Draft
Do not cite or quote

The Mortality Effects of Nepal's Vitamin A Distribution Program

Shea O. Rutstein, Ph.D.
Pav Govindasamy, Ph.D.

ORC Macro
Calverton, MD, USA
December 2002

The Mortality Effects of Nepal's Vitamin A Distribution Program

I. Introduction

a. Purpose of the research

Since 1993 a vitamin A supplement distribution program for young children was progressively initiated into the 75 districts of Nepal. In 1999, vitamin A supplements also began to be distributed nationally during the National Immunization Day campaigns. The purpose of the current analysis is to evaluate the impact of the distribution of vitamin A supplements on infant and child mortality. Analyses will estimate the reduction in various age-specific mortality rates of children under age five years. These rate reductions will then be translated into numbers of deaths averted by the program.

b. Description of Nepal's Vitamin A distribution program

Although diarrhea and pneumonia continue to be the leading causes of childhood deaths in Nepal, an underlying cause of excess mortality in children less than five years of age is vitamin A deficiency. Without vitamin A, children have little resistance to infection. Vitamin A deficiency is a severe public health problem in Nepal and results in large part from widespread malnutrition, seasonal non-availability of vitamin A-rich foods and general food deficit. Women and pre-school aged children comprise the population at highest risk for vitamin A and other nutritional deficiencies.

Surveys over the past 15 years show that about 3% of preschool children in the population-dense lower terai are vitamin A deficient (xerophthalmia). The prevalence may be much higher in the desolate western and far western hills where xerophthalmia rates of 13% (in Jumla) and extremely high child mortality have been reported. These findings have led WHO to classify VAD in Nepal as a "clinical" public health problem. Sub clinical VAD is likely to be 5-10 times these rates. Two large field trials have shown child mortality (over 5 months of age) can be lowered by one-third with high potency vitamin A dosing every 4-6 months. Infants under 6 months of age, however, may not benefit from this approach. VAD in pregnant and lactating women is a problem in the terai and the far west regions with night blindness affecting 16% to 52% of all women during pregnancy.[1]

In the 1980s, USAID/Nepal supported groundbreaking research to assess the impact of vitamin A supplementation on morbidity and mortality of children. The studies demonstrated that twice-yearly supplementation could reduce mortality among children 6-60 months of age by as much as 30 percent. As a result, in 1992, the Ministry of Health (MOH) requested USAID/Nepal's assistance to develop a national program to distribute vitamin A capsules to all children aged 6-60 months in 32 districts designated severely vitamin A deficient. USAID/Nepal and its partners responded by providing training for female community health volunteers (FCHV), assisting with development of nutrition

[1] "OMNI Micronutrient Fact Sheets: Nepal". Opportunities for Micronutrient Interventions Project (OMNI): http://www.jsi.com/intl/omni/nepal.htm.

education materials, and logistical support. The United Nations Children's Fund responded by supplying capsules, and the Ministry of Health manages their distribution.[2]

The Nepal Vitamin A Supplement Program (NVAP) began in 1993. By design, the program was phased in district by district by providing technical and logistic support to a new selection of districts each year. This support included training, advocacy, support for capsule supply, assistance with community promotion, and monitoring, laying a foundation for the program to be sustained by the districts and their female community health volunteers (FCHVs).

The first FCHVs were trained in 1993. They learned why vitamin A deficiency is a problem, the value of producing and consuming nutritious foods, and how to administer vitamin A. They also learned to organize a vitamin A capsule distribution program in their communities, in cooperation with local leaders. FCHVs, who often cannot read or write, were trained to: identify the children in their communities, and register their names in a notebook with the help of a family member or local school teacher; provide nutritional information to community members; and to mobilize mothers' groups, farmers groups, non-governmental organizations, political and social service organizations, and schools to participate in capsule distribution. As a result, more than 6,500 FCHVs provided vitamin A capsules to 470,000 children, representing 90 percent of the target population in eight districts. In 1995, over 14,000 trained FCHVs provided vitamin A capsule supplementation to one million children (86 percent of the total children) in 23 of the priority districts. This training has helped to integrate vitamin A supplementation into the primary health care systems in these districts, but has also increased the status of FCHVs in their communities. FCHVs play a key role in motivating mothers to seek preventive health care and treatment for their sick children. One father commented, "Our children still get sick, but they don't die the way they used to. We know that it is because of the capsule (vitamin A) that the FCHV gives." In addition to distributing vitamin A capsules, they distribute contraceptives and oral rehydration salts, and are the primary source of information about health and family planning.[3]

b. Other sources of vitamin A

Vitamin A is available through the consumption of foodstuffs rich in beta carotene (yellow & orange fruits and vegetables, such as papayas, mangoes, yams, squash, pumpkin, carrots, cantaloupe, etc; dark green leafy vegetables, such as kale, spinach, chard, etc.) and in retinol from meats, especially liver, certain fish and their livers, egg yolks, and oils. Private source supplements in the form of daily vitamins and medically supplied high dose supplements may be available to the richer urban dwellers.

---

[2] USAID/Nepal. ***National Vitamin A Capsule Distribution,*** USAID/Kathmandu, Department of State, Washington, DC,

[3]

Data and Methodology

a. Data

The present study utilizes two sources of data: the Demographic and Health Survey of Nepal of 2001 and information on Vitamin A program implementation.

i. DHS

The Nepal 2001 DHS provides this study with data on infant and child mortality levels and trends, as well as data on potentially confounding variables. The Nepal 2001 DHS was nationally representative survey of ever-married women 15 to 49 years of age. Eligible respondents to the survey were all women who slept in the dwelling the night before the interview. Women interviewers conducted face-to-face interviews with each eligible woman. Data on mortality of children was provided through a birth history, which collected information for each child on date of birth, sex, birth order, whether still alive and age at death if not alive. Other data important for this study that is provided by the DHS are women's and household characteristics, such as education and economic status, and the use of health services before, during and after the birth of each child.

ii. Program

Information on when a district entered the vitamin A distribution program was obtained by Lyndon Brown from the program offices.

c. Methodology

i. General methodology

The gradual introduction of vitamin A program distribution by geographic area provides a quasi-experimental design that allows the determination of the impact of the distribution over time. The time of the incorporation of each of Nepal's 75 districts into the program is known. The time spread of introduction allows before-after comparisons to be made for each district. Since coverage was very high (90% or above of eligible children) once the district was incorporated, there is no need to adjust for coverage.

