 , 3.60)	N.S.
	Stunted alone	*6,316*	23.23	0.41	0.27	1.53	(0.58 , 4.03)	N.S.
	Wasted alone	*656*	33.23	0.00	0.23	0.00	(0.00 , 38.17) *	N.S.
	Wasted & Stunted	*876*	30.25	0.38	0.65	0.57	(0.02 , 4.60) *	N.S.
Age of Child	1-5 years	*6,239*	27.63	0.46	0.40	1.16	(0.51 , 2.68)	N.S.
	5-10 years	*5,271*	23.47	0.57	0.35	1.63	(0.66 , 4.06)	N.S.
Sex of Child	Boys	*5,955*	26.20	0.64	0.50	1.28	(0.61 , 2.71)	N.S.
	Girls	*5,606*	25.29	0.42	0.24	1.78	(0.64 , 4.89)	N.S.
Area	Urban	*220*	40.91	0.00	0.00	NA	NA NA	NA
	Rural	*11,371*	25.46	0.55	0.38	1.47	(0.80 , 2.68)	N.S.
Terrain	Hills	*3,670*	22.10	0.12	0.14	0.88	(0.04 , 7.03) *	N.S.
	Terrai	*7,920*	27.44	0.69	0.49	1.42	(0.76 , 2.66)	N.S.

			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Child Fully Immunized		*3,860*	**66.97**	**0.15**	**0.16**	**0.99**	**(0.18 , 7.71)**	N.S.
Intervention	Capsule	*850*	67.88	0.17	0.00	NA	(0.03 , ∞)	N.S.
	PHC & Caps	*956*	70.61	0.00	0.00	NA	NA NA	NA
	Nut Ed & PHC	*1,012*	67.89	0.15	0.62	0.24	(0.01 , 3.11)	N.S.
	Sympt Treat	*1,040*	62.02	0.16	0.00	NA	(0.03 , ∞)	N.S.
Nutritional Status	Normal	*848*	69.58	0.00	0.00	NA	NA NA	NA
	Stunted alone	*2,150*	66.67	0.14	0.00	NA	(0.14 , ∞)	N.S.
	Wasted alone	*226*	71.24	0.00	0.00	NA	NA NA	NA
	Wasted & Stunted	*504*	64.68	0.31	1.12	0.27	(0.01 , 3.59)	N.S.
Age of Child	1-5 years	*3,860*	66.97	0.15	0.16	0.99	(0.18 , 7.71)	N.S.
	5-10 years	----	----	----	----	----	------ ------	-----
Sex of Child	Boys	*1,951*	66.94	0.08	0.31	0.25	(0.01 , 3.25)	N.S.
	Girls	*1,883*	67.07	0.16	0.00	NA	(0.14 , ∞)	N.S.
Area	Urban	*100*	78.00	0.00	0.00	NA	NA NA	NA
	Rural	*3,760*	66.68	0.16	0.16	1.00	(0.18 , 7.31)	N.S.
Terrain	Hills	*1,391*	59.09	0.12	0.00	NA	(0.04 , ∞)	N.S.
	Terrai	*2,468*	71.39	0.11	0.28	0.40	(0.04 , 3.85)	N.S.
Maternal Literacy		*38,127*	**12.77**	**0.02**	**0.35**	**0.06**	**(0.01 , 0.42)**	****
Intervention	Capsule	*8,952*	15.67	0.00	0.20	0.00	(0.00 , 1.19)	*
	PHC & Caps	*9,886*	12.83	0.00	0.26	0.00	(0.00 , 0.99)	*
	Nut Ed & PHC	*9,751*	15.83	0.00	0.39	0.00	(0.00 , 0.52)	**
	Sympt Treat	*9,539*	6.85	0.15	0.54	0.28	(0.01 , 1.45)	N.S.
Nutritional Status	Normal	*12,926*	14.86	0.05	0.45	0.11	(0.01 , 2.59)	***
	Stunted alone	*19,866*	12.00	0.00	0.23	0.00	(0.00 , 0.56)	**
	Wasted alone	*2,113*	10.74	0.00	0.48	0.00	(0.00 , 1.23)	N.S.
	Wasted & Stunted	*2,340*	10.51	0.00	0.48	0.00	(0.01 , 1.46)	N.S.
Age of Child	1-5 years	*16,652*	13.55	0.00	0.34	0.00	(0.00 , 0.40)	***
	5-10 years	*20,948*	12.13	0.04	0.36	0.11	(0.02 , 0.79)	***
Sex of Child	Boys	*19,362*	12.94	0.04	0.42	0.09	(0.01 , 0.48)	****
	Girls	*18,694*	12.59	0.00	0.26	0.00	(0.00 , 0.50)	**
Area	Urban	*1,119*	49.87	0.00	0.18	0.00	(0.00 , 19.10)	N.S.
	Rural	*37,008*	11.65	0.02	0.35	0.07	(0.01 , 0.47)	*****
Terrain	Hills	*13,107*	13.76	0.00	0.06	0.00	(0.00 , 3.35)	N.S.
	Terrai	*25,020*	12.25	0.03	0.50	0.07	(0.00 , 0.33)	****

Intervention Activities (Second Year)			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		*37,033*	**55.98**	**0.26**	**0.39**	**0.66**	**(0.46 , 0.95)**	**
Intervention	Capsule	*8,633*	51.81	0.13	0.22	0.62	(0.22 , 1.74)	N.S.
	PHC & Caps	*9,705*	57.17	0.16	0.34	0.48	(0.21 , 1.11)	*
	Nut Ed & PHC	*9,413*	66.99	0.30	0.42	0.72	(0.35 , 1.46)	N.S.
	Sympt Treat	*9,284*	47.45	0.48	0.57	0.83	(0.47 , 1.46)	N.S.
Nutritional Status	Normal	*12,533*	57.21	0.32	0.52	0.61	(0.35 , 1.07)	*
	Stunted alone	*19,318*	55.76	0.17	0.27	0.62	(0.33 , 1.15)	N.S.
	Wasted alone	*2,062*	53.30	0.36	0.52	0.70	(0.17 , 2.77) *	N.S.
	Wasted & Stunted	*2,275*	56.57	0.31	0.61	0.51	(0.13 , 1.87) *	N.S.
Age of Child	1-5 years	*16,207*	56.79	0.27	0.34	0.79	(0.45 , 1.39)	N.S.
	5-10 years	*20,320*	55.59	0.24	0.44	0.54	(0.33 , 0.88)	**
Sex of Child	Boys	*18,800*	56.57	0.33	0.45	0.73	(0.46 , 1.15)	N.S.
	Girls	*18,165*	55.42	0.19	0.31	0.61	(0.34 , 1.11)	N.S.
Area	Urban	*1,099*	70.52	0.00	0.31	0.00	(0.00 , 7.94) *	N.S.
	Rural	*35,934*	55.53	0.27	0.39	0.69	(0.48 , 0.99)	**
Terrain	Hills	*12,834*	52.00	0.05	0.08	0.61	(0.14 , 2.72) *	N.S.
	Terrai	*24,200*	52.78	0.39	0.53	0.74	(0.51 , 1.08)	NS
Mother Knows All Correct Foods		*38,148*	**14.85**	**0.09**	**0.35**	**0.25**	**(0.10 , 0.62)**	***
Intervention	Capsule	*8,953*	15.18	0.00	0.20	0.00	(0.00 , 1.23) *	N.S.
	PHC & Caps	*9,893*	14.98	0.07	0.25	0.27	(0.01 , 1.46) *	N.S.
	Nut Ed & PHC	*9,758*	19.40	0.00	0.41	0.00	(0.00 , 0.41) *	***
	Sympt Treat	*9,546*	9.76	0.43	0.52	0.82	(0.25 , 2.11) *	N.S.
Nutritional Status	Normal	*12,933*	16.06	0.05	0.46	0.10	(0.01 , 0.53) *	***
	Stunted alone	*19,877*	14.29	0.14	0.22	0.63	(0.19 , 1.63) *	N.S.
	Wasted alone	*2,117*	13.60	0.00	0.49	0.00	(0.00 , 2.51) *	N.S.
	Wasted & Stunted	*2,339*	15.39	0.00	0.51	0.00	(0.00 , 1.92) *	N.S.
Age of Child	1-5 years	*16,662*	15.01	0.08	0.33	0.24	(0.04 , 0.83) *	**
	5-10 years	*20,959*	14.80	0.06	0.36	0.18	(0.03 , 0.60) *	***
Sex of Child	Boys	*19,367*	15.08	0.17	0.41	0.42	(0.17 , 1.04)	*
	Girls	*18,710*	14.61	0.00	0.27	0.00	(0.00 , 0.42) *	***
Area	Urban	*1,119*	35.39	0.00	0.14	0.00	(0.00 , 34.69) *	N.S
	Rural	*37,029*	14.23	0.09	0.35	0.27	(0.11 , 0.66)	***
Terrain	Hills	*7,008*	69.59	0.08	0.05	1.75	(0.22 , 43.28) *	N.S.
	Terrai	*14,961*	76.38	0.53	0.11	4.66	(1.85 , 15.09) *	***

Intervention Activities (Second Year)			Participation Rate (%)	XIB Rate of participants	XIB Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		38,104	**97.00**	**0.30**	**0.52**	**0.58**	**(0.25 , 1.31)**	N.S.
Intervention	Capsule	8,941	97.56	0.16	0.46	0.35	(0.06 , 7.48) *	N.S.
	PHC & Caps	9,886	96.54	0.22	0.29	0.75	(0.14 , 15.76) *	N.S.
	Nut Ed & PHC	9,743	97.72	0.33	0.45	0.72	(0.14 , 14.94) *	N.S.
	Sympt Treat	9,534	96.21	0.50	0.55	0.90	(0.26 , 5.56) *	N.S.
Nutritional Status	Normal	12,920	96.94	0.42	0.00	NA	(0.53 , ∞) *	N.S.
	Stunted alone	19,848	97.08	0.19	0.86	0.22	(0.08 , 0.55)	****
	Wasted alone	2,115	97.30	0.44	0.00	NA	(0.07 , ∞) *	N.S.
	Wasted & Stunted	2,338	96.62	0.35	1.27	0.28	(0.00 , 0.67) *	N.S.
Age of Child	1-5 years	16,646	97.09	0.28	1.03	0.27	(0.11 , 0.68)	***
	5-10 years	20,932	96.91	0.33	0.15	2.11	(0.41 , 42.76) *	N.S.
Sex of Child	Boys	19,347	97.02	0.37	0.35	1.08	(0.32 , 6.55) *	N.S.
	Girls	18,687	97.01	0.22	0.72	0.31	(0.12 , 1.01) *	**
Area	Urban	1,119	97.41	0.09	0.00	NA	(0.00 , ∞) *	N.S.
	Rural	36,986	96.99	0.31	0.54	0.57	(0.25 , 1.31)	N.S.
Terrain	Hills	13,087	97.30	0.04	0.56	0.07	(0.01 , 0.52) *	****
	Terrai	25,017	96.85	0.44	0.51	0.87	(0.35 , 2.79) *	N.S.
Importance of Wild Greens		38,097	**78.12**	**0.22**	**0.62**	**0.35**	**(0.24 , 0.50)**	****
Intervention	Capsule	8,944	75.38	0.09	0.41	0.22	(0.08 , 0.61)	***
	PHC & Caps	9,884	76.58	0.08	0.69	0.11	(0.04 , 0.29)	****
	Nut Ed & PHC	9,739	78.84	0.26	0.58	0.45	(0.22 , 0.91)	**
	Sympt Treat	9,531	81.54	0.42	0.91	0.46	(0.26 , 0.85)	**
Nutritional Status	Normal	12,923	73.93	0.25	0.83	0.30	(0.17 , 0.52)	****
	Stunted alone	19,842	82.85	0.16	0.44	0.37	(0.20 , 0.70)	***
	Wasted alone	2,115	66.05	0.43	0.42	1.03	(0.26 , 5.05) *	N.S.
	Wasted & Stunted	2,337	75.40	0.34	0.70	0.49	(0.13 , 1.97) *	N.S.
Age of Child	1-5 years	16,646	79.00	0.18	0.72	0.25	(0.14 , 0.45)	****
	5-10 years	20,924	77.69	0.25	0.58	0.42	(0.26 , 0.69)	****
Sex of Child	Boys	19,344	77.78	0.26	0.77	0.34	(0.21 , 0.53)	****
	Girls	18,683	78.52	0.18	0.42	0.42	(0.23 , 0.77)	***
Area	Urban	1,119	44.15	0.00	0.16	0.00	(0.00 , 24.04) *	N.S.
	Rural	36,978	79.14	0.22	0.66	0.33	(0.23 , 0.48)	****
Terrain	Hills	13,092	92.60	0.05	0.10	0.48	(0.07 , 11.11) *	N.S.
	Terrai	25,005	70.53	0.33	0.69	0.48	(0.33 , 0.70)	****

RR confidence intervals : Taylor series CI calculated ;
designates at least one cell count is < 5 - and mid-p exact CI are used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR5.XLS

Table C.3. New Cases (%) of Corneal Xerophthalmia by Activity Paricipation Following First Year of Implementation (12 Month Exam)

New cases (%) of Corneal Xerophthalmia by Activity Participation Following First Year of Implementation