Districts were incorporated into the program at six-month intervals. Therefore a data set was created which uses as analytical units (cases) a six-month period of time for each district. The time period of the analysis runs from April 1990 through October 2000. Thus there are potentially 1650 cases (75*11*2). However, the DHS did not cover all districts (due to rebel activity), and not all the districts had entered the program by the time of the survey. The actual number of analysis units is 1518.

ii. Dependent variables

The dependent variables include mortality rates for the following ages:

Under 6 months
6 to 11 months
12-23 months
24-59 months
6 to 59 months

Mortality of children below age 6 months is not investigated since it is less likely to be affected by vitamin A status. Mortality rates for each six-month period for each district were calculated using the synthetic cohort life table approach.[4] This approach uses the birth dates of children along with age at death of non-surviving children to calculate mortality rates strictly specific to age and time period. Other means of calculating mortality rates, such as true cohort rates and indirect estimation are not appropriate for the analysis since the effect of changes in mortality rates are spread across several time periods.

Due to the small number of births and surviving children for each half year in each district in the survey, individual case values are unlikely to be statistically significant estimates of prevailing mortality levels; however, taken as two groups, cases with and without program distribution, the estimates should be significant. Because the variation between the survey-based estimate and the true value for each district in each half-year is due to the random effects of sampling, each group of cases is likely to be an unbiased estimate of mortality as well.

iii. Independent variables

The principal independent variable is the time (half year) when a particular district entered the vitamin A distribution program. Two variations of program entry are studied. The first is the number of periods in which the program existed in the district, with zero indicating the first period of program effort. For periods before program entry, a case is assigned the value of –1. In the second variation, a dichotomous relationship is used, 0 for no program in the district during a particular half-year period and 1 for the period of program entry and all subsequent periods. Significant correlation between program periods and mortality along with lower mortality in program periods will indicate the effect of the program.

As will be seen below, when districts entered the program was not random. Consequently, the relationship between program presence and mortality reduction could be due to confounding factors that relate to both. Several other independent variables were calculated in order to control for possible spurious relationships. These variables are

Region and ecological region of district

[4] Shea Rutstein and Guillermo Rojas, Guide to DHS Statistics, Demographic and Health Surveys, ORC Macro: Calverton, MD, (forthcoming).

Percent of households in urban areas of the district

Percent of women who are literate
Percent of women with primary education or more
Percent of women with secondary education or more

Mean value of the wealth index for the district
Percent of households in the district in each wealth quintile

Percent of children stunted, wasted and underweight in the district
Percent of children eating meat and vitamin A rich vegetables
Percent of children ill from diarrhea and acute respiratory illness
Percent of sick children who were medically treated
Percent of children 12-23 months who received a measles vaccination
Other variables found significantly related to when a district entered into program.

In addition, the calendar date of each period is included as an independent variable to adjust for the overall trend in mortality rates.

Several of these control variables deserve a brief comment on their inclusion. Districts that are of easy access, with large urban areas and with high levels of women's education are likely to be districts with lower mortality. If "easy" districts or high mortality level districts were the first to enter the program then the mortality effects of program presence would be respectively over- and understated. For districts where there are high percentages of children with other sources of vitamin A, such as meat and vitamin A rich vegetables, we would not expect large program effects. Vitamin A has been shown to be especially protective against mortality when a child is ill with measles.[5] In districts with high levels of measles vaccination, mortality from measles would be low irrespective of program presence. Similarly, the effects of program presence on mortality should be reduced in districts with higher levels of medical treatment of childhood diseases and lower levels of malnutrition.

These control variables are available for times at or around the time of the survey. It is an assumption of the methodology used that the differences between districts seen at the time of the survey also existed during the preceding time periods used in the analysis.

iv. Generation of cases

The analysis units were generated by aggregating the individual survey data into district by half-year units. For the mortality rates, synthetic cohort rates were calculated for each district for each half-year. For program presence, the district identification variable was recoded into program phase at district entry. This variable was then recoded into two variables, one indicating program presence and the other program duration. Other independent variables were aggregated by numerator (such as number of ever-married women age 15-49 with secondary or higher education) and denominator (such as total

[5] See for example, D'Souza RM, D'Souza R. "Vitamin A for treating measles in children (Cochrane Review)." In: *The Cochrane Library,* Issue 4, 2002. Oxford: Update Software.

number of ever-married women age 15-49) for each district, and the numerators were divided by the appropriate denominators to get percents and means. Case sampling weights were used in the aggregations.

v. Analytical methodology

The district level data were first examined using bivariate distributions to determine relationships between the dependent and independent variables and district. Next 1990 mortality levels (i.e. prior to the vitamin A program in any district) according to year of entry into the program were examined by bivariate distributions in order to ascertain if program entry was based on mortality level. Finally, multivariate linear regression was used to ascertain the contribution of the vitamin A program to mortality decline, holding constant possible confounding factors.

II. Results

a. Mortality levels and trend

Under-five mortality estimated from the 2001 Nepal DHS was about 91 deaths under age five years per 1000 births for the five-year period preceding the survey. According to the survey, this value represented a decline of 35 deaths per 1000 births from the period five to nine years preceding the survey and 67 deaths per 1000 births from the period ten to fourteen years preceding the survey. Thus, under-five mortality declined about 43% in ten years. Table 1 shows the levels and trends in several mortality rates of young children. It is seen that in the same ten-year period, infant mortality declined by 40% and child mortality (ages one to five years) declined 49%.

The trend in under-five mortality by single calendar year from 1990 to 2000 using the aggregate district data can be seen in figure 1. The rate fell from about 154 in 1990 to 72 in 2000, a decline of 43%. However, as indicated in the graph, the decline was not linear. Indeed the rate for 1994 was almost as high as that of 1990 (table 2).

b. Program coverage

The Nepal Vitamin A Distribution Program was implemented over a several-year period beginning in 1993. Vitamin A supplements are given out twice a year, in April and October, which are termed phases of the program. The geographical coverage of the program expanded by incorporating new districts into the program area at each phase. The phase (date) at which each district entered the program is given in Appendix Table 1.

The geographic distribution of districts entering the program was not random. As Tables 3 and 4 indicate, districts of the Terai ecological region were the first to enter the program. They were followed by western hill and mountain districts, then eastern hill and mountain districts and finally by central hill and mountain districts (Also see Figure 2—map).

The percentage of the 69 districts in the NDHS and the percentage of children 6 to 59 months incorporated into the program by calendar year are given in figure 3. Over half of the children of the districts were covered by the program by 1995 even though over half of the districts were only covered by 1997.

c. Bivariate relationships

Is mortality related to program presence in a district? Table 5 shows that there are significant correlations between young child mortality rates and program presence in a district for all rates except ages 6 to 11 months. The binary form of the dependent variable appears to work the best. Phase of first inclusion is only significantly related to mortality of children under age six months. Table 6 gives the average mortality rates by whether or not the program was present in the districts. When the program was present, under-five mortality dropped by 28 deaths per thousand births, or 23 percent. Excluding the first 6 months of life when vitamin A supplementation is thought to be less effective, mortality fell from 23 to 16 deaths per thousand survivors to age 6 months, when the program was present. This fall represents a 30 percent decline.

The length of time that the program is operative in the district may be related to its effectiveness as both providers and patients become familiar with it. In order to see whether there is such a learning process, table 7 shows mortality rates according to the length of time since the program was introduced into the district. For under-five mortality there does not appear to be a pattern with duration of program (excluding when the program was not yet started). However, mortality at 6 to 59 months does seem to be lower for districts with 5 or more years of duration. This finding may be an artifact of time of introduction and a general decline in mortality rates that is unrelated to program duration. In the multivariate analysis, date is controlled to allow a better interpretation of this apparent relationship.

d. Confounders

Above, it was seen that the program was implemented on a geographical basis. This basis could be related to other factors that may confound the relationship between mortality decline and program presence. In order to examine the presence of confounders, several tabulations were made.

1. Initial mortality level

Either consciously or as a result of geographic region, programs may have been introduced first into regions with higher or lower levels of mortality than average. Tables 8 and 9 test whether there is a relationship between phase of program implementation in a district and level of mortality. From table 9 it is evident that there is some relationship between the phase (date) of program entry and mortality. The strength of the relationships between 1990-92 mortality rates and phase of program start are very weak, except for mortality under 6 months and under five years as an overall measure. None of the correlations are significant, however. Figures 4 and 5 show the strongest two relationships graphically.

2. Urbanization and economic status

Urban areas and wealthier households are known to have lower mortality rates in Nepal than rural and poorer households (Ministry of Health [Nepal] et. al. 2002, pp. 130-131.). If either of these characteristics is related to when the vitamin A program started in a district, then the relationship found above between program presence and mortality levels could be biased. Table 10 shows the correlations between these and other potentially confounding variables and the beginning phase of the program in a district. Neither percentage of the households that was urban nor the average level of household wealth is significantly related to program start.[6] When the households are ranked into wealth quintiles[7], the percentage of households in the middle quintile is significantly related to program start. It is surprising, however, that the percentages in the other quintiles are not significantly related.

3. Women's education

Similar to urbanization and wealth, children born to Nepalese mothers with higher levels of education have reduced risks of dying at young ages (Ministry of Health [Nepal] et. al. 2002, pp. 130-131.). Three indicators of education were investigated: the percent of interviewed women in a district who are literate, the percentage with primary completed education or more, and the percentage with secondary education or more. Of the three, only literacy is related to the timing of program start (Table 10). However from Figure 7 it is evident that most of this relationship is due to a few districts that entered the program during the middle phases.

4. Food and nutritional status

The vitamin A supplements provided by the program only have value for children (and breastfeeding mothers) who are deficient in vitamin A. Children who eat meat and vitamin A-rich fruits and vegetables are less likely to be deficient and the value of supplementation would be reduced for these children. Nutritional status of children is also important since

---

[6] The relative level of household wealth is measured by the wealth index, a composite of household possessions, services and other measures of economic status. See (ref.) for a description of index construction. Wealth quintiles were calculated by attributing the value of the wealth index to all household members in the 2001 Nepal DHS and then ranking those members into quintiles. The quintile cut-off points were then applied to each household to get the percentage of households in each quintile in each district.

[7] Wealth quintiles were calculated by attributing the value of the wealth index to all household members in the 2001 Nepal DHS and then ranking those members into quintiles. The quintile cut-off points were then applied to each household to get the percentage of households in each quintile in each district.

children are more vulnerable if they are wasted, stunted, or underweight. Besides changing the impact of a vitamin A program, there could be a bias in analyzing impact if the vitamin A program was targeted on districts with high levels of micronutrient and/or macronutrient deficiency. Even without targeting, if the starting date of the program were correlated with deficiency, then results of analysis may be biased.

From table 10, it is obvious that nutrient deficiency is correlated with the phase of start of the program. For both sources of food-based vitamin A, meat and fruits and vegetables, there is a positive correlation with the starting phase. This means that the program was more likely to begin in areas where children were more deficient in vitamin A. There are negative correlations with wasting and underweight, so that acute malnutrition was more likely in districts that started early in the program. There is no significant correlation with chronic malnutrition, measured by the percentage of children who are stunted.

A word of caution is necessary when considering these relationships. Foods ate and nutritional status is measured at the time of the survey, not at or before the start of the program in a district. It is therefore assumed that 1) the program did not affect feeding and nutritional status (other than vitamin A status) and 2) the nutritional and feeding situation is approximately the same at the time of the survey as it was before the program started in the district.

5. Disease prevalence, treatment and prevention

Presumably the benefit of vitamin A supplementation for mortality reduction works through reducing case fatality rates for measles and other infectious diseases. A potential bias in the evaluation of program supplementation could arise if the variation in districts in disease prevalence, treatment and prevention was associated with the startup of the program in the districts. From table 10, neither the prevalence of diarrhea nor acute respiratory illness nor the treatment of either disease is seen to be significantly associated with the startup phase of the program. Measles vaccination rates are significantly related in a positive direction (i.e. higher rates for districts with later entry). This relationship could bias (downward) the estimated effects of the supplementation program unless it is statistically allowed for.

e. Multivariate relationships

1. Vitamin A program

After controlling for the effects of potentially confounding characteristics, the vitamin A program is found to have large and significant effects on mortality for all ages of children under five years as shown in Table 11. There is little additional effect of program duration in a district above that of program presence (as shown by the standardized coefficient, Beta, value).