Intervention Activities (First Year)		N	Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		*45,694*	**42.21**	**0.057**	**0.064**	**0.89**	**(0.42 , 1.89)**	N.S.
Intervention	Capsule	*11,019*	83.41	0.065	0.055	1.19	(0.18 , 27.66) *	N.S.
	PHC & Caps	*11,791*	80.91	0.042	0.089	0.47	(0.08 , 3.68) *	N.S.
	Nut Ed & PHC	*11,719*	3.43	0.249	0.035	7.04	(0.28 , 56.26) *	**
	Sympt Treat	*11,165*	1.38	0.000	0.091	0.00	(0.00 , 25.15) *	N.S.
Nutritional Status	Normal	*14,177*	42.94	0.115	0.062	1.86	(0.59 , 5.86) *	N.S.
	Stunted alone	*23,147*	42.76	0.030	0.045	0.67	(0.17 , 2.68) *	N.S.
	Wasted alone	*2,694*	38.98	0.000	0.122	0.00	(0.00 , 5.44) *	N.S.
	Wasted & Stunted	*3,068*	37.58	0.000	0.052	0.00	(0.00 , 31.56) *	N.S.
Age of Child	1-5 years	*20,045*	42.73	0.047	0.035	1.34	(0.34 , 5.36) *	N.S.
	5-10 years	*24,840*	41.98	0.067	0.090	0.74	(0.30 , 1.86)	N.S.
Sex of Child	Boys	*23,359*	41.48	0.072	0.088	0.82	(0.32 , 2.09)	N.S.
	Girls	*22,293*	42.99	0.042	0.039	1.06	(0.28 , 3.95) *	N.S.
Area	Urban	*1,444*	50.28	0.000	0.279	0.00	(0.00 , 3.43) *	N.S.
	Rural	*44,249*	41.95	0.059	0.055	1.09	(0.49 , 2.39)	N.S.
Terrain	Hills	*15,782*	38.25	0.000	0.041	0.00	(0.00 , 1.80) *	N.S.
	Terrai	*29,913*	44.30	0.083	0.078	1.06	(0.48 , 2.37)	N.S.
Received Mebendazole		*45,680*	**49.34**	**0.035**	**0.082**	**0.43**	**(0.19 , 0.99)**	**
Intervention	Capsule	*11,005*	11.74	0.155	0.051	3.01	(0.40 , 15.28) *	N.S.
	PHC & Caps	*11,792*	86.99	0.019	0.261	0.07	(0.01 , 0.42) *	****
	Nut Ed & PHC	*11,719*	81.65	0.010	0.186	0.06	(0.00 , 0.45) *	****
	Sympt Treat	*11,164*	12.68	0.141	0.072	1.97	(0.28 , 8.85) *	N.S.
Nutritional Status	Normal	*14,175*	48.66	0.072	0.096	0.75	(0.24 , 2.37) *	N.S.
	Stunted alone	*23,137*	50.11	0.017	0.061	0.28	(0.06 , 1.37) *	*
	Wasted alone	*2,692*	50.48	0.000	0.150	0.00	(0.00 , 3.41) *	N.S.
	Wasted & Stunted	*3,069*	50.44	0.065	0.000	NA	(0.05 , ∞) *	N.S.
Age of Child	1-5 years	*20,034*	48.74	0.010	0.058	0.18	(0.02 , 1.46) *	*
	5-10 years	*24,836*	49.78	0.057	0.104	0.54	(0.22 , 1.36)	N.S.
Sex of Child	Boys	*23,346*	49.61	0.043	0.119	0.36	(0.13 , 1.01) *	**
	Girls	*22,292*	49.06	0.037	0.044	0.83	(0.22 , 3.09) *	N.S.
Area	Urban	*1,442*	28.02	0.000	0.193	0.00	(0.00 , 8.92) *	N.S.
	Rural	*44,238*	50.03	0.036	0.077	0.47	(0.20 , 1.09)	*
Terrain	Hills	*15,776*	51.14	0.012	0.026	0.48	(0.02 , 6.28) *	N.S.
	Terrai	*29,904*	48.38	0.048	0.110	0.44	(0.18 , 1.06)	*

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Jeevan Jal		*16,536*	**56.14**	**0.043**	**0.069**	**0.63**	**(0.15 , 2.47)** *	**N.S.**
Intervention	Capsule	*5,922*	53.77	0.047	0.055	0.86	(0.02 , 33.54) *	N.S.
	PHC & Caps	*3,729*	62.78	0.000	0.072	0.00	(0.00 , 11.27) *	N.S.
	Nut Ed & PHC	*4,170*	69.83	0.034	0.000	NA	(0.02 , ∞) *	N.S.
	Sympt Treat	*4,712*	40.75	0.052	0.072	0.73	0..025 9.56) *	N.S.
Nutritional Status	Normal	*4,742*	58.37	0.036	0.000	NA	(0.04 , ∞) *	N.S.
	Stunted alone	*8,553*	54.95	0.000	0.104	0.00	(0.00 , 0.91) *	**
	Wasted alone	*962*	58.63	0.177	0.000	NA	(0.04 , ∞) *	N.S.
	Wasted & Stunted	*1,216*	56.09	0.000	0.187	0.00	(0.00 , 14.88) *	N.S.
Age of Child	1-5 years	*8,572*	56.66	0.021	0.000	NA	(0.02 , 6.28) *	N.S.
	5-10 years	*7,699*	55.49	0.047	0.146	0.32	(0.04 , 1.63) *	N.S.
Sex of Child	Boys	*8,542*	56.30	0.042	0.054	0.78	(0.08 , 7.46) *	N.S
	Girls	*7,981*	55.97	0.022	0.057	0.39	(0.01 , 5.47) *	N.S.
Area	Urban	*399*	77.44	0.000	0.000	NA	NA	NA
	Rural	*16,137*	55.62	0.045	0.070	0.64	(0.15 , 2.52) *	N.S.
Terrain	Hills	*5,733*	52.89	0.000	0.074	0.00	(0.00 , 3.09) *	N.S.
	Terrai	*10,801*	57.87	0.064	0.044	1.46	(0.26 , 11.37) *	N.S.
Received Cotrimoxazole		*13,842*	**21.28**	**0.068**	**0.073**	**0.93**	**(0.13 , 4.00)** *	**N.S.**
Intervention	Capsule	*3,230*	13.78	0.225	0.072	3.13	(0.11 , 41.25) *	N.S.
	PHC & Caps	*3,172*	26.32	0.000	0.086	0.00	(0.00 , 9.72) *	N.S.
	Nut Ed & PHC	*3,647*	32.82	0.084	0.000	NA	(0.11 , ∞) *	N.S.
	Sympt Treat	*3,793*	12.34	0.000	0.120	0.00	(0.00 , 7.93) *	N.S.
Nutritional Status	Normal	*4,022*	21.16	0.000	0.126	0.00	(0.00 , 4.16) *	N.S.
	Stunted alone	*7,180*	22.47	0.062	0.072	0.86	(0.04 , 6.87) *	N.S.
	Wasted alone	*930*	16.87	0.000	0.000	NA	NA	NA
	Wasted & Stunted	*1,005*	20.20	0.000	0.125	0.00	(0.00 , 75.06) *	N.S.
Age of Child	1-5 years	*7,493*	74.00	0.036	0.000	NA	(0.10 , ∞) *	N.S.
	5-10 years	*7,396*	70.25	0.115	0.045	2.54	(0.38 , 58.90) *	N.S.
Sex of Child	Boys	*7,156*	20.95	0.067	0.088	0.75	(0.03 , 5.46) *	N.S.
	Girls	*6,675*	21.62	0.069	0.076	0.91	(0.10 , 7.22) *	N.S.
Area	Urban	*304*	72.37	0.000	0.000	NA	NA	NA
	Rural	*13,537*	21.13	0.070	0.075	0.93	(0.14 , 4.04) *	N.S.
Terrain	Hills	*4,779*	27.91	0.000	0.058	0.00	(0.00 , 8.97) *	N.S.
	Terrai	*9,063*	17.78	0.124	0.081	1.54	(0.21 , 7.30) *	N.S.

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Child Fully Immunized		*4,593*	**64.88**	**0.034**	**0.062**	**0.54**	**(0.01 , 21.12)** ~	N.S.
Intervention	Capsule	*1,079*	68.77	0.135	0.297	0.45	(0.01 , 17.73) ~	N.S.
	PHC & Caps	*1,172*	67.83	0.000	0.000	NA	NA	NA
	Nut Ed & PHC	*1,121*	66.55	0.000	0.000	NA	NA	NA
	Sympt Treat	*1,220*	57.13	0.000	0.000	NA	NA	NA
Nutritional Status	Normal	*1,020*	70.39	0.139	0.331	0.42	(0.01 , 16.42) ~	N.S.
	Stunted alone	*2,485*	63.82	0.000	0.000	NA	NA	NA
	Wasted alone	*261*	68.58	0.000	0.000	NA	NA	NA
	Wasted & Stunted	*566*	61.48	0.000	0.000	NA	NA	NA
Age of Child	1-5 years	*4,593*	64.88	0.034	0.062	0.54	(0.01 , 21.12) ~	N.S.
	5-10 years	-----	------	------	------	------	------ ------	-----
Sex of Child	Boys	*2,346*	66.45	0.064	0.000	NA	(0.03 , ∞) ~	N.S.
	Girls	*2,243*	63.26	0.000	0.121	0.00	(0.00 , 11.03) ~	N.S.
Area	Urban	*137*	78.10	0.000	0.000	NA	NA	NA
	Rural	*4,456*	64.47	0.035	0.063	0.55	(0.01 , 21.50) ~	N.S.
Terrain	Hills	*1,701*	59.55	0.000	0.000	NA	NA	NA
	Terrai	*2,892*	68.02	0.051	0.108	0.47	(0.01 , 18.35) ~	N.S.
Maternal Literacy		*39,643*	**10.56**	**0.024**	**0.051**	**0.47**	**(0.06 , 3.52)** ~	N.S.
Intervention	Capsule	*9,616*	13.98	0.074	0.060	1.23	(0.05 , 8.90) ~	N.S.
	PHC & Caps	*10,146*	10.86	0.000	0.044	0.00	(0.00 , 9.15) ~	N.S.
	Nut Ed & PHC	*10,216*	12.47	0.000	0.011	0.00	(0.00 , 133.40) ~	N.S.
	Sympt Treat	*9,665*	4.82	0.000	0.087	NA	(0.00 , 8.98) ~	N.S.
Nutritional Status	Normal	*12,342*	12.60	0.000	0.083	0.00	(0.00 , 2.74) ~	N.S.
	Stunted alone	*20,262*	10.10	0.049	0.033	1.48	(0.06 , 10.06) ~	N.S.
	Wasted alone	*2,347*	8.52	0.000	0.093	0.00	(0.00 , 37.34) ~	N.S.
	Wasted & Stunted	*2,682*	8.91	0.000	0.041	0.00	(0.00 , 194.20) ~	N.S.
Age of Child	1-5 years	*17,479*	11.14	0.000	0.032	0.00	(0.00 , 6.54) ~	N.S.
	5-10 years	*21,531*	10.22	0.045	0.067	0.68	(0.03 , 3.86) ~	N.S.
Sex of Child	Boys	*20,275*	10.94	0.000	0.072	0.00	(0.00 , 2.12) ~	N.S.
	Girls	*19,334*	10.15	0.051	0.029	1.77	(0.07 , 12.80) ~	N.S.
Area	Urban	*1,292*	43.19	0.000	0.136	0.00	(0.00 , 24.99) ~	N.S.
	Rural	*38,351*	9.46	0.028	0.049	0.56	(0.07 , 4.23) ~	N.S.
Terrain	Hills	*13,786*	9.87	0.000	0.016	0.00	(0.00 , 31.71) ~	N.S.
	Terrai	*25,857*	10.93	0.035	0.069	0.51	(0.02 , 2.83) ~	N.S.

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		*8,559*	**96.75**	**0.012**	**0.000**	NA	(0.01 , ∞) *	N.S.
Intervention	Capsule	*2,230*	94.89	0.047	0.000	NA	(0.03 , ∞) *	N.S.
	PHC & Caps	*2,623*	95.27	0.000	0.000	NA	NA	NA
	Nut Ed & PHC	*3,364*	98.81	0.000	0.000	NA	NA	NA
	Sympt Treat	*342*	100.00	0.000	-	-	- -	-
Nutritional Status	Normal	*2,900*	96.48	0.036	0.000	NA	(0.02 , ∞) *	N.S.
	Stunted alone	*4,353*	97.40	0.000	0.000	NA	NA	NA
	Wasted alone	*454*	94.71	0.000	0.000	NA	NA	NA
	Wasted & Stunted	*500*	96.00	0.000	0.000	NA	NA	NA
Age of Child	1-5 years	*3,810*	96.96	0.000	0.000	NA	NA	NA
	5-10 years	*4,663*	96.65	0.022	0.000	NA	(0.00 , ∞) *	N.S.
Sex of Child	Boys	*4,402*	97.07	0.023	0.000	NA	(0.00 , ∞) *	N.S.
	Girls	*4,150*	96.41	0.000	0.000	NA	NA	NA
Area	Urban	*510*	99.61	0.000	0.000	NA	NA	NA
	Rural	*8,049*	96.57	0.013	0.000	NA	(0.00 , ∞) *	N.S.
Terrain	Hills	*2,939*	98.33	0.035	0.000	NA	(0.00 , ∞) *	N.S.
	Terrai	*5,621*	95.91	0.019	0.000	NA	(0.00 , ∞) *	NS
Mother Knows All Correct Foods		*39,672*	**8.59**	**0.000**	**0.052**	**0.00**	**(0.02 , 8.25)** *	N.S.
Intervention	Capsule	*9,626*	10.10	0.000	0.069	0.00	(0.00 , 5.77) *	N.S.
	PHC & Caps	*10,162*	6.79	0.000	0.042	0.00	(0.00 , 15.32) *	N.S.
	Nut Ed & PHC	*10,218*	15.72	0.000	0.012	0.00	(0.00 , 101.90) *	N.S.
	Sympt Treat	*9,666*	1.44	0.000	0.084	0.00	(0.00 , 31.36) *	N.S.
Nutritional Status	Normal	*12,358*	9.27	0.000	0.080	0.00	(0.00 , 6.54) *	N.S.
	Stunted alone	*20,271*	9.06	0.000	0.038	0.00	(0.00 , 5.36) *	N.S.
	Wasted alone	*2,350*	5.57	0.000	0.090	0.00	(0.00 , 5.36) *	N.S.
	Wasted & Stunted	*2,683*	6.67	0.000	0.040	0.00	(0.00 , 265.80) *	N.S.
Age of Child	1-5 years	*17,487*	8.50	0.000	0.031	0.00	(0.00 , 8.84) *	N.S.
	5-10 years	*21,551*	8.81	0.000	0.076	0.00	(0.00 , 2.29) *	N.S.
Sex of Child	Boys	*20,292*	8.56	0.000	0.070	0.00	(0.00 , 2.77) *	N.S.
	Girls	*19,346*	8.63	0.000	0.034	0.00	(0.00 , 6.86) *	N.S.
Area	Urban	*1,295*	18.76	0.000	0.095	0.00	(0.00 , 82.26) *	N.S.
	Rural	*38,377*	8.24	0.000	0.051	0.00	(0.00 , 2.02) *	N.S.
Terrain	Hills	*13,793*	10.22	0.000	0.016	0.00	(0.00 , 30.52) *	N.S.
	Terrai	*25,879*	7.72	0.000	0.071	0.00	(0.00 , 2.30) *	N.S.

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		*39,556*	**92.16**	**0.038**	**0.129**	**0.30**	**(0.10 , 1.05)** ˜	**
Intervention	Capsule	*9,596*	93.04	0.056	0.150	0.37	(0.04 , 3.20) ˜	N.S.
	PHC & Caps	*10,121*	89.46	0.022	0.000	NA	(0.03 , ∞) ˜	N.S.
	Nut Ed & PHC	*10,188*	93.83	0.000	0.159	0.00	(0.00 , 1.25) ˜	****
	Sympt Treat	*9,649*	92.39	0.079	0.136	0.58	(0.09 , 13.10) ˜	N.S.
Nutritional Status	Normal	*12,326*	92.05	0.053	0.102	0.52	(0.08 , 12.01) ˜	N.S.
	Stunted alone	*20,210*	92.57	0.027	0.133	0.20	(0.04 , 1.49) ˜	**
	Wasted alone	*2,345*	89.98	0.095	0.000	NA	(0.03 , ∞) ˜	N.S.
	Wasted & Stunted	*2,675*	92.00	0.041	0.000	NA	(0.01 , ∞) ˜	N.S.
Age of Child	1-5 years	*17,447*	92.85	0.031	0.000	NA	(0.09 , ∞) ˜	N.S.
	5-10 years	*21,481*	91.76	0.051	0.226	0.22	(0.07 , 0.83) ˜	***
Sex of Child	Boys	*20,236*	92.31	0.054	0.129	0.42	(0.10 , 2.79) ˜	N.S.
	Girls	*19,286*	92.04	0.028	0.065	0.43	(0.06 , 10.30) ˜	N.S.
Area	Urban	*1,295*	92.97	0.083	0.000	NA	(0.00 , ∞) ˜	N.S.
	Rural	*38,261*	92.14	0.037	0.133	0.28	(0.09 , 0.99) ˜	**
Terrain	Hills	*13,752*	92.42	0.008	0.096	0.08	(0.00 , 3.20) ˜	**
	Terrai	*25,802*	92.03	0.055	0.097	0.56	(0.14 , 3.68) ˜	N.S.
Importance of Wild Greens		*39,608*	**69.71**	**0.036**	**0.083**	**0.43**	**(0.18 , 1.04)**	*
Intervention	Capsule	*9,605*	71.26	0.029	0.145	0.20	(0.03 , 1.14) ˜	**
	PHC & Caps	*10,134*	72.63	0.014	0.072	0.19	(0.01 , 2.48) ˜	N.S.
	Nut Ed & PHC	*10,202*	70.72	0.014	0.000	NA	(0.02 , ∞) ˜	N.S.
	Sympt Treat	*9,665*	64.04	0.081	0.115	0.70	(0.78 , 2.94) ˜	N.S.
Nutritional Status	Normal	*12,328*	64.45	0.050	0.114	0.44	(0.11 , 1.74) ˜	N.S.
	Stunted alone	*20,250*	76.94	0.026	0.064	0.40	(0.08 , 2.14) ˜	N.S.
	Wasted alone	*2,348*	56.18	0.076	0.097	0.78	(0.02 , 30.45) ˜	N.S.
	Wasted & Stunted	*2,678*	61.24	0.061	0.000	NA	(0.03 , ∞) ˜	N.S.
Age of Child	1-5 years	*17,462*	70.28	0.016	0.039	0.42	(0.04 , 4.06) ˜	N.S.
	5-10 years	*21,512*	69.58	0.047	0.107	0.44	(0.15 , 1.25)	N.S.
Sex of Child	Boys	*20,263*	69.20	0.043	0.112	0.38	(0.13 , 1.13)	*
	Girls	*19,309*	70.27	0.029	0.035	0.85	(0.16 , 4.62) ˜	N.S.
Area	Urban	*1,290*	38.22	0.000	0.125	0.00	(0.00 , 30.72) ˜	N.S.
	Rural	*38,317*	70.77	0.037	0.071	0.52	(0.20 , 1.31)	N.S.
Terrain	Hills	*13,771*	91.34	0.016	0.000	NA	(0.03 , ∞) ˜	N.S.
	Terrai	*25,836*	58.18	0.047	0.093	0.50	(0.19 , 1.32)	N.S.

RR confidence intervals : Taylor series CI calculated ;
˜ designates at least one cell count is < 5 - and mid-p exact CI is used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR2.XLS

Table C.4. New Cases (%) of Corneal Xerophthalmia by Activity Paricipation Following Second Year of Implementation (24 Month Exam)

New cases (%) of Corneal Xerophthalmia by Activity Participation Following Second Year of Implementation

Intervention Activities (Second Year)		N	Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		44,197	**45.22**	**0.080**	**0.062**	**1.29**	**(0.64 , 2.61)**	N.S.
Intervention	Capsule	10,482	87.76	0.043	0.000	NA	(0.13 , ∞) *	N.S.
	PHC & Caps	11,518	89.19	0.078	0.000	NA	(0.27 , ∞) *	N.S.
	Nut Ed & PHC	11,038	2.24	0.810	0.056	14.67	(2.03 , 69.65) *	****
	Sympt Treat	11,158	2.39	0.749	0.083	9.13	(1.34 , 38.51) *	****
Nutritional Status	Normal	15,059	45.79	0.145	0.123	1.18	(0.49 , 2.85)	N.S.
	Stunted alone	22,945	45.77	0.048	0.032	1.48	(0.40 , 5.52) *	N.S.
	Wasted alone	2,455	43.46	0.000	0.072	0.00	(0.00 , 24.72) *	N.S.
	Wasted & Stunted	2,672	41.73	0.090	0.000	NA	(0.07 , ∞) *	N.S.
Age of Child	1-5 years	19,070	44.79	0.035	0.047	0.74	(0.18 , 3.10) *	N.S.
	5-10 years	24,507	45.68	0.125	0.075	1.67	(0.74 , 3.75)	N.S.
Sex of Child	Boys	22,554	44.87	0.099	0.072	1.37	(0.55 , 3.36)	N.S.
	Girls	21,561	45.60	0.061	0.051	1.19	(0.38 , 3.70)	N.S.
Area	Urban	1,304	56.75	0.000	0.000	NA	NA NA	NA
	Rural	42,893	44.87	0.083	0.063	1.31	(0.65 , 2.65)	N.S.
Terrain	Hills	7,113	13.62	0.103	0.000	NA	(0.33 , ∞) *	**
	Terrai	21,211	34.74	0.692	0.116	6.02	(3.43 , 10.57)	****
Received Mebendazole		44,193	**50.69**	**0.085**	**0.055**	**1.54**	**(0.75 , 3.17)**	N.S.
Intervention	Capsule	10,458	10.91	0.175	0.011	16.36	(1.24 , 482.6) *	***
	PHC & Caps	11,517	90.24	0.058	0.089	0.65	(0.10 , 15.04) *	N.S.
	Nut Ed & PHC	11,052	86.42	0.094	0.000	NA	(0.40 , ∞) *	N.S.
	Sympt Treat	11,165	11.79	0.076	0.102	0.75	(0.03 , 4.47) *	N.S.
Nutritional Status	Normal	15,060	50.82	0.118	0.149	0.79	(0.33 , 1.91)	N.S.
	Stunted alone	22,938	50.44	0.060	0.009	6.88	(0.85 , 55.93) *	**
	Wasted alone	2,456	52.73	0.077	0.000	NA	(0.05 , ∞) *	N.S.
	Wasted & Stunted	2,673	50.84	0.074	0.000	NA	(0.05 , ∞) *	N.S.
Age of Child	1-5 years	19,056	50.09	0.063	0.011	5.98	(0.72 , 49.70)	*
	5-10 years	24,514	51.15	0.104	0.092	1.13	(0.51 , 2.52)	N.S.
Sex of Child	Boys	22,546	50.80	0.114	0.054	2.10	(0.80 , 5.53)	N.S.
	Girls	21,566	50.59	0.055	0.056	0.98	(0.31 , 3.03)	N.S.
Area	Urban	1,302	26.96	0.000	0.000	NA	NA NA	NA
	Rural	42,892	51.41	0.086	0.058	1.50	(0.73 , 3.08)	N.S.
Terrain	Hills	14,990	51.51	0.000	0.000	NA	NA NA	NA
	Terrai	29,204	50.27	0.129	0.083	1.57	(0.76 , 3.23)	N.S.

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Jeevan Jal		*13,245*	**61.14**	**0.049**	**0.097**	**0.51**	**(0.12 , 2.01)** *	**N.S.**
Intervention	Capsule	*3,119*	55.69	0.000	0.145	0.00	(0.00 , 2.76) *	N.S.
	PHC & Caps	*3,762*	73.29	0.036	0.000	NA	(0.02 , ∞) *	N.S.
	Nut Ed & PHC	*2,999*	70.42	0.047	0.000	NA	(0.02 , ∞) *	N.S.
	Sympt Treat	*3,362*	44.32	0.067	0.107	0.63	(0.02 , 8.26) *	N.S.
Nutritional Status	Normal	*3,940*	64.70	0.039	0.144	0.27	(0.01 , 3.59) *	N.S.
	Stunted alone	*7,320*	58.72	0.023	0.066	0.35	(0.01 , 4.62) *	N.S.
	Wasted alone	*683*	64.71	0.000	0.000	NA	NA NA	NA
	Wasted & Stunted	*1,011*	63.20	0.156	0.000	NA	(0.02 , ∞) *	N.S.
Age of Child	1-5 years	*7,528*	63.54	0.042	0.036	1.15	(0.10 , 12.67)	N.S.
	5-10 years	*5,618*	57.76	0.031	0.169	0.18	(0.02 , 1.63)	*
Sex of Child	Boys	*6,841*	60.97	0.048	0.150	0.32	(0.06 , 1.75)	N.S.
	Girls	*6,379*	61.37	0.026	0.041	0.63	(0.04 , 10.07)	N.S.
Area	Urban	*226*	88.05	0.000	0.000	NA	NA NA	NA
	Rural	*13,019*	60.67	0.051	0.098	0.52	(0.14 , 1.93)	N.S.
Terrain	Hills	*4,499*	51.88	0.000	0.000	NA	NA NA	NA
	Terrai	*8,745*	65.90	0.069	0.168	0.41	(0.11 , 1.54)	N.S.
Received Cotrimoxazole		*11,629*	**25.76**	**0.067**	**0.104**	**0.64**	**(0.14 , 2.96)**	**N.S.**
Intervention	Capsule	*2,788*	17.07	0.000	0.087	0.00	(0.00 , 16.87) *	N.S.
	PHC & Caps	*3,284*	35.78	0.085	0.142	0.60	(0.02 , 5.62) *	N.S.
	Nut Ed & PHC	*2,387*	40.05	0.105	0.000	NA	(0.08 , ∞) *	N.S.
	Sympt Treat	*3,170*	12.27	0.000	0.144	0.00	(0.00 , 7.98) *	N.S.
Nutritional Status	Normal	*3,500*	27.31	0.105	0.197	0.53	(0.02 , 3.85) *	N.S.
	Stunted alone	*6,326*	23.27	0.000	0.082	0.00	(0.00 , 3.68) *	N.S.
	Wasted alone	*663*	33.48	0.000	0.000	NA	NA NA	NA
	Wasted & Stunted	*880*	30.11	0.377	0.000	NA	(0.12 , ∞) *	N.S.
Age of Child	1-5 years	*6,246*	27.63	0.116	0.044	2.62	(0.27 , 25.18) *	N.S.
	5-10 years	*5,301*	23.52	0.000	0.148	0.00	(0.00 , 2.11) *	N.S.
Sex of Child	Boys	*5,993*	26.23	0.127	0.090	1.41	(0.18 , 7.94) *	N.S.
	Girls	*5,617*	25.28	0.000	0.119	0.00	(0.00 , 2.43) *	N.S.
Area	Urban	*220*	40.91	0.000	0.000	NA	NA NA	NA
	Rural	*11,409*	25.47	0.069	0.106	0.65	(0.10 , 2.73) *	N.S.
Terrain	Hills	*3,670*	22.10	0.000	0.000	NA	NA NA	NA
	Terrai	*7,958*	27.44	0.092	0.156	0.59	(0.09 , 2.47) *	N.S.