For mortality under age 5 years, the vitamin A program presence in a district reduced mortality by almost 48 deaths per thousand births on average. The least effect was at ages 6-11 months, for which the program reduced mortality by almost 7 deaths per 1000 survivors to age 6 months. It is puzzling that mortality under 5 months has the greatest drop, of about 25 deaths per 1000 births, of any of the component age groups since the program was not expected to affect mortality at ages below 6 months. Evidently the program had more than the expected benefits.

2. Other factors

Among the control variables, several other factors were found to be important for lowered mortality in a district in addition to whether the vitamin A program was present. By decreasing level of importance, they are percent of women literate, percent of children underweight, percent of households urban, percent of children vaccinated for measles, and percent of children receiving ORT for diarrhea. In all but the last, the direction of the relationship is that which is expected.

III. Discussion

It is clear that Nepal's vitamin A program has been successful in reducing the burden of young child mortality. Because of its gradual introduction by district, the impact of the program can be measured. Even after controlling for important potentially confounding factors, the vitamin A supplementation program is shown to be extremely effective in preventing deaths. This analysis is statistical, not biological, so that the pathways by which the program is effective cannot be determined. The program may be effective not just by distributing supplements but also by increasing health service contact with children, promoting better nutrition and in general changing attitudes for child mortality from fatalism to activism.

The introduction of the program was related to ecological region (Terai, Hill, and Mountain) and region with implications for relationships between female literacy, feeding and nutritional status and the timing of start of the program. These factors in themselves are important for mortality, but do not account for most of the effect of the program. Indeed, because it appears that the program was introduced into the worse-off districts first, its national impact is understated unless proper account is taken of which districts were introduced.

One interesting relationship is that for children under 6 months of age. The distribution program does not target these children. How then is there a significant and large relationship with program presence in a district? From Table 12, it is seen that some of these children (9%) did indeed receive a vitamin A capsule[8] Some 65% of these children have taken part in recent National Immunization Day campaigns, where vitamin A was distributed. Furthermore, about 90% of children have had mothers who received a vitamin A dose within two months of their birth. If either of these last two factors is related to program presence, then the effect on the under-six months mortality rate is at least partially explained. Other explanations may come about by improvement in women's vitamin A status linked to the program, due to its educational aspects.

IV. Conclusions

Between mid 1995 and mid 2000, 779 thousand children were born per year in Nepal, according to the United Nations medium population projection,[9] in this same period, an average of 67.9% of children lived in districts covered by the program or a total of 5*779*72.5% = 2, 824 thousand children. The estimated reduction in under five year mortality of 47.6 deaths per thousand births means that about 134 thousand deaths were averted in this time period due to the program. If the program had not been implemented, there would have been about 27,000 more deaths per year, and the under-five mortality rate would have been about 126 instead of the 91 deaths per thousand births as given by the 2001 Nepal DHS.[10]

In the year 2000 the impact is even greater. About 792 thousand children were born in Nepal in that year. At a coverage rate estimated to be 95.1% in that year, the program averted about 36,000 deaths.

---

[8] Indeed, the estimate from the table is biased downward since it is based on children by their current age. The survey was conducted from January to June 2001. Thus many of the children under 6 months of age at the time of the survey would not have had the opportunity to be present during program distribution which takes place every six months (in April and October). Thus the children less than six months of age at the time of the survey under-represents exposure to the program for children when they were under six months of age in the past.

[9] United Nations Population Division, **World Population Prospects, The 1998 Revision**, Volume I: Comprehensive Tables. United Nations Department of Economic and Social Affairs: New York, 1999.

[10] This 28% decline compares well with small scales studies of mortality decline with supplementation. For example see Humphrey JH, Agoestina T, Wu L, et al. Impact of neonatal vitamin A supplementation on infant morbidity and mortality rates. J Pediatr. 1996; 128: 489-496.

Table 1

Infant and child mortality rates by five-year periods preceding the survey (excluding month of interview)

	Mortality rate				
Years prior to survey	Neonatal mortality (NN)	Post-neonatal mortality (PNN)	Infant mortality (1q0)	Childhood mortality (4q1)	Under-5 mortality (5q0)
0-4	39	26	64	29	91
5-9	57	34	90	40	126
10-14	63	44	107	57	158

Table 2. Mortality Rates by Year

YEAR	Mortality rate 0-5 months	Mortality rate 6-11 months	Mortality rate 12-23 months	Mortality rate 24-59 months	Mortality rate 6-59 months	Under 5 years
1990	74	32	46	30	39	154
1991	79	16	12	32	23	134
1992	75	14	19	27	23	130
1993	78	10	21	28	25	131
1994	89	19	22	27	25	149
1995	64	20	16	23	21	118
1996	65	8	10	21	16	101
1997	57	11	13	18	16	97
1998	43	14	13	18	16	85
1999	45	11	6	17	13	77
2000	45	5	13	11	11	72

Table 3. Average phase at program introduction by Ecological Region

Ecological Region	Mean	Districts	Std. Deviation
Mountain	9.5	13	3.21
Hill	10.3	36	3.07
Terai	2.6	20	2.09
Total	7.9	69	4.46

Table 4. Average phase at program introduction by region

REGION	Mean	Districts	Std. Deviation
Eastern terai	1.6	5	0.49
Central terai	2.4	7	3.12
Western terai	2.7	3	1.26
Far-western terai	3.0	2	0.00
Mid-western terai	4.0	3	0.82
Far-western hill	4.8	4	0.83
Western mountain	6.6	7	0.50
Western hill	9.3	11	1.92
Mid-western hill	10.0	4	3.83
Eastern hill	11.4	8	0.49
Eastern mountain	12.0	3	0.00
Central hill	13.2	9	1.32
Central mountain	13.7	3	0.48
Total	7.9	69	4.46

Table 5. Correlations between Mortality Rates 1990-2000 and Program Phase and Presence

	Program Phase at Entry		**Years since beginning of program**		**Whether district in program in specific year**	
	Pearson Correlation	**Significance**	**Pearson Correlation**	**Significance**	**Pearson Correlation**	**Significance**
Mortality rate 0-5 months	-0.102	**	-0.038		-0.068	**
Mortality rate 6-11 months	-0.041		-0.026		-0.027	
Mortality rate 12-23 months	-0.039		-0.059	*	-0.067	**
Mortality rate 24-59 months	-0.021		-0.111	**	-0.105	**
Mortality rate 6-59 months	-0.041		-0.1	**	-0.103	**
**	Correlation is significant at the 0.01 level (1-tailed).					
*	Correlation is significant at the 0.05 level (1-tailed).					

Table 6. Mortality rates in 1990-2000 by whether program is present in district

Whether district in program in specific year	Mortality rate 0-5 months	Mortality rate 6-11 months	Mortality rate 12-23 months	Mortality rate 24-59 months	Mortality rate 6-59 months	Under 5 years
Not in program	69	16	20	26	23	126
In program	57	13	12	19	16	98
Total	65	15	17	23	21	115

Table 7. Mortality rates 1990-2000 by duration of program in district

Years since beginning of program	Mortality rate 0-5 months	Mortality rate 6-11 months	Mortality rate 12-23 months	Mortality rate 24-59 months	Mortality rate 6-59 months	Under 5 years
Program not started	69	16	20	26	23	126
Year of start of program	47	12	12	22	18	90
1	65	12	16	18	17	108
2	45	17	11	18	16	88
3	69	11	13	21	17	110
4	58	10	16	17	16	98
5	71	16	7	17	14	107
6	50	7	9	11	10	76
7	62	10	12	11	11	93
Total	65	15	17	23	21	115

Table 8. Mortality in 1990-92 by Phase of Program Introduction into District

Phase	Mortality rate 0-5 months	Mortality rate 6-11 months	Mortality rate 12-23 months	Mortality rate 24-59 months	Mortality rate 6-59 months	Under 5 years
1	108	23	12	29	23	164
2	74	9	14	19	16	112
3	113	12	17	29	24	164
4	77	16	21	10	15	120
5	61	47	32	23	27	150
6	165	16	74	73	66	296
7	112	111	147	70	113	334
8	32	22	13	17	16	80
9	41	9	14	10	11	71
10	63	19	28	26	25	128
11	105	0	14	17	14	133
12	39	0	19	21	19	78
13	21	0	5	49	26	75
14	78	32	9	31	23	139
15	67	44	1	39	28	145
Total	76	21	26	30	28	139

Table 9. Correlations between Mortality Rates in 1990-92 and Phase of District Entry

Mortality Rate	Pearson Correlation	Significance
0-5 months	-.197	
6-11 months	-.029	
12-23 months	-.058	
24-59 months	.026	
6-59 months	-.030	
Under 5 years	-.157	

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Table 10. Correlations with phase (time) of district entry into program

	Pearson Correlation	Significance
Percent Urban	0.099	
Mean Wealth Index value	0.162	
Percent of HH in lowest wealth quintile	0.071	
Percent of HH in second wealth quintile	-0.161	
Percent of HH in third wealth quintile	-0.392	**
Percent of HH in fourth wealth quintile	0.130	
Percent of HH in highest wealth quintile	0.137	
Percent of interviewed women who are literate	0.278	*
Percent of interviewed women who have primary complete or more education	0.198	
Percent of interviewed women who have secondary complete or more education	0.191	
Percent of children 6-59 who ate meat yesterday	0.294	**
Percent of children 6-59 who ate vitamin A rich fruit and vegetables yesterday	0.397	**
Percent of children 6-59 who are stunted	0.032	
Percent of children 6-59 who are wasted	-0.629	**
Percent of children 6-59 who are underweight	-0.401	**
Percent of children 6-59 with diarrhea in last 2 weeks	-0.101	
Percent of diarrheic children 6-59 treated with ORT	-0.051	
Percent of children 6-59 with ARI in last 2 weeks	0.102	
Percent of ARI children 6-59 who got medical attention	0.183	
Percent of children 12-23 who got a measles vaccination	0.218	*

** Correlation is significant at the 0.01 level (1-tailed).

* Correlation is significant at the 0.05 level (1-tailed).

Table 11. Regression results for effect of program presence in district on district young child mortality

Age	Variable	B	Std error	Beta	t	Sig.	Confidence Interval	
<6 months								
	Whether district in program in specific year	-25.5	4.7	-0.142	-5.4	0.000	-34.8	-16.2
	Years since beginning of program	-5.8	1.2	-0.134	-4.9	0.000	-8.2	-3.5
6-11months								
	Whether district in program in specific year	-6.8	3.2	-0.058	-2.1	0.034	-13.0	-0.5
	Years since beginning of program	-1.7	0.8	-0.061	-2.2	0.030	-3.3	-0.2
12-23 months								
	Whether district in program in specific year	-10.0	3.1	-0.085	-3.2	0.001	-16.2	-3.9
	Years since beginning of program	-2.1	0.8	-0.073	-2.6	0.008	-3.6	-0.5
24-59 months								
	Whether district in program in specific year	-12.0	1.7	-0.179	-7.1	0.000	-15.3	-8.6
	Years since beginning of program	-3.4	0.4	-0.210	-8.0	0.000	-4.2	-2.6
6-59 months								
	Whether district in program in specific year	-11.1	1.8	-0.156	-6.1	0.000	-14.6	-7.5
	Years since beginning of program	-2.8	0.5	-0.164	-6.1	0.000	-3.7	-1.9
Under 5 years								
	Whether district in program in specific year	-47.6	6.0	-0.199	-7.9	0.000	-59.4	-35.8
	Years since beginning of program	-11.6	1.5	-0.202	-7.7	0.000	-14.6	-8.7

Control variables: Percent of children 6-59 who are underweight, Percent of HH in third wealth quintile, Percent of children 6-59 with diarrhea in last 2 weeks, Percent of HH in fourth wealth quintile, Whether district in program in specific year, Percent of children 12-23 who got a measles vaccination, Percent of ARI children 6-59 who got medical attention, Percent of children 6-59 who ate vitamin A rich fruit and vegetables yesterday, Percent of diarrheic children 6-59 treated with ORT, Percent of children 6-59 with ARI in last 2 weeks, Percent Urban, Percent of interviewed women who have primary complete or more education, Percent of children 6-59 who are wasted, Percent of children 6-59 who ate meat yesterday, Percent of HH in second wealth quintile, Percent of children 6-59 who are stunted, Percent of interviewed women with secondary or more education, Percent of HH in lowest wealth quintile, Percent of interviewed women who are literate, Mean Wealth Index value.