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)		Chi Square p-value
Child Fully Immunized		*3,862*	**66.93**	**0.000**	**0.000**	NA	NA	NA	NA
Intervention	Capsule	*851*	67.92	0.000	0.000	NA	NA	NA	NA
	PHC & Caps	*956*	70.61	0.000	0.000	NA	NA	NA	NA
	Nut Ed & PHC	*1,013*	67.92	0.000	0.000	NA	NA	NA	NA
	Sympt Treat	*1,042*	61.90	0.000	0.000	NA	NA	NA	NA
Nutritional Status	Normal	*849*	69.49	0.000	0.000	NA	NA	NA	NA
	Stunted alone	*2,191*	66.68	0.000	0.000	NA	NA	NA	NA
	Wasted alone	*226*	71.24	0.000	0.000	NA	NA	NA	NA
	Wasted & Stunted	*505*	64.55	0.000	0.000	NA	NA	NA	NA
Age of Child	1-5 years	*3,862*	66.93	0.000	0.000	NA	NA	NA	NA
	5-10 years	—	------	------	------	------	------	------	-----
Sex of Child	Boys	*1,953*	66.87	0.000	0.000	NA	NA	NA	NA
	Girls	*1,883*	67.07	0.000	0.000	NA	NA	NA	NA
Area	Urban	*100*	78.00	0.000	0.000	NA	NA	NA	NA
	Rural	*3,761*	66.66	0.000	0.000	NA	NA	NA	NA
Terrain	Hills	*1,392*	59.12	0.000	0.000	NA	NA	NA	NA
	Terrai	*2,469*	71.36	0.000	0.000	NA	NA	NA	NA
Maternal Literacy		*38,293*	**12.73**	**0.000**	**0.081**	**0.00**	**(0.00 , 9.83)** *		**
Intervention	Capsule	*8,979*	15.64	0.000	0.053	0.00	(0.00 , 6.02) *		N.S.
	PHC & Caps	*9,931*	12.78	0.000	0.058	0.00	(0.00 , 5.60) *		N.S.
	Nut Ed & PHC	*9,785*	15.81	0.000	0.109	0.00	(0.00 , 2.10) *		N.S.
	Sympt Treat	*9,598*	6.81	0.000	0.112	0.00	(0.00 , 4.78) *		N.S.
Nutritional Status	Normal	*12,999*	14.79	0.000	0.172	0.00	(0.00 , 0.98) *		*
	Stunted alone	*19,922*	11.99	0.000	0.040	0.00	(0.00 , 3.92) *		N.S.
	Wasted alone	*2,139*	10.61	0.000	0.052	0.00	(0.00 , 160.20) *		N.S.
	Wasted & Stunted	*2,347*	10.48	0.000	0.000	NA	NA	NA	NA
Age of Child	1-5 years	*16,670*	13.54	0.000	0.042	0.00	(0.00 , 4.14) *		N.S.
	5-10 years	*21,091*	12.09	0.000	0.113	0.00	(0.00 , 1.11) *		*
Sex of Child	Boys	*19,473*	12.89	0.000	0.088	0.00	(0.00 , 1.49) *		N.S.
	Girls	*18,749*	12.56	0.000	0.073	0.00	(0.00 , 1.97) *		N.S.
Area	Urban	*1,122*	49.82	0.000	0.000	NA	NA	NA	NA
	Rural	*37,172*	11.61	0.000	0.082	0.00	(0.00 , 0.90) *		*
Terrain	Hills	*13,113*	13.76	0.000	0.000	NA	NA	NA	NA
	Terrai	*25,180*	12.20	0.000	0.122	0.00	(0.00 , 0.84) *		*

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		*37,199*	**55.91**	**0.043**	**0.104**	**0.42**	**(0.19 , 0.94)**	**
Intervention	Capsule	*8,659*	51.74	0.000	0.048	0.00	(0.00 , 3.24) *	N.S.
	PHC & Caps	*9,751*	57.12	0.000	0.120	0.00	(0.00 , 0.62) *	***
	Nut Ed & PHC	*9,447*	66.91	0.079	0.128	0.62	(0.16 , 2.59) *	N.S.
	Sympt Treat	*9,343*	47.38	0.090	0.740	0.74	(0.18 , 2.71) *	N.S.
Nutritional Status	Normal	*12,607*	57.09	0.083	0.203	0.41	(0.15 , 1.11)	*
	Stunted alone	*19,373*	55.72	0.009	0.070	0.13	(0.02 , 1.10) *	**
	Wasted alone	*2,066*	55.30	0.090	0.000	NS	(0.05 , ∞) *	N.S.
	Wasted & Stunted	*2,282*	56.49	0.000	0.000	NA	NA NA	NA
Age of Child	1-5 years	*16,225*	56.77	0.000	0.086	0.00	(0.00 , 0.49) *	***
	5-10 years	*20,463*	55.49	0.079	0.121	0.66	(0.27 , 1.58)	N.S.
Sex of Child	Boys	*18,912*	56.46	0.056	0.109	0.51	(0.18 , 1.44)	N.S.
	Girls	*18,219*	55.39	0.030	0.098	0.30	(0.08 , 1.14) *	N.S.
Area	Urban	*1,102*	70.51	0.000	0.000	NA	NA NA	NA
	Rural	*36,097*	55.46	0.045	0.106	0.42	(0.19 , 0.95)	**
Terrain	Hills	*12,838*	62.01	0.000	0.000	NA	NA NA	NA
	Terrai	*24,360*	52.69	0.070	0.148	0.47	(0.21 , 1.07)	*
Mother Knows All Correct Foods		*38,314*	**14.81**	**0.070**	**0.070**	**1.00**	**(0.35 , 2.89)**	**N.S.**
Intervention	Capsule	*8,980*	15.16	0.000	0.053	0.00	(0.00 , 6.24) *	N.S.
	PHC & Caps	*9,938*	14.91	0.000	0.047	0.00	(0.00 , 6.36) *	N.S.
	Nut Ed & PHC	*9,792*	19.37	0.158	0.076	2.08	(0.43 , 8.37) *	N.S.
	Sympt Treat	*9,604*	9.73	0.107	0.092	1.16	(0.05 , 7.27) *	N.S.
Nutritional Status	Normal	*13,007*	15.96	0.145	0.146	0.99	(0.29 , 3.12) *	N.S.
	Stunted alone	*19,931*	14.28	0.000	0.041	0.00	(0.00 , 3.21) *	N.S.
	Wasted alone	*2,143*	13.49	0.346	0.000	NA	(0.34 , ∞) *	**
	Wasted & Stunted	*2,347*	15.47	0.000	0.000	NA	NA NA	NA
Age of Child	1-5 years	*16,680*	15.01	0.000	0.042	0.00	(0.00 , 3.67) *	N.S.
	5-10 years	*21,101*	14.73	0.129	0.094	1.36	(0.39 , 3.83) *	N.S.
Sex of Child	Boys	*19,479*	15.04	0.102	0.073	1.41	(0.32 , 4.69) *	N.S.
	Girls	*18,765*	14.57	0.037	0.069	0.53	(0.03 , 3.12) *	N.S.
Area	Urban	*1,121*	35.33	0.000	0.000	NA	NA NA	NA
	Rural	*37,192*	14.19	0.076	0.072	1.05	(0.36 , 3.04)	N.S.
Terrain	Hills	*13,116*	16.25	0.000	0.000	NA	NA NA	NA
	Terrai	*25,197*	14.05	0.113	0.106	1.06	(0.31 , 2.88) *	N.S.

			Participation Rate (%)	X2-3B Rate of participants	X2-3B Rate of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		*38,269*	**96.99**	**0.073**	**0.000**	NA	**(0.27 , ∞)** -	N.S.
Intervention	Capsule	*8,968*	97.56	0.046	0.000	NA	(0.02 , ∞) -	N.S.
	PHC & Caps	*9,932*	96.52	0.052	0.000	NA	(0.04 , ∞) -	N.S.
	Nut Ed & PHC	*9,778*	97.71	0.094	0.000	NA	(0.06 , ∞) -	N.S.
	Sympt Treat	*9,593*	96.20	0.108	0.000	NA	(0.11 , ∞) -	N.S.
Nutritional Status	Normal	*12,993*	96.93	0.151	0.000	NA	(0.19 , ∞) -	N.S.
	Stunted alone	*19,903*	97.07	0.036	0.000	NA	(0.06 , ∞) -	N.S.
	Wasted alone	*2,141*	97.34	0.048	0.000	NA	(0.00 , ∞) -	N.S.
	Wasted & Stunted	*2,346*	96.55	0.000	0.000	NA	NA NA	NA
Age of Child	1-5 years	*16,663*	97.09	0.037	0.000	NA	(0.05 , ∞) -	N.S.
	5-10 years	*21,074*	96.89	0.103	0.000	NA	(0.21 , ∞) -	N.S.
Sex of Child	Boys	*19,458*	96.99	0.079	0.000	NA	(0.14 , ∞) -	N.S.
	Girls	*18,741*	97.01	0.066	0.000	NA	(0.11 , ∞) -	N.S.
Area	Urban	*1,122*	97.42	0.000	0.000	NA	NA NA	NA
	Rural	*37,148*	96.97	0.075	0.000	NA	(0.27 , ∞) -	N.S.
Terrain	Hills	*13,094*	97.29	0.000	0.000	NA	NA NA	NA
	Terrai	*25,176*	96.83	0.111	0.000	NA	(0.28 , ∞) -	N.S.
Importance of Wild Greens		*38,263*	**78.00**	**0.060**	**0.107**	**0.56**	**(0.25 , 1.26)**	N.S.
Intervention	Capsule	*8,971*	75.28	0.000	0.180	0.00	(0.00 , 0.37) -	****
	PHC & Caps	*9,931*	76.35	0.040	0.128	0.31	(0.05 , 1.80) -	N.S.
	Nut Ed & PHC	*9,772*	78.71	0.078	0.096	0.81	(0.17 , 5.84) -	N.S.
	Sympt Treat	*9,590*	81.55	0.128	0.000	NA	(0.65 , ∞) -	N.S.
Nutritional Status	Normal	*12,997*	73.77	0.156	0.117	1.33	(0.47 , 4.68) -	N.S.
	Stunted alone	*19,896*	82.82	0.012	0.146	0.08	(0.01 , 0.42) -	****
	Wasted alone	*2,141*	65.67	0.071	0.000	NA	(0.17 , ∞) -	N.S.
	Wasted & Stunted	*2,344*	75.38	0.000	0.000	NA	NA NA	NA
Age of Child	1-5 years	*16,664*	78.95	0.030	0.057	0.53	(0.10 , 4.17) -	N.S.
	5-10 years	*21,512*	69.58	0.047	0.107	0.44	(0.15 , 1.25)	N.S.
Sex of Child	Boys	*19,455*	77.63	0.079	0.069	1.15	(0.35 , 5.10) -	N.S.
	Girls	*18,738*	78.44	0.041	0.149	0.27	(0.09 , 0.85)	**
Area	Urban	*1,122*	44.12	0.000	0.000	NA	NA NA	NA
	Rural	*37,142*	79.03	0.061	0.116	0.53	(0.24 , 1.18)	N.S.
Terrain	Hills	*13,098*	92.59	0.000	0.000	NA	NA NA	NA
	Terrai.	*25,165*	70.41	0.102	0.121	0.84	(0.38 , 1.87)	N.S.

OR confidence intervals : Taylor series CI calculated ;
- designates at least one cell count is < 5 - and mid-p exact CI are used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR2.XLS

Table C.5. Prevalence (%) of Wasting (< -2 s.d.) by Activity Paricipation Following First Year of Implementation (12 Month Exam)

Prevalence of Wasting (% < -2 S.D. WFH) by Activity Participation Following First Year of Implementation

Intervention Activities (First Year)		N	Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		*43,777*	**42.10**	**12.13**	**14.42**	**0.84**	**(0.80 , 0.88)**	**
Intervention	Capsule	*10,362*	79.33	12.12	10.13	1.20	(1.04 , 1.37)	**
	PHC & Caps	*11,441*	75.67	12.64	12.97	0.97	(0.87 , 1.09)	N.S.
	Nut Ed & PHC	*10,941*	3.06	15.22	15.14	1.01	(0.78 , 1.30)	N.S.
	Sympt Treat	*11,110*	1.17	19.23	13.66	1.41	(0.99 , 2.01)	*
Age of Child	1-5 years	*20,309*	41.43	13.01	15.22	0.85	(0.80 , 0.92)	****
	5-10 years	*20,259*	42.34	12.16	14.96	0.81	(0.76 , 0.87)	****
Sex of Child	Boys	*22,347*	38.57	12.99	14.94	0.87	(0.81 , 0.93)	****
	Girls	*21,427*	40.59	11.97	12.75	0.94	(0.87 , 1.01)	*
Area	Urban	*1,290*	46.43	8.18	13.02	0.63	(0.45 , 0.87)	***
	Rural	*42,564*	39.33	12.64	13.92	0.91	(0.86 , 0.95)	****
Terrain	Hills	*14,888*	35.63	6.84	5.15	1.33	(1.16 , 1.51)	****
	Terrai	*28,966*	41.56	14.98	18.85	0.79	(0.75 , 0.84)	****
Received Mebendazole		*43,763*	**49.69**	**13.66**	**13.25**	**1.03**	**(0.98 , 1.08)**	N.S.
Intervention	Capsule	*10,346*	10.74	12.24	11.66	1.05	(0.89 , 1.24)	N.S.
	PHC & Caps	*11,442*	80.48	13.33	10.25	1.30	(1.14 , 1.49)	****
	Nut Ed & PHC	*10,945*	74.28	15.67	13.71	1.14	(1.03 , 1.27)	**
	Sympt Treat	*11,108*	12.07	14.91	13.55	1.10	(0.96 , 1.26)	N.S.
Age of Child	1-5 years	*20,301*	47.34	14.26	14.37	0.99	(0.93 , 1.06)	N.S.
	5-10 years	*20,255*	49.60	14.50	13.07	1.11	(1.04 , 1.19)	***
Sex of Child	Boys	*22,337*	45.39	15.42	13.19	1.17	(1.10 , 1.25)	****
	Girls	*21,425*	44.92	13.18	11.82	1.12	(1.04 , 1.20)	***
Area	Urban	*1,289*	27.46	11.58	10.59	1.09	(0.78 , 1.54)	N.S.
	Rural	*42,554*	45.68	14.38	12.62	1.14	(1.09 , 1.20)	****
Terrain	Hills	*14,882*	46.36	6.09	5.47	1.11	(0.98 , 1.27)	N.S.
	Terrai	*28,961*	44.51	18.75	16.04	1.17	(1.11 , 1.23)	****

			Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Jeevan Jal		*15,734*	**56.24**	**14.36**	**13.83**	**1.04**	**(0.96 , 1.12)**	N.S.
Intervention	Capsule	*3,672*	53.95	12.92	13.90	0.93	(0.79 , 1.10)	N.S.
	PHC & Caps	*3,610*	61.02	12.35	14.64	0.84	(0.71 , 1.00)	**
	Nut Ed & PHC	*3,907*	68.34	16.37	15.12	1.08	(0.92 , 1.27)	N.S.
	Sympt Treat	*4,733*	40.44	16.93	12.34	1.37	(1.19 , 1.58)	****
Age of Child	1-5 years	*8,632*	56.57	15.87	14.72	1.08	(0.97 , 1.19)	N.S.
	5-10 years	*6,377*	55.23	13.86	13.87	1.00	(0.88 , 1.13)	N.S.
Sex of Child	Boys	*8,249*	55.16	16.07	14.36	1.12	(1.01 , 1.24)	**
	Girls	*7,652*	54.94	13.18	12.82	1.03	(0.91 , 1.16)	N.S.
Area	Urban	*368*	77.72	11.54	13.41	0.86	(0.46 , 1.63)	N.S.
	Rural	*15,553*	54.53	14.80	13.66	1.08	(1.00 , 1.17)	**
Terrain	Hills	*5,362*	50.80	6.39	6.29	1.02	(0.83 , 1.25)	N.S.
	Terrai	*10,560*	57.23	18.43	17.95	1.03	(0.95 , 1.11)	N.S.
Received Cotrimoxazole		*13,225*	**21.44**	**12.24**	**14.61**	**0.84**	**(0.75 , 0.93)**	***
Intervention	Capsule	*3,061*	13.82	8.04	14.37	0.56	(0.40 , 0.78)	****
	PHC & Caps	*3,051*	25.63	8.18	14.68	0.56	(0.43 , 0.72)	****
	Nut Ed & PHC	*3,338*	33.19	14.80	15.29	0.97	(0.82 , 1.15)	N.S.
	Sympt Treat	*3,841*	11.30	15.67	15.03	1.04	(0.83 , 1.32)	N.S.
Age of Child	1-5 years	*7,008*	20.55	11.32	15.93	0.71	(0.61 , 0.83)	****
	5-10 years	*5,525*	21.61	13.65	14.64	0.93	(0.79 , 1.09)	N.S.
Sex of Child	Boys	*6,830*	20.32	12.54	16.17	0.78	(0.67 , 0.90)	****
	Girls	*6,438*	21.09	11.49	13.46	0.85	(0.72 , 1.00)	*
Area	Urban	*275*	30.55	7.14	8.90	0.80	(0.33 , 1.96)	N.S.
	Rural	*13,016*	20.46	12.17	14.95	0.81	(0.73 , 0.91)	****
Terrain	Hills	*4,450*	26.97	5.42	6.25	0.87	(0.66 , 1.14)	N.S.
	Terrai	*8,841*	17.50	17.13	18.67	0.92	(0.81 , 1.03)	N.S.

			Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Child Fully Immunized		*4,378*	**65.24**	**18.59**	**19.71**	**0.94**	**(0.83 , 1.07)**	N.S.
Intervention	Capsule	*1,156*	66.96	17.83	17.80	1.00	(0.77 , 1.30)	N.S.
	PHC & Caps	*1,365*	66.08	17.96	19.65	0.91	(0.73 , 1.15)	N.S.
	Nut Ed & PHC	*1,246*	67.58	20.07	22.03	0.91	(0.73 , 1.14)	N.S.
	Sympt Treat	*1,315*	56.88	20.45	22.40	0.91	(0.74 , 1.12)	N.S.
Age of Child	1-5 years	*5,124*	64.54	20.02	20.69	0.97	(0.86 , 1.08)	N.S.
	5-10 years	-----	NA	NA	NA	NA	NA NA	NA
Sex of Child	Boys	*2,574*	65.89	20.46	23.69	0.86	(0.74 , 1.00)	*
	Girls	*2,490*	62.45	17.68	17.86	0.99	(0.83 , 1.18)	N.S.
Area	Urban	*134*	83.58	10.71	4.55	2.36	(0.32 , 17.21)	N.S.
	Rural	*4,950*	63.74	19.33	20.89	0.93	(0.83 , 1.04)	N.S.
Terrain	Hills	*1,802*	60.21	10.14	7.25	1.40	(1.02 , 1.92)	**
	Terrai	*3,281*	66.47	23.43	29.45	0.80	(0.71 , 0.90)	****
Maternal Literacy		*38,164*	**10.64**	**10.88**	**13.73**	**0.79**	**(0.72 , 0.87)**	****
Intervention	Capsule	*9,166*	14.30	8.92	12.21	0.73	(0.61 , 0.88)	****
	PHC & Caps	*9,916*	11.40	8.05	12.96	0.62	(0.51 , 0.76)	****
	Nut Ed & PHC	*9,721*	12.46	13.79	15.43	0.89	(0.77 , 1.04)	N.S.
	Sympt Treat	*9,640*	5.07	9.41	14.11	0.67	(0.50 , 0.88)	***
Age of Child	1-5 years	*17,879*	11.21	10.22	14.96	0.68	(0.60 , 0.78)	****
	5-10 years	*17,587*	10.17	11.79	13.87	0.85	(0.74 , 0.97)	**
Sex of Child	Boys	*19,584*	11.04	10.87	14.61	0.74	(0.66 , 0.84)	****
	Girls	*18,789*	10.47	9.41	12.73	0.74	(0.64 , 0.85)	****
Area	Urban	*1,183*	40.83	11.39	10.86	1.05	(0.76 , 1.45)	N.S.
	Rural	*37,259*	9.82	10.03	13.76	0.73	(0.66 , 0.81)	****
Terrain	Hills	*13,045*	9.89	6.28	5.83	1.08	(0.86 , 1.35)	N.S.
	Terrai	*25,397*	11.23	11.96	17.81	0.67	(0.61 , 0.74)	****

			Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		8,275	**96.80**	**11.49**	**17.36**	**0.66**	**(0.51 , 0.87)**	***
Intervention	Capsule	2,061	95.34	8.55	17.71	0.48	(0.31 , 0.76)	***
	PHC & Caps	2,597	94.99	10.01	16.15	0.62	(0.41 , 0.93)	**
	Nut Ed & PHC	3,209	99.00	13.53	12.50	1.08	(0.43 , 2.72)	N.S.
	Sympt Treat	362	100.00	12.98	—	—	— —	—
Age of Child	1-5 years	3,812	97.14	11.29	17.43	0.65	(0.43 , 0.98)	**
	5-10 years	3,810	96.64	12.36	16.41	0.75	(0.50 , 1.12)	N.S.
Sex of Child	Boys	4,252	97.20	11.81	13.45	0.88	(0.55 , 1.40)	N.S.
	Girls	3,961	96.47	10.57	18.57	0.57	(0.40 , 0.82)	N.S.
Area	Urban	436	99.08	8.56	0.00	NA	NA NA	NA
	Rural	7,795	96.73	11.37	16.47	0.69	(0.52 , 0.92)	**
Terrain	Hills	2,688	97.81	5.67	8.47	0.67	(0.28 , 1.57)	N.S.
	Terrai	5,541	96.41	13.93	18.59	0.75	(0.56 , 1.01)	<.1
Mother Knows All Correct Foods		38,191	**8.66**	**9.52**	**13.80**	**0.69**	**(0.62 , 0.77)**	****
Intervention	Capsule	9,172	9.87	7.40	12.21	0.61	(0.48 , 0.77)	****
	PHC & Caps	9,929	6.92	7.57	12.77	0.59	(0.45 , 0.77)	****
	Nut Ed & PHC	9,723	15.73	10.14	16.17	0.63	(0.54 , 0.73)	****
	Sympt Treat	9,643	1.58	8.55	13.96	0.61	(0.36 , 1.03)	*
Age of Child	1-5 years	17,891	8.29	8.42	14.97	0.56	(0.47 , 0.67)	****
	5-10 years	17,594	8.77	10.24	13.98	0.73	(0.63 , 0.85)	****
Sex of Child	Boys	19,598	8.56	9.18	14.67	0.63	(0.54 , 0.73)	****
	Girls	18,801	8.45	8.31	12.77	0.65	(0.55 , 0.77)	****
Area	Urban	1,182	15.40	9.34	11.30	0.83	(0.51 , 1.34)	N.S.
	Rural	37,284	8.29	8.74	13.82	0.63	(0.56 , 0.71)	****
Terrain	Hills	13,051	10.16	4.60	6.01	0.77	(0.59 , 0.99)	**
	Terrai	25,435	7.65	11.61	17.60	0.66	(0.58 , 0.75)	****

			Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		*38,082*	**92.18**	**13.25**	**15.42**	**0.86**	**(0.79 , 0.94)**	****
Intervention	Capsule	*9,142*	93.23	11.64	12.44	0.94	(0.75 , 1.16)	N.S.
	PHC & Caps	*9,909*	89.35	11.98	15.83	0.76	(0.65 , 0.88)	****
	Nut Ed & PHC	*9,685*	94.28	14.86	21.12	0.70	(0.59 , 0.83)	****
	Sympt Treat	*9,624*	92.27	13.96	13.04	1.07	(0.88 , 1.30)	N.S.
Age of Child	1-5 years	*17,853*	92.70	14.19	17.11	0.83	(0.73 , 0.94)	***
	5-10 years	*17,545*	91.77	13.49	15.44	0.87	(0.77 , 0.99)	**
Sex of Child	Boys	*19,544*	92.20	14.01	16.20	0.86	(0.77 , 0.97)	**
	Girls	*18,749*	92.31	12.21	14.56	0.84	(0.74 , 0.96)	***
Area	Urban	*1,177*	92.61	11.19	8.05	1.44	(0.67 , 2.89)	N.S.
	Rural	*37,185*	92.24	13.20	15.63	0.84	(0.77 , 0.92)	****
Terrain	Hills	*13,006*	92.51	5.85	5.65	1.04	(0.79 , 1.35)	N.S.
	Terrai	*25,356*	92.12	16.90	20.21	0.84	(0.76 , 0.92)	****
Importance of Wild Greens		*38,134*	**70.23**	**11.24**	**18.58**	**0.61**	**(0.57 , 0.64)**	****
Intervention	Capsule	*9,145*	71.08	11.00	13.42	0.82	(0.73 , 0.92)	***
	PHC & Caps	*9,910*	72.31	11.25	15.52	0.72	(0.65 , 0.81)	****
	Nut Ed & PHC	*9,705*	68.42	12.15	21.89	0.56	(0.51 , 0.61)	****
	Sympt Treat	*9,636*	64.22	10.59	19.84	0.53	(0.48 , 0.59)	****
Age of Child	1-5 years	*17,870*	69.45	12.32	19.20	0.64	(0.60 , 0.69)	****
	5-10 years	*17,565*	68.82	11.41	18.64	0.61	(0.57 , 0.66)	****
Sex of Child	Boys	*19,558*	68.52	11.89	19.21	0.62	(0.58 , 0.66)	****
	Girls	*18,772*	69.52	10.57	16.59	0.64	(0.59 , 0.69)	****
Area	Urban	*1,177*	36.02	10.38	11.55	0.90	(0.64 , 1.27)	N.S.
	Rural	*37,218*	70.05	11.27	18.37	0.61	(0.58 , 0.65)	****
Terrain	Hills	*13,029*	91.96	5.81	6.30	0.92	(0.72 , 1.18)	N.S.
	Terrai	*25,367*	57.21	15.76	19.06	0.83	(0.78 , 0.87)	****

RR confidence intervals : Taylor Series CI calculated
designates at least one cell count is < 5 - and mid-p exact CI are used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR3.XLS

Table C.6. Prevalence (%) of Stunting (< -2 s.d.) by Activity Paricipation Following Second Year of Implementation (12 Month Exam)

Prevalence of Stunting (% < -2 S.D. HFA) by Activity Participation Following First Year of Implementation

Intervention Activities (First Year)		N	Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		*43,518*	**42.24**	**60.60**	**60.86**	**1.00**	**(0.98 , 1.01)**	N.S.
Intervention	Capsule	*10,443*	79.36	59.33	55.08	1.19	(1.08 , 1.31)	****
	PHC & Caps	*11,534*	75.58	61.09	53.04	1.39	(1.28 , 1.51)	****
	Nut Ed & PHC	*11,023*	3.08	61.65	61.30	1.02	(0.81 , 1.27)	N.S.
	Sympt Treat	*11,173*	1.15	56.59	60.51	0.85	(0.60 , 1.21)	N.S.
Age of Child	1-5 years	*20,463*	41.48	63.22	66.02	0.96	(0.94 , 0.98)	****
	5-10 years	*20,381*	42.35	57.84	55.63	1.04	(1.01 , 1.07)	***
Sex of Child	Boys	*22,529*	38.55	60.75	59.81	1.02	(0.99 , 1.04)	N.S.
	Girls	*21,564*	40.64	59.70	59.42	1.00	(0.98 , 1.03)	N.S.
Area	Urban	*1,298*	46.69	52.15	48.12	1.08	(0.97 , 1.21)	N.S.
	Rural	*42,875*	39.34	60.52	59.90	1.01	(0.99 , 1.03)	N.S.
Terrain	Hills	*14,986*	35.67	74.16	74.74	0.99	(0.97 , 1.01)	N.S.
	Terrai	*29,188*	41.55	54.09	51.03	1.06	(1.04 , 1.08)	****
Received Mebendazole		*43,505*	**49.68**	**61.38**	**60.13**	**1.02**	**(1.01 , 1.04)**	***
Intervention	Capsule	*10,427*	10.72	58.86	58.37	1.02	(0.90 , 1.16)	N.S.
	PHC & Caps	*11,535*	80.38	60.44	53.73	1.32	(1.20 , 1.44)	****
	Nut Ed & PHC	*11,028*	74.18	62.08	59.01	1.14	(1.04 , 1.24)	***
	Sympt Treat	*11,173*	12.04	60.15	60.51	0.98	(0.88 , 1.11)	N.S.
Age of Child	1-5 years	*20,454*	47.30	65.37	64.38	1.02	(1.00 , 1.04)	N.S.
	5-10 years	*20,377*	49.59	56.94	56.20	1.01	(0.99 , 1.04)	N.S.
Sex of Child	Boys	*22,790*	45.98	62.24	59.27	1.05	(1.03 , 1.07)	****
	Girls	*21,563*	44.90	60.73	58.55	1.04	(1.01 , 1.06)	***
Area	Urban	*1,296*	27.24	46.74	51.33	0.91	(0.80 , 1.03)	N.S.
	Rural	*42,866*	45.64	61.26	59.19	1.04	(1.02 , 1.05)	****
Terrain	Hills	*14,979*	46.31	76.49	72.82	1.05	(1.03 , 1.07)	****
	Terrai	*29,184*	44.47	52.73	51.97	1.01	(0.99 , 1.04)	N.S.

			Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Jeevan Jal		*15,617*	**56.23**	**61.71**	**64.80**	**0.95**	**(0.93 , 0.98)**	****
Intervention	Capsule	*3,700*	53.78	59.40	59.01	1.02	(0.89 , 1.16)	N.S.
	PHC & Caps	*3,640*	60.91	58.86	62.05	0.88	(0.76 , 1.00)	*
	Nut Ed & PHC	*3,935*	68.23	63.20	65.92	0.89	(0.77 , 1.02)	*
	Svmpt Treat	*4,762*	40.42	61.30	66.87	0.78	(0.70 , 0.89)	****
Age of Child	1-5 years	*8,700*	56.47	63.95	68.52	0.93	(0.91 , 0.96)	****
	5-10 years	*6,420*	55.11	57.38	59.30	0.97	(0.93 , 1.01)	N.S.
Sex of Child	Boys	*8,314*	55.03	60.92	64.08	0.95	(0.92 , 0.98)	***
	Girls	*7,702*	54.89	60.76	63.67	0.95	(0.92 , 0.99)	***
Area	Urban	*370*	77.84	54.86	53.66	1.02	(0.81 , 1.28)	N.S.
	Rural	*15,667*	54.44	61.04	64.01	0.95	(0.93 , 0.98)	****
Terrain	Hills	*5,390*	50.72	76.08	79.03	0.96	(0.94 , 0.99)	***
	Terrai	*10,647*	57.13	53.99	55.08	0.98	(0.95 , 1.01)	N.S.
Received Cotrimoxazole		*13,139*	**21.58**	**64.66**	**62.25**	**1.04**	**(1.01 , 1.07)**	**
Intervention	Capsule	*3,080*	13.73	67.61	58.00	1.51	(1.22 , 1.88)	****
	PHC & Caps	*3,079*	25.56	60.74	61.13	0.98	(0.83 , 1.16)	N.S.
	Nut Ed & PHC	*3,368*	33.22	66.58	62.52	1.19	(1.03 , 1.39)	**
	Svmpt Treat	*3,861*	11.37	58.77	64.52	0.78	(0.64 , 0.96)	**
Age of Child	1-5 years	*7,056*	20.52	68.58	65.51	1.05	(1.01 , 1.09)	**
	5-10 years	*5,563*	21.66	59.00	57.85	1.02	(0.97 , 1.08)	N.S.
Sex of Child	Boys	*6,887*	20.36	63.84	62.39	1.02	(0.98 , 1.07)	N.S.
	Girls	*6,479*	21.08	63.84	61.02	1.05	(1.00 , 1.09)	*
Area	Urban	*276*	30.80	47.06	52.88	0.89	(0.68 , 1.16)	N.S.
	Rural	*13,111*	20.47	64.34	61.90	1.04	(1.01 , 1.07)	**
Terrain	Hills	*4,469*	26.94	76.41	78.84	0.97	(0.93 , 1.00)	*
	Terrai	*8,919*	17.55	54.12	54.13	1.00	(0.95 , 1.05)	N.S.

			Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Child Fully Immunized		*4,385*	**65.22**	**68.25**	**74.23**	**0.92**	**(0.88 , 0.96)**	****
Intervention	Capsule	*1,171*	67.04	61.02	70.73	0.65	(0.50 , 0.84)	***
	PHC & Caps	*1,385*	66.06	66.78	75.11	0.67	(0.52 , 0.86)	***
	Nut Ed & PHC	*1,264*	67.25	72.35	75.85	0.83	(0.64 , 1.09)	N.S.
	Sympt Treat	*1,332*	56.98	73.39	77.14	0.82	(0.63 , 1.05)	N.S.
Age of Child	1-5 years	*5,152*	64.23	68.36	74.99	0.91	(0.88 , 0.94)	****
	5-10 years	—	NA	NA	NA	NA	NA NA	NA
Sex of Child	Boys	*2,615*	65.77	67.97	75.42	0.90	(0.86 , 0.95)	****
	Girls	*2,518*	62.47	68.66	74.60	0.92	(0.88 , 0.97)	***
Area	Urban	*135*	83.70	46.90	31.82	1.47	(0.78 , 2.80)	N.S.
	Rural	*5,018*	63.69	69.12	75.47	0.92	(0.88 , 0.95)	****
Terrain	Hills	*1,825*	60.16	77.50	82.53	0.94	(0.90 , 0.98)	***
	Terrai	*3,330*	66.43	63.83	70.04	0.91	(0.87 , 0.96)	****
Maternal Literacy		*38,008*	**10.73**	**56.45**	**61.42**	**0.92**	**(0.89 , 0.95)**	****
Intervention	Capsule	*9,238*	14.28	51.63	60.03	0.71	(0.63 , 0.80)	****
	PHC & Caps	*9,995*	11.39	54.75	60.33	0.80	(0.70 , 0.90)	****
	Nut Ed & PHC	*9,794*	12.43	56.20	61.96	0.79	(0.70 , 0.89)	****
	Sympt Treat	*9,699*	5.08	51.72	60.63	0.70	(0.58 , 0.83)	****
Age of Child	1-5 years	*18,014*	11.20	57.41	66.19	0.87	(0.83 , 0.90)	****
	5-10 years	*17,696*	10.17	52.61	57.08	0.92	(0.88 , 0.97)	****
Sex of Child	Boys	*19,747*	11.02	52.82	61.24	0.86	(0.83 , 0.90)	****
	Girls	*18,913*	10.47	55.00	60.27	0.91	(0.88 , 0.95)	****
Area	Urban	*1,191*	40.81	46.09	54.47	0.85	(0.75 , 0.95)	***
	Rural	*27,538*	9.81	54.85	60.88	0.90	(0.87 , 0.93)	****
Terrain	Hills	*13,132*	9.93	60.74	75.66	0.80	(0.77 , 0.84)	****
	Terrai	*25,595*	11.19	50.68	52.98	0.96	(0.92 , 0.99)	**

			Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		*8,286*	**96.80**	**59.28**	**51.70**	**1.15**	**(1.02 , 1.29)**	**
Intervention	Capsule	*2,081*	95.29	58.75	60.20	0.94	(0.62 , 1.42)	N.S.
	PHC & Caps	*2,618*	94.92	56.82	55.64	1.05	(0.74 , 1.49)	N.S.
	Nut Ed & PHC	*3,222*	99.01	58.43	59.38	0.96	(0.47 , 1.95)	N.S.
	Sympt Treat	*1,160*	100.00	51.09	NA	NA	NA NA	NA
Age of Child	1-5 years	*3,837*	97.11	62.45	66.67	0.94	(0.82 , 1.07)	N.S.
	5-10 years	*3,830*	96.61	55.11	49.23	1.12	(0.94 , 1.34)	N.S.
Sex of Child	Boys	*4,283*	97.22	58.02	60.50	0.96	(0.83 , 1.11)	N.S.
	Girls	*3,988*	96.39	57.41	56.25	1.02	(0.88 , 1.18)	N.S.
Area	Urban	*469*	99.36	45.28	66.67	0.68	(0.30 , 1.52)	N.S.
	Rural	*7,848*	96.70	58.22	57.92	1.01	(0.90 , 1.12)	N.S.
Terrain	Hills	*2,707*	97.82	69.11	81.36	0.85	(0.75 , 0.96)	**
	Terrai	*5,581*	96.34	52.06	51.47	1.01	(0.88 , 1.16)	NS
Mother Knows All Correct Foods		*38,037*	**8.74**	**61.18**	**60.83**	**1.01**	**(0.98 , 1.03)**	N.S.
Intervention	Capsule	*9,245*	9.88	57.06	59.04	0.92	(0.80 , 1.06)	N.S.
	PHC & Caps	*10,009*	6.91	60.69	59.55	1.05	(0.90 , 1.23)	N.S.
	Nut Ed & PHC	*9,798*	15.69	60.64	61.35	0.97	(0.87 , 1.09)	N.S.
	Sympt Treat	*9,702*	1.59	51.95	60.30	0.71	(0.52 , 0.98)	**
Age of Child	1-5 years	*18,027*	8.28	63.20	65.36	0.97	(0.93 , 1.01)	*
	5-10 years	*17,706*	8.77	58.21	56.45	1.03	(0.00 , 0.00)	N.S.
Sex of Child	Boys	*19,762*	8.55	60.59	60.26	1.01	(0.97 , 1.05)	N.S.
	Girls	*18,923*	8.44	58.01	59.85	0.97	(0.93 , 1.01)	N.S.
Area	Urban	*1,191*	15.53	46.49	51.89	0.90	(0.76 , 1.06)	N.S.
	Rural	*37,564*	8.28	60.01	60.29	1.00	(0.97 , 1.03)	N.S.
Terrain	Hills	*13,139*	10.15	67.17	74.98	0.90	(0.86 , 0.93)	****
	Terrai	*25,615*	7.66	53.85	52.60	1.02	(0.98 , 1.07)	N.S.

			Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		*37,930*	**92.21**	**61.04**	**58.59**	**1.04**	**(1.01 , 1.08)**	***
Intervention	Capsule	*9,215*	93.25	58.91	57.56	1.06	(0.90 , 1.25)	N.S.
	PHC & Caps	*9,990*	89.35	60.07	55.92	1.19	(1.04 , 1.35)	***
	Nut Ed & PHC	*9,760*	94.26	61.25	61.07	1.01	(0.85 , 1.20)	N.S.
	Sympt Treat	*9,683*	92.29	60.04	61.04	0.96	(0.82 , 1.12)	N.S.
Age of Child	1-5 years	*17,989*	92.72	65.20	64.89	1.00	(0.96 , 1.05)	N.S.
	5-10 years	*17,655*	91.77	56.84	53.68	1.06	(1.01 , 1.11)	**
Sex of Child	Boys	*19,707*	92.21	60.42	58.59	1.03	(0.99 , 1.08)	N.S.
	Girls	*18,873*	92.30	59.78	58.43	1.02	(0.98 , 1.07)	N.S.
Area	Urban	*1,185*	92.66	51.55	47.13	1.19	(0.87 , 1.38)	N.S.
	Rural	*37,462*	92.24	60.36	58.84	1.03	(0.99 , 1.06)	N.S.
Terrain	Hills	*13,094*	92.51	74.09	75.33	0.98	(0.95 , 1.02)	N.S.
	Terrai	*25,554*	92.13	52.89	50.30	1.05	(1.01 , 1.10)	**
Importance of Wild Greens		*37,980*	**70.35**	**64.95**	**51.24**	**1.27**	**(1.24 , 1.29)**	****
Intervention	Capsule	*9,218*	71.09	60.61	54.48	1.29	(1.17 , 1.41)	****
	PHC & Caps	*9,991*	72.34	63.11	50.80	1.66	(1.52 , 0.00)	****
	Nut Ed & PHC	*9,779*	68.45	65.40	52.25	1.73	(1.58 , 1.88)	****
	Sympt Treat	*9,695*	64.20	66.69	48.49	2.13	(1.95 , 2.32)	****
Age of Child	1-5 years	*18,005*	69.48	67.62	59.68	1.13	(1.11 , 1.16)	****
	5-10 years	*17,677*	68.81	62.33	44.07	1.41	(1.37 , 0.00)	****
Sex of Child	Boys	*19,722*	68.55	64.55	51.11	1.26	(1.23 , 1.30)	****
	Girls	*18,892*	69.53	63.27	51.62	1.23	(1.19 , 1.26)	****
Area	Urban	*1,184*	36.32	52.33	50.66	1.03	(0.92 , 1.16)	N.S.
	Rural	*37,497*	70.05	64.10	51.37	1.25	(1.22 , 1.27)	****
Terrain	Hills	*13,116*	91.92	74.25	73.40	1.01	(0.97 , 1.05)	N.S.
	Terrai	*25,566*	57.27	55.39	49.18	1.13	(1.10 , 1.15)	****

RR confidence intervals : Taylor series CI calculated ;
designates at least one cell count is < 5 - and mid-p exact CI are used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR4.XLS

Table C.7. Prevalence (%) of Wasting (< -2 s.d.) by Activity Paricipation Following First Year of Implementation (24 Month Exam)

Prevalence of Wasting (% < -2 S.D. WFH) by Activity Participation Following Second Year of Implementation

Intervention Activities (Second Year)		N	Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		*43,434*	**45.35**	**11.12**	**12.50**	**0.89**	**(0.85 , 0.94)**	****
Intervention	Capsule	*10,324*	87.73	10.50	10.81	0.97	(0.82 , 1.15)	N.S.
	PHC & Caps	*11,361*	89.26	11.48	11.39	1.01	(0.85 , 1.19)	N.S.
	Nut Ed & PHC	*10,775*	2.19	14.41	12.73	1.13	(0.83 , 1.55)	N.S.
	Sympt Treat	*10,974*	2.40	15.97	12.59	1.27	(0.96 , 1.68)	N.S.
Age of Child	1-5 years	*18,849*	44.97	11.48	13.21	0.87	(0.80 , 0.94)	****
	5-10 years	*24,261*	45.72	10.85	11.96	0.91	(0.85 , 0.97)	***
Sex of Child	Boys	*22,270*	45.00	11.72	13.68	0.86	(0.80 , 0.92)	****
	Girls	*21,084*	45.74	10.47	11.21	0.93	(0.86 , 1.01)	*
Area	Urban	*1,266*	57.11	12.31	21.36	0.58	(0.45 , 0.74)	****
	Rural	*42,168*	45.00	11.08	12.29	0.90	(0.85 , 0.95)	****
Terrain	Hills	*14,803*	41.14	6.29	6.01	1.05	(0.92 , 1.19)	N.S.
	Terrai	*28,900*	47.08	13.29	15.97	0.83	(0.79 , 0.88)	****
Received Mebendazole		*43,429*	**50.72**	**12.10**	**11.64**	**1.04**	**(0.99 , 1.09)**	N.S.
Intervention	Capsule	*10,301*	10.83	12.10	10.38	1.17	(0.98 , 1.38)	*
	PHC & Caps	*11,361*	90.29	11.23	13.51	0.83	(0.71 , 0.97)	**
	Nut Ed & PHC	*10,786*	86.72	12.68	13.48	0.94	(0.82 , 1.08)	N.S.
	Sympt Treat	*10,981*	11.83	14.86	12.36	1.20	(1.04 , 1.38)	**
Age of Child	1-5 years	*18,837*	50.19	12.24	12.63	0.97	(0.90 , 1.05)	N.S.
	5-10 years	*24,268*	51.15	12.03	10.86	1.11	(1.03 , 1.19)	***
Sex of Child	Boys	*22,262*	50.73	13.28	12.31	1.08	(1.01 , 1.16)	**
	Girls	*21,088*	50.73	10.86	10.90	1.00	(0.92 , 1.08)	N.S.
Area	Urban	*1,265*	27.51	7.76	19.41	0.40	(0.27 , 0.59)	****
	Rural	*42,164*	51.42	12.17	11.30	1.08	(1.02 , 1.14)	***
Terrain	Hills	*14,701*	51.32	6.71	5.63	1.19	(1.05 , 1.35)	***
	Terrai	*28,629*	50.24	15.02	14.66	1.02	(0.97 , 1.08)	N.S.

		Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value	5% CI)	Chi Square p-value
	13,079	**61.10**	**13.60**	**12.17**	**1.12**	**(1.02 , 1.23)**	**	.84 , 1.10)	N.S.
	3,090	55.53	12.53	10.33	1.21	(0.99 , 1.48)	*	.70 , 1.31)	N.S.
ıps	3,731	73.33	12.17	12.96	0.94	(0.78 , 1.14)	N.S.	.92 , 1.70)	N.S.
PHC	2,934	70.62	14.33	13.23	1.08	(0.89 , 1.32)	N.S.	.61 , 0.99)	**
ıat	3,323	44.18	16.49	12.56	1.31	(1.11 , 1.55)	***	77 , 1.28)	N.S.
	7,441	63.65	14.53	13.31	1.09	(0.97 , 1.23)	N.S.	92 , 1.00)	**
;	5,581	57.68	12.27	10.75	1.14	(0.98 , 1.32)	*	---- ------	-----
	6,772	60.97	14.22	12.90	1.10	(0.97 , 1.25)	N.S.	78 , 1.12)	N.S.
	6,283	61.29	12.88	11.31	1.14	(0.99 , 1.31)	*	78 , 1.19)	N.S.
	224	87.95	14.21	7.41	1.92	(0.48 , 7.60)	N.S.	24 , 1.62)	N.S.
	12,854	60.63	13.59	12.17	1.12	(1.02 , 1.22)	**	85 , 1.12)	N.S.
	4,446	52.07	7.43	6.52	1.14	(0.92 , 1.41)	N.S.	78 , 1.39)	N.S.
	8,634	65.75	16.12	16.23	0.99	(0.90 , 1.10)	N.S.	73 , 0.99)	**
	11,451	**25.62**	**16.67**	**12.50**	**1.33**	**(1.21 , 1.47)**	****	**74 , 0.88)**	****
	2,758	16.90	14.81	10.43	1.42	(1.11 , 1.82)	***	34 , 1.18)	N.S.
Caps	3,255	35.79	15.36	13.30	1.16	(0.97 , 1.37)	N.S.	52 , 0.90)	***
& PHC	2,320	39.91	17.17	11.55	1.49	(1.21 , 1.82)	****	52 , 0.85)	****
reat	3,118	12.09	21.75	14.12	1.54	(1.25 , 1.91)	****	53 , 1.01)	*
;	6,162	27.59	16.94	13.00	1.30	(1.14 , 1.48)	****	54 , 0.84)	****
rs	5,248	23.36	16.23	11.88	1.37	(1.17 , 1.59)	****	'6 , 0.97)	**
	5,922	26.02	17.39	13.08	1.33	(1.16 , 1.52)	****	'5 , 0.95)	***
	5,510	25.23	15.68	11.89	1.32	(1.14 , 1.53)	****	6 , 0.87)	****
	215	40.47	17.24	14.84	1.16	(0.62 , 2.16)	N.S.	4 , 1.09)	N.S.
	11,236	25.35	16.68	12.47	1.34	(1.21 , 1.48)	****	8 , 0.83)	****
	3,626	22.06	8.25	6.23	1.32	(1.01 , 1.74)	**	3 , 1.47)	**
	7,827	27.29	19.85	15.62	1.27	(1.14 , 1.41)	****	6 , 0.81)	****

			Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		*36,587*	**56.02**	**11.78**	**12.29**	**0.96**	**(0.91 , 1.01)**	**N.S.**
Intervention	Capsule	*8,530*	51.78	10.62	10.62	1.00	(0.88 , 1.13)	N.S.
	PHC & Caps	*9,622*	57.22	10.35	13.53	0.76	(0.69 , 0.85)	*****
	Nut Ed & PHC	*9,240*	67.05	13.38	12.18	1.10	(0.98 , 1.23)	N.S.
	Sympt Treat	*9,195*	47.60	12.47	12.72	0.98	(0.88 , 1.09)	NS
Age of Child	1-5 years	*16,052*	56.88	12.44	12.58	0.99	(0.91 , 1.07)	N.S.
	5-10 years	*20,263*	55.51	11.23	12.10	0.93	(0.86 , 1.00)	*
Sex of Child	Boys	*18,698*	56.51	12.82	13.29	0.96	(0.90 , 1.04)	N.S.
	Girls	*17,822*	55.55	10.67	11.21	0.95	(0.87 , 1.03)	N.S.
Area	Urban	*1,075*	70.60	15.42	20.57	0.75	(0.57 , 0.98)	**
	Rural	*35,512*	55.58	11.64	12.13	0.96	(0.91 , 1.02)	N.S.
Terrain	Hills	*12,685*	62.25	7.00	4.95	1.42	(1.22 , 1.64)	*****
	Terrai	*23,902*	52.71	14.77	15.39	0.96	(0.90 , 1.02)	NS
Mother Knows All Correct Foods		*37,669*	**14.86**	**11.74**	**12.02**	**0.98**	**(0.90 , 1.06)**	**N.S.**
Intervention	Capsule	*8,844*	15.17	9.46	10.77	0.88	(0.74 , 1.05)	N.S.
	PHC & Caps	*9,807*	14.97	11.31	11.63	0.97	(0.83 , 1.14)	N.S.
	Nut Ed & PHC	*9,570*	19.48	12.98	13.05	0.99	(0.87 , 1.13)	N.S.
	Sympt Treat	*9,450*	9.80	13.28	12.56	1.06	(0.89 , 1.26)	N.S.
Age of Child	1-5 years	*16,498*	15.03	12.62	12.41	1.02	(0.91 , 1.14)	N.S.
	5-10 years	*20,891*	14.79	11.04	11.73	0.94	(0.84 , 1.05)	N.S.
Sex of Child	Boys	*19,254*	15.08	12.85	13.02	0.99	(0.89 , 1.09)	N.S.
	Girls	*18,346*	14.63	10.54	10.95	0.96	(0.85 , 1.08)	N.S.
Area	Urban	*1,092*	35.35	16.06	17.28	0.93	(0.70 , 1.23)	N.S.
	Rural	*36,577*	14.25	11.42	11.90	0.96	(0.88 , 1.04)	N.S.
Terrain	Hills	*12,957*	16.36	7.45	5.99	1.24	(1.05 , 1.47)	**
	Terrai	*24,712*	14.07	14.35	15.10	0.95	(0.87 , 1.04)	N.S.

Previous Page Blank

			Participation Rate (%)	Wasting of participants	Wasting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		*37,625*	**96.99**	**11.98**	**12.20**	**0.98**	**(0.84 , 1.15)**	N.S.
Intervention	Capsule	*8,832*	97.54	10.61	9.68	1.10	(0.73 , 1.65)	N.S.
	PHC & Caps	*9,800*	96.56	11.48	14.24	0.81	(0.62 , 1.05)	N.S.
	Nut Ed & PHC	*9,555*	97.75	13.06	12.56	1.04	(0.73 , 1.49)	N.S.
	Sympt Treat	*9,439*	96.15	12.68	11.57	1.10	(0.82 , 1.46)	N.S.
Age of Child	1-5 years	*16,480*	97.12	12.41	13.29	0.93	(0.74 , 1.18)	N.S.
	5-10 years	*20,862*	96.89	11.64	11.27	1.03	(0.83 , 1.29)	N.S.
Sex of Child	Boys	*19,233*	97.00	13.01	12.48	1.04	(0.84 , 1.30)	N.S.
	Girls	*18,323*	97.00	10.87	11.84	0.92	(0.73 , 1.16)	N.S.
Area	Urban	*1,093*	97.44	17.00	14.29	1.23	(0.48 , 2.98)	N.S.
	Rural	*36,533*	96.98	11.83	12.14	0.97	(0.83 , 1.14)	N.S.
Terrain	Hills	*12,936*	97.31	6.24	6.32	0.99	(0.65 , 1.49)	N.S.
	Terrai	*24,690*	96.82	15.00	14.80	1.01	(0.85 , 1.20)	N.S.
Importance of Wild Greens		*37,619*	**78.20**	**10.82**	**16.13**	**0.67**	**(0.63 , 0.71)**	****
Intervention	Capsule	*8,835*	75.46	9.64	13.42	0.72	(0.63 , 0.82)	****
	PHC & Caps	*9,798*	76.50	10.18	16.20	0.63	(0.56 , 0.70)	****
	Nut Ed & PHC	*9,552*	78.96	11.76	17.81	0.66	(0.59 , 0.74)	****
	Sympt Treat	*9,436*	81.76	11.55	17.55	0.66	(0.58 , 0.74)	****
Age of Child	1-5 years	*16,481*	78.99	11.44	16.18	0.71	(0.65 , 0.77)	****
	5-10 years	*20,856*	77.70	10.33	16.15	0.64	(0.59 , 0.69)	****
Sex of Child	Boys	*19,230*	77.77	11.83	17.08	0.69	(0.64 , 0.75)	****
	Girls	*18,320*	78.68	9.75	15.08	0.65	(0.59 , 0.71)	****
Area	Urban	*1,091*	44.27	17.18	16.61	1.03	(0.79 , 1.35)	N.S.
	Rural	*36,527*	79.21	10.72	16.09	0.67	(0.63 , 0.71)	****
Terrain	Hills	*12,940*	92.58	6.24	5.94	1.05	(0.81 , 1.36)	N.S.
	Terrai	*24,679*	70.66	13.98	17.48	0.80	(0.75 , 0.85)	****

RR confidence intervals : Taylor Series CI calculated

* designates at least one cell count is < 5 - and mid-p exact CI are used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR7.XLS

Table C.8. Prevalence (%) of Stuntting (‹ -2 s.d.) by Activity Paricipation Following Second Year of Implementation (24 Month Exam)

Prevalence of Stunting (% < -2 S.D. HFA) by Activity Participation Following Second Year of Implementation

Intervention Activities (First Year)		N	Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Received Vitamin A Capsule		43,494	45.36	59.29	59.37	1.00	(0.98 , 1.01)	N.S.
Intervention	Capsule	10,362	87.72	60.19	55.97	1.08	(1.02 , 1.13)	***
	PHC & Caps	11,367	89.21	58.66	56.44	1.04	(0.99 , 1.09)	N.S.
	Nut Ed & PHC	10,796	2.21	59.41	59.79	0.99	(0.89 , 1.10)	N.S.
	Sympt Treat	10,970	2.38	52.87	59.68	0.89	(0.79 , 0.99)	**
Age of Child	1-5 years	18,782	44.97	64.33	66.24	0.97	(0.95 , 0.99)	***
	5-10 years	24,286	45.74	55.55	54.11	1.03	(1.00 , 1.05)	**
Sex of Child	Boys	22,205	45.05	60.33	59.79	1.01	(0.99 , 1.03)	N.S.
	Girls	21,210	45.71	58.21	58.86	0.99	(0.97 , 1.01)	N.S.
Area	Urban	1,287	56.88	53.42	46.31	1.15	(1.03 , 1.29)	**
	Rural	42,208	45.01	59.52	59.68	1.00	(0.98 , 1.01)	N.S.
Terrain	Hills	14,783	41.18	72.45	75.10	0.96	(0.95 , 0.98)	****
	Terrai	28,712	47.52	53.42	50.29	1.06	(1.04 , 1.09)	****
Received Mebendazole		43,490	50.69	59.04	59.62	0.99	(0.97 , 1.01)	N.S.
Intervention	Capsule	10,339	10.86	56.90	59.99	0.95	(0.90 , 1.00)	**
	PHC & Caps	11,368	90.24	58.35	58.88	0.99	(0.94 , 1.04)	N.S.
	Nut Ed & PHC	10,806	86.66	59.81	59.47	1.01	(0.96 , 1.05)	N.S.
	Sympt Treat	10,977	11.82	60.76	59.38	1.02	(0.98 , 1.07)	N.S.
Age of Child	1-5 years	18,771	50.18	65.84	64.94	1.01	(0.99 , 1.04)	N.S.
	5-10 years	24,292	51.16	54.01	55.54	0.97	(0.95 , 0.99)	**
Sex of Child	Boys	22,196	50.77	59.94	60.13	1.00	(0.98 , 1.02)	N.S.
	Girls	21,213	50.61	58.04	59.08	0.98	(0.96 , 1.00)	N.S.
Area	Urban	1,286	27.29	50.14	50.48	0.99	(0.88 , 1.12)	N.S.
	Rural	42,205	51.40	59.18	60.04	0.99	(0.97 , 1.00)	*
Terrain	Hills	14,780	51.73	73.29	74.77	0.98	(0.96 , 1.00)	**
	Terrai	28,710	50.15	51.48	52.07	0.99	(0.97 , 1.01)	N.S.

	Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value	% CI)	Chi Square p-value
13,034	**61.26**	**62.19**	**67.47**	**0.92**	**(0.90 , 0.95)**	****	92 , 1.00)	**
3,092	55.72	60.42	68.08	0.89	(0.84 , 0.94)	****	35 , 1.04)	N.S.
3,716	73.28	63.46	62.84	1.01	(0.96 , 1.07)	N.S.	91 , 1.09)	N.S.
2,929	70.64	63.65	69.42	0.92	(0.87 , 0.97)	***	37 , 1.01)	N.S.
3,298	44.51	59.88	68.58	0.87	(0.83 , 0.92)	****	39 , 1.03)	N.S.
7,402	63.82	66.96	71.99	0.93	(0.90 , 0.96)	****	92 , 1.00)	**
5,574	57.79	55.39	62.52	0.89	(0.85 , 0.93)	****	--- ------	-----
6,734	61.18	61.31	68.29	0.90	(0.87 , 0.93)	****	1 , 1.03)	N.S.
6,277	61.38	63.04	66.46	0.95	(0.91 , 0.98)	***	9 , 1.00)	**
226	87.61	63.64	57.14	1.11	(0.79 , 1.56)	N.S.	5 , 1.73)	N.S.
12,809	60.79	62.15	67.51	0.92	(0.90 , 0.94)	****	1 , 0.99)	**
4,412	52.33	76.18	78.84	0.97	(0.94 , 1.00)	**	1 , 1.01)	N.S.
8,622	65.82	56.49	59.35	0.95	(0.92 , 0.99)	**	3 , 1.05)	N.S.
11,450	**25.66**	**59.60**	**64.56**	**0.92**	**(0.89 , 0.95)**	****	**9 , 0.94)**	****
2,760	16.96	55.77	64.18	0.87	(0.80 , 0.95)	****	2 , 0.91)	****
3,248	35.68	63.42	61.03	1.04	(0.98 , 1.10)	N.S.	9 , 0.99)	**
2,325	40.04	58.75	69.01	0.85	(0.80 , 0.91)	****	2 , 1.01)	N.S.
3,115	12.17	54.88	65.28	0.84	(0.76 , 0.92)	****	9 , 0.92)	****
6,144	27.65	65.51	69.54	0.94	(0.91 , 0.98)	***	5 , 0.91)	****
5,245	23.36	51.51	59.35	0.87	(0.82 , 0.92)	****	), 0.98)	****
5,901	26.13	59.01	64.69	0.91	(0.87 , 0.96)	****	7 , 0.94)	****
5,528	25.16	60.24	64.35	0.94	(0.89 , 0.98)	***	3 , 0.96)	****
217	40.09	58.62	50.00	1.17	(0.92 , 1.50)	N.S.	3 , 1.10)	N.S.
11,231	25.38	59.61	64.79	0.92	(0.89 , 0.95)	****	), 0.95)	****
3,604	22.17	74.84	78.86	0.95	(0.91 , 0.99)	**	3 , 0.84)	****
7,844	27.26	53.93	57.54	0.94	(0.90 , 0.98)	***	5 , 1.02)	N.S.

[redacted]

			Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Mother Knows Vit A Importance		*36,646*	**56.04**	**59.18**	**59.93**	**0.99**	**(0.97 , 1.00)**	N.S.
Intervention	Capsule	*8,571*	51.86	59.89	60.37	0.99	(0.96 , 1.03)	N.S.
	PHC & Caps	*9,626*	57.20	58.68	58.16	1.01	(0.98 , 1.04)	N.S.
	Nut Ed & PHC	*9,252*	67.14	58.23	62.01	0.94	(0.91 , 0.97)	****
	Sympt Treat	*9,199*	47.54	60.46	59.74	1.01	(0.98 , 1.05)	NS
Age of Child	1-5 years	*16,008*	56.93	64.75	66.59	0.97	(0.95 , 0.99)	**
	5-10 years	*20,282*	55.50	54.77	54.98	1.00	(0.97 , 1.02)	N.S.
Sex of Child	Boys	*18,653*	56.59	60.02	60.79	0.99	(0.96 , 1.01)	N.S.
	Girls	*17,926*	55.53	58.27	58.97	0.99	(0.96 , 1.01)	N.S.
Area	Urban	*1,093*	70.63	53.11	46.73	1.14	(0.99 , 1.30)	*
	Rural	*32,553*	60.71	59.42	50.86	1.17	(1.14 , 1.19)	****
Terrain	Hills	*12,677*	62.23	70.64	78.78	0.90	(0.88 , 0.92)	****
	Terrai	*23,970*	52.77	52.03	51.95	1.00	(0.98 , 1.03)	NS
Mother Knows All Correct Foods		*37,748*	**14.90**	**57.51**	**59.80**	**0.96**	**(0.94 , 0.99)**	***
Intervention	Capsule	*8,886*	15.25	56.09	60.56	0.93	(0.88 , 0.97)	***
	PHC & Caps	*9,813*	15.00	59.65	58.19	1.02	(0.98 , 1.07)	N.S.
	Nut Ed & PHC	*9,590*	19.57	56.85	60.24	0.94	(0.90 , 0.99)	***
	Sympt Treat	*9,458*	9.73	57.61	60.30	0.96	(0.90 , 1.01)	N.S.
Age of Child	1-5 years	*16,458*	15.05	61.45	66.21	0.93	(0.90 , 0.96)	****
	5-10 years	*20,914*	14.80	54.18	54.92	0.99	(0.95 , 1.02)	N.S.
Sex of Child	Boys	*19,214*	15.10	58.27	60.81	0.96	(0.93 , 0.99)	***
	Girls	*18,465*	14.69	56.69	58.69	0.97	(0.93 , 1.00)	*
Area	Urban	*1,113*	35.22	49.74	52.84	0.94	(0.83 , 1.06)	N.S.
	Rural	*36,636*	14.28	58.09	59.96	0.97	(0.95 , 0.99)	**
Terrain	Hills	*12,954*	16.34	68.35	74.70	0.92	(0.89 , 0.94)	****
	Terrai	*24,795*	14.15	50.97	52.21	0.98	(0.94 , 1.01)	N.S.

Provisional Page Mark

			Participation Rate (%)	Stunting of participants	Stunting of Non-participants	Relative Risk	(95% CI)	Chi Square p-value
Monthly weighing		*37,704*	**97.02**	**59.45**	**59.39**	**1.00**	**(0.95 , 1.05)**	N.S.
Intervention	Capsule	*8,874*	97.59	59.82	60.75	0.98	(0.88 , 1.10)	N.S.
	PHC & Caps	*9,807*	96.56	58.38	59.35	0.98	(0.90 , 1.08)	N.S.
	Nut Ed & PHC	*9,576*	97.77	59.59	60.28	0.99	(0.89 , 1.10)	N.S.
	Sympt Treat	*9,447*	96.21	60.08	57.82	1.04	(0.95 , 1.14)	N.S.
Age of Child	1-5 years	*16,441*	97.14	65.46	66.38	0.99	(0.92 , 1.05)	N.S.
	5-10 years	*20,886*	96.91	54.80	54.80	1.00	(0.93 , 1.07)	N.S.
Sex of Child	Boys	*19,193*	97.02	60.44	60.07	1.01	(0.94 , 1.08)	N.S.
	Girls	*18,440*	97.04	58.38	58.42	1.00	(0.93 , 1.07)	N.S.
Area	Urban	*1,112*	97.57	51.61	59.26	0.73	(0.63 , 1.20)	N.S.
	Rural	*36,591*	97.01	59.69	59.45	1.00	(0.96 , 1.06)	N.S.
Terrain	Hills	*12,931*	97.35	73.53	78.13	0.94	(0.89 , 1.00)	*
	Terrai	*24,772*	96.85	52.07	51.15	1.02	(0.95 , 1.09)	N.S.
Importance of Wild Greens		*37,697*	**78.17**	**62.32**	**49.13**	**1.27**	**(1.24 , 1.30)**	****
Intervention	Capsule	*8,877*	75.43	62.14	52.77	1.18	(1.13 , 1.23)	****
	PHC & Caps	*9,804*	76.52	61.96	46.74	1.33	(1.26 , 1.39)	****
	Nut Ed & PHC	*9,572*	78.91	62.61	48.19	1.30	(1.24 , 1.36)	****
	Sympt Treat	*9,444*	81.70	62.53	48.78	1.28	(1.22 , 1.35)	****
Age of Child	1-5 years	*16,443*	78.93	67.33	58.50	1.15	(1.12 , 1.19)	****
	5-10 years	*20,880*	77.72	58.44	42.05	1.39	(1.34 , 1.44)	****
Sex of Child	Boys	*19,190*	77.74	63.51	49.58	1.28	(1.24 , 1.32)	****
	Girls	*18,438*	78.65	61.05	48.53	1.26	(1.22 , 1.30)	****
Area	Urban	*1,112*	44.15	57.43	47.34	1.21	(1.08 , 1.36)	****
	Rural	*36,585*	79.20	62.40	49.27	1.27	(1.24 , 1.30)	****
Terrain	Hills	*12,937*	92.53	73.78	71.95	1.03	(0.98 , 1.07)	N.S.
	Terrai	*24,762*	70.66	54.48	46.10	1.18	(1.15 , 1.22)	****

RR confidence intervals : Taylor Series CI calculated ;
* designates at least one cell count is < 5 - and mid-p exact CI are used

Chi Square p-values : N.S. = > 0.1 ; * = < 0.1 ; ** = < 0.05 ; *** = < 0.01 ; **** = < 0.001

RR8.XLS

Appendix D: Tables from Chapter 4

TABLE D4.1
INVESTMENT AND ANNUAL OPERATING COSTS OF DELIVERING ONE VITAMIN A CAPSULE PER CHILD PER YEAR PER DISTRICT (U.S. dollars)

Item	Initial cost
Initial training	1,000
Stocks of vitamin A	1,000
Total initial investment	**$2,000**

Item	Recurring costs
Refresher training	1,000
Vitamin A supplies	3,000
Miscellaneous	1,000
Total annual operating cost	**$5,000**

TABLE D4.2
INITIAL INVESTMENT AND ANNUAL OPERATING COSTS OF DELIVERING TWO CAPSULES PER CHILD PER DISTRICT OF 200,000 POPULATION (U.S. dollars)

Item	Cost in U.S. $
Initial Investment	
Training	$8,000
Stocks of pharmaceuticals	2,000
Total initial investment	**$10,000**
Recurrent Costs	
Refresher and replacement training	$2,000
Supplies	8,000
Newsletter	2,000
Supervision	2,000

Miscellaneous	1,000
Total annual operating cost	**$15,000**

TABLE D4.3
INITIAL INVESTMENT AND ANNUAL OPERATING COSTS OF DELIVERING THREE CAPSULES PER CHILD PER DISTRICT OF POPULATION 200,000 (U.S. dollars)

Item:	**Initial cost:**
Training	$8,000
Stocks of pharmaceuticals	2,000
Total initial investment	**$10,000**

Item	**Recurring costs**
Refresher and replacement training*	$2,000
Vitamin A	9,000
ORS and paracetamol	2,000
Newsletter	2,000
Supervision	3,000
Miscellaneous	2,000
* years 2-5 only	
Total annual operating costs	**$20,000**

TABLE D4.4
INITIAL INVESTMENT AND ANNUAL OPERATING COSTS OF A PRIMARY HEALTH CARE STRATEGY WITH VITAMIN A CAPSULE DISTRIBUTION FOR REDUCING VITAMIN A DEFICIENCIES IN A DISTRICT OF POPULATION 200,000 (U.S. dollars)

Item:	**Initial cost:**
Training	$13,000
Stocks of pharmaceuticals	5,000
Total initial investment	**$18,000**

Item:	Recurring costs:
Training: Replacement	$2,000
Training: Refresher	5,000
Supplies: Vitamin A	6,000
Mabendazole	12,000
Co-trimoxazole	6,000
Paracetamol	1,000
oral rehydration salts	2,000
Newsletter	2,000
Supervision	3,000
Miscellaneous	2,000
Total annual operating cost	**$41,000**

TABLE D4.5
COSTS OF OPERATING ADULT LITERACY CLASSES IN ONE DISTRICT for one year
(Rupees/U.S. dollars)

Item	Unit	Rps/unit	$/unit	Quantity	Total cost $
Training:					
Allowance	day/person	50	1.42	2900	4131.05
Transport	per person	70	1.99	400	797.72
Paper supplies	per person	20	0.57	400	227.92
Tea	per person	45	1.28	400	512.82
Supplies:					
Lanterns	unit	100	2.85	400	1139.00
Metal boxes	unit	110	3.13	400	1253.00
Blackboards	unit	50	1.42	400	570.00
Kerosene oil	liter	7	0.20	30x400	2393.00
Chalk	packet	10	0.28	2x400	228.00
Registers	unit	20	0.57	400	228.00
Pens	unit	7	0.20	500	100.00
Pencils	unit	1	0.03	14000	399.00
Exercise books	unit	2	0.06	8000	456.00
Sharpeners	unit	3	0.09	500	43.00
Erasers	unit	3	0.09	1500	128.00
Salaries:					
Teachers	month	300	8.55	6x400	20513.00
Supervision	visit	25	0.71	6x400	1709.00
Total Operating Cost					**$34,829.00**

TABLE D4.6
INITIAL INVESTMENT AND ANNUAL OPERATING COSTS OF NUTRITION EDUCATION WITH PRIMARY HEALTH CARE IN A DISTRICT OF 200,000 POPULATION
(U.S. dollars)

Item:	**Initial Cost**
Training	16,000
Scales	14,000
Stocks of pharmaceuticals	3,000
Total initial investment	**$33,000**

Item	**Recurring costs:**
Training: Replacement	3,000
Training: Refresher	8,000
Supplies: Pharmaceuticals	21,000
Seeds	3,000
Newsletter	2,000
Educational materials	3,000
Supervision	5,000
Adult literacy centers**	35,000
miscellaneous	2,000
Total annual operating cost (without adult literacy program)	**$47,000**
Total annual operating cost (with adult literacy program)**	**$82,000**