Table 12. Vaccinations in National Immunization Day campaigns, Reception of Vitamin A capsule in Distribution Program, and Mother's Reception of Vitamin A in First Two Months after Delivery by Age of Child

Age in months	Any vaccinations in last 2 years as part of campaigns					Received vitamin A capsule					Mother received vitamin A in first two months after delivery				
	No	Yes	Don't know	Total	N	No	Yes	DK	Total	N	No	Yes	Missing	Total	N
<6	35%	65%	0%	100%	486	91%	9%	0%	100%	501	90%	10%	0%	100%	681
6-11	3%	97%	0%	100%	616	35%	65%	0%	100%	555	88%	12%	0%	100%	669
12-17	1%	99%	0%	100%	637	6%	94%	0%	100%	589	89%	10%	0%	100%	661
18-23	0%	100%	0%	100%	664	3%	97%	0%	100%	629	88%	12%	0%	100%	656
24-29	0%	100%	0%	100%	625	3%	98%	0%	100%	602	90%	10%	0%	100%	487
30-35	1%	99%	0%	100%	608	3%	97%	1%	100%	582	90%	10%	0%	100%	426
36-41	0%	100%	0%	100%	698	2%	98%	0%	100%	670	93%	7%	0%	100%	377
42-47	1%	99%	0%	100%	623	1%	98%	0%	100%	580	90%	10%	0%	100%	290
48-53	0%	99%	0%	100%	647	2%	98%	0%	100%	619	92%	8%	0%	100%	258
54-59	0%	100%	0%	100%	644	3%	96%	1%	100%	621	92%	8%	0%	100%	239
Total	3%	97%	0%	100%	6248	13%	86%	0%	100%	5948	90%	10%	0%	100%	4745

Figure 1
Under 5 Mortality Trend

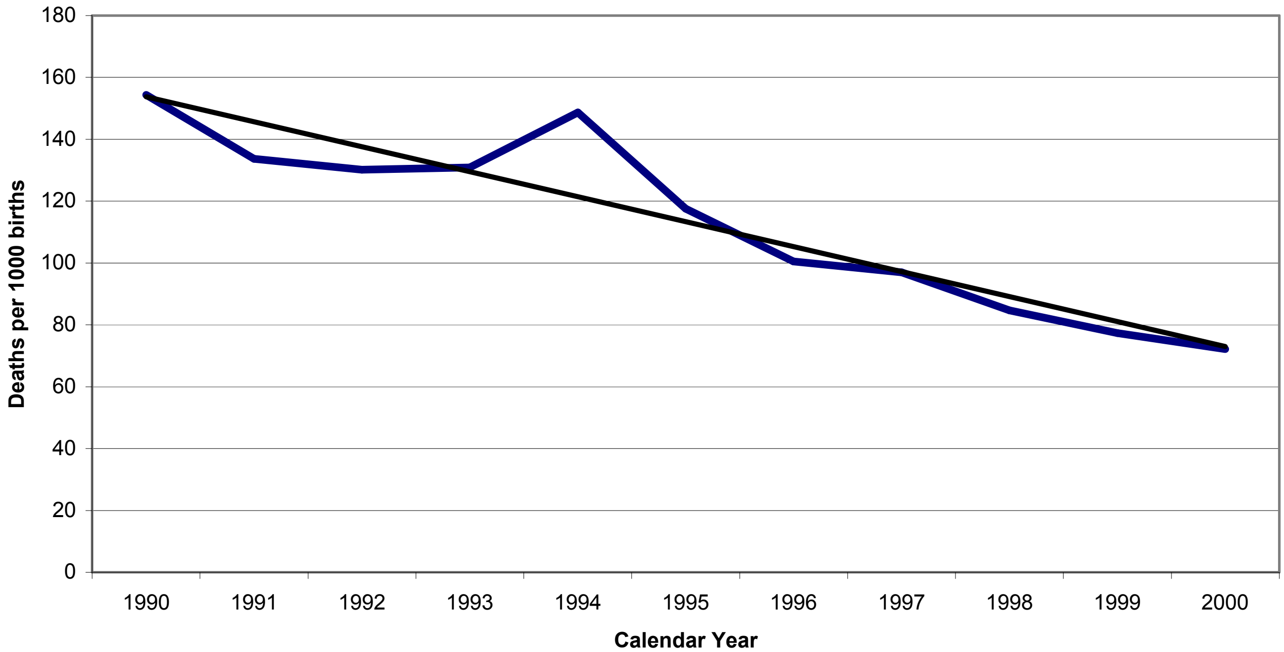


Figure 2

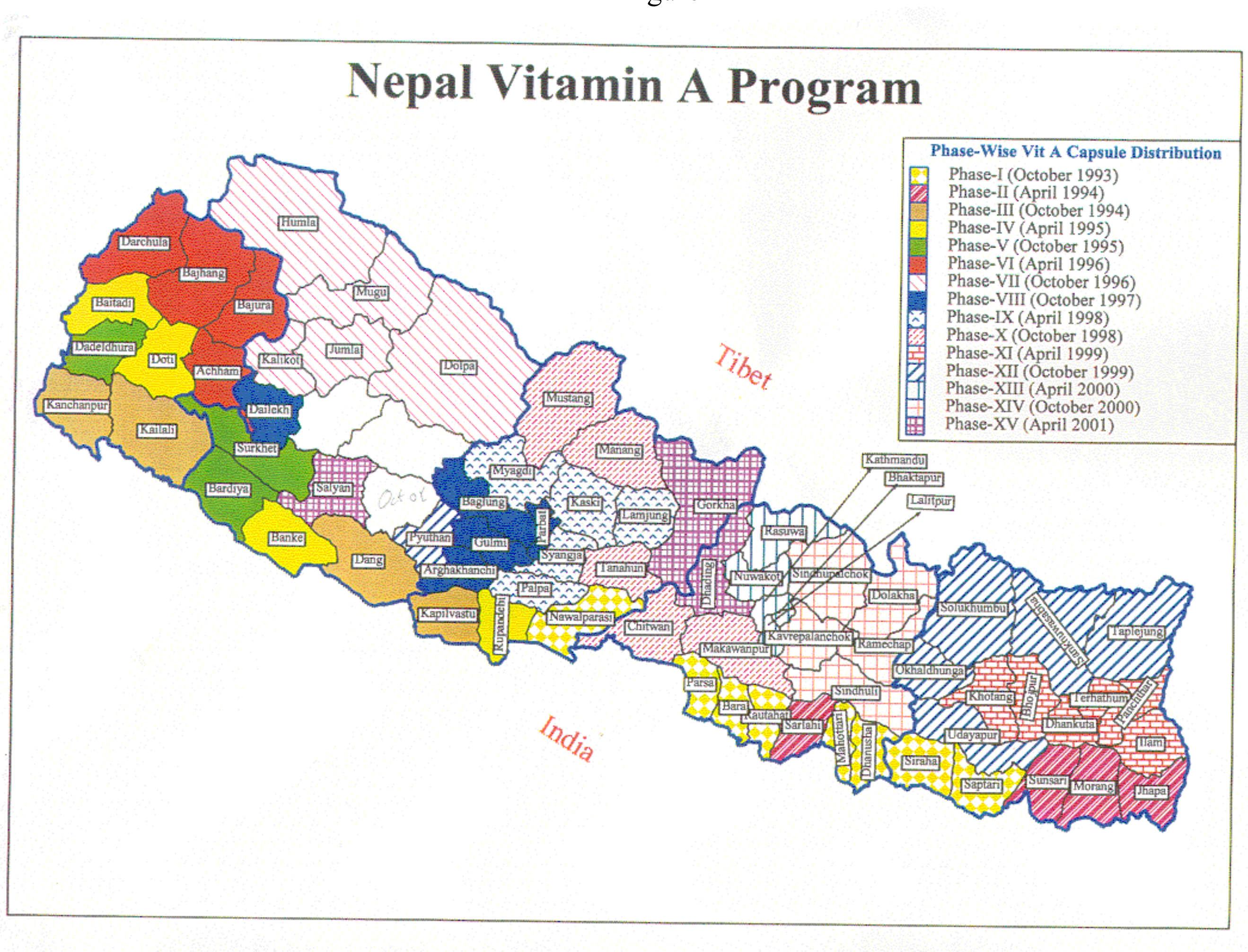


Figure 3.
Program Coverage 1990-2000

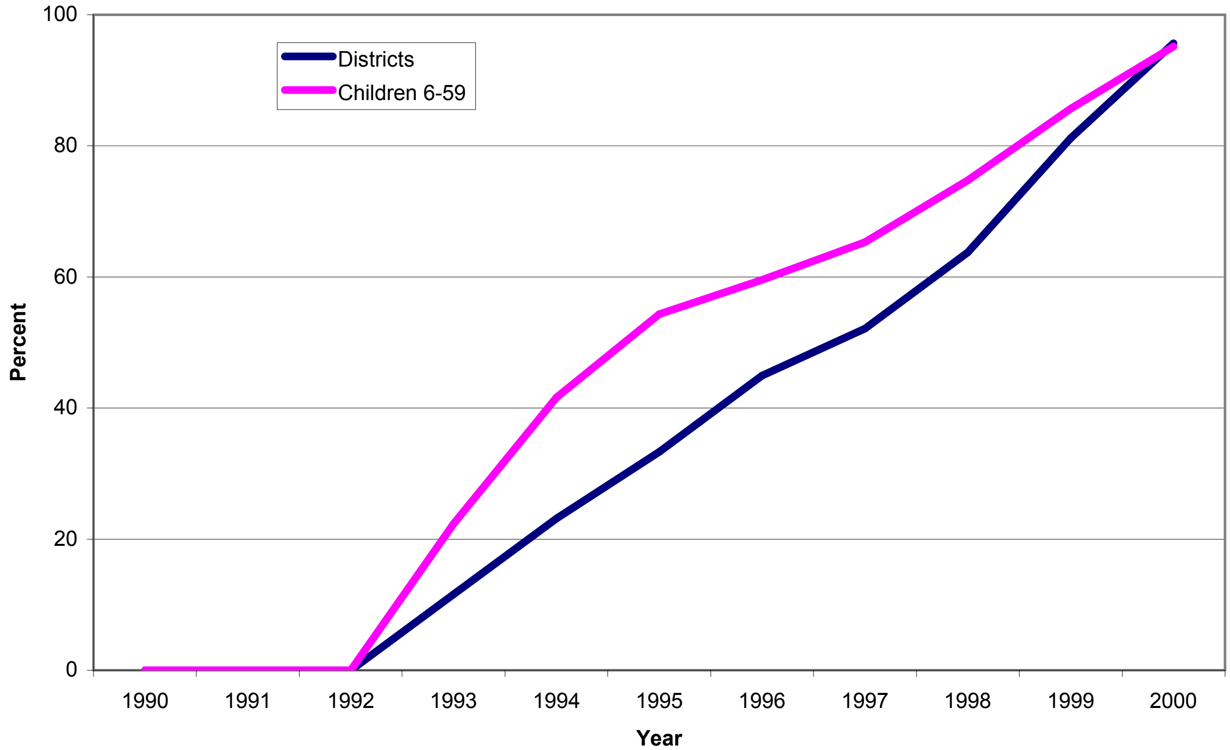


Figure 4. Mortality 0-5 months in 1990-92 by Program Phase

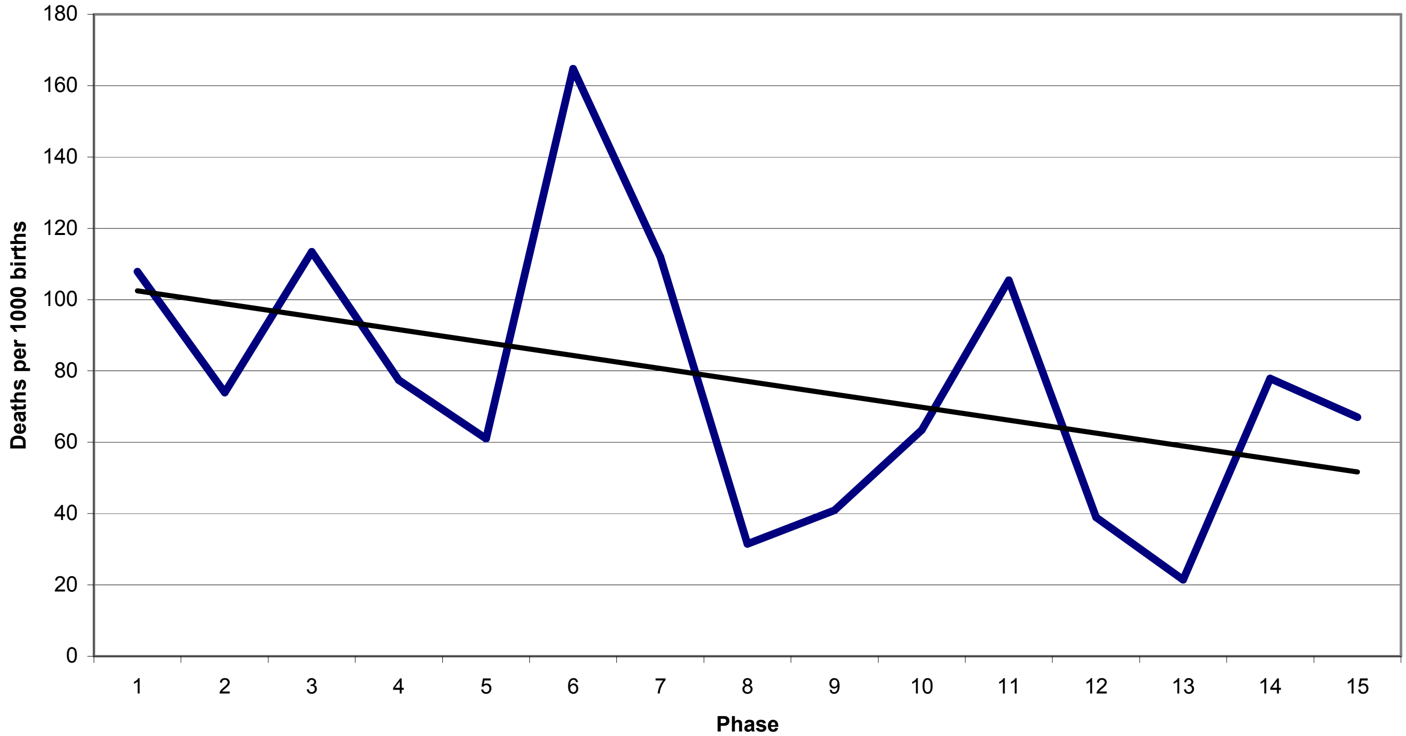


Figure 5. Under 5 Years Mortality Rate in 1990-92 by Program Phase

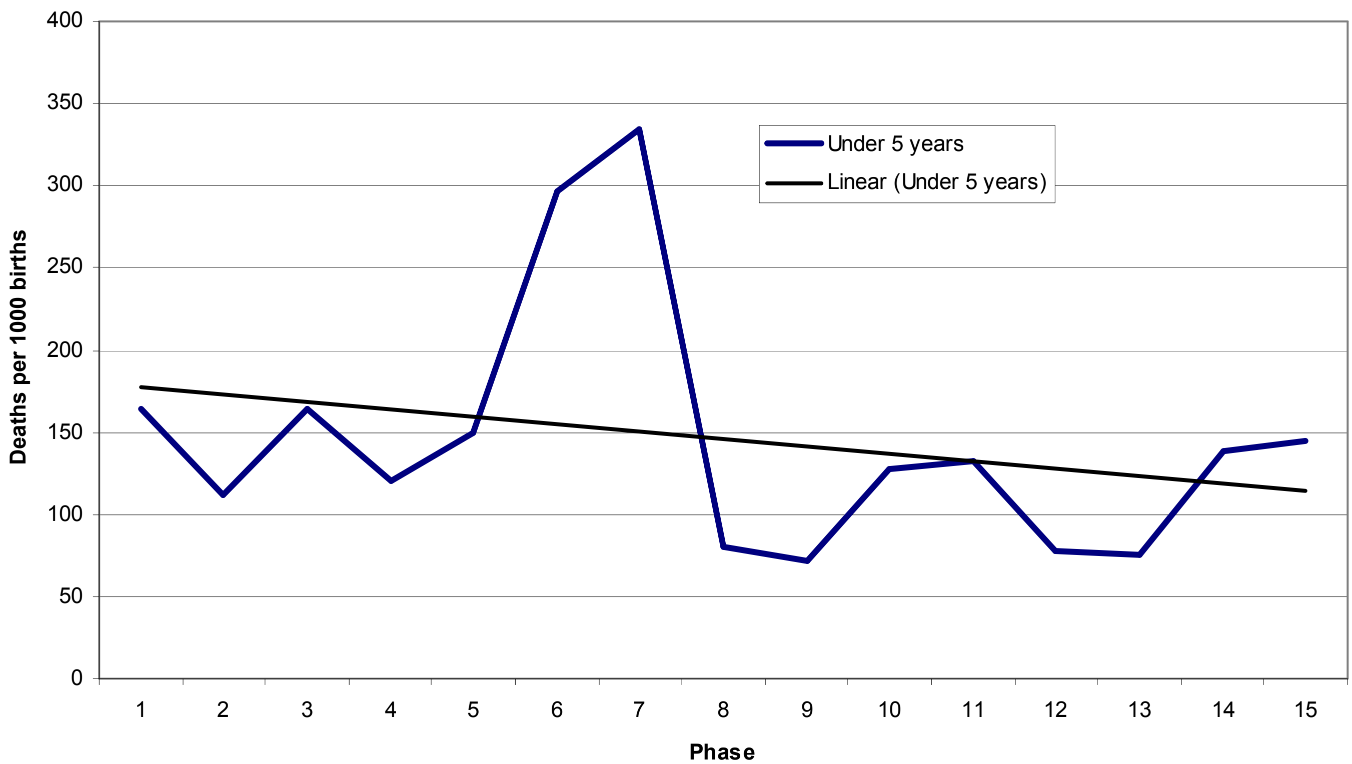


Figure 6. Percent of Households in the Third Wealth Quintile by Program Phase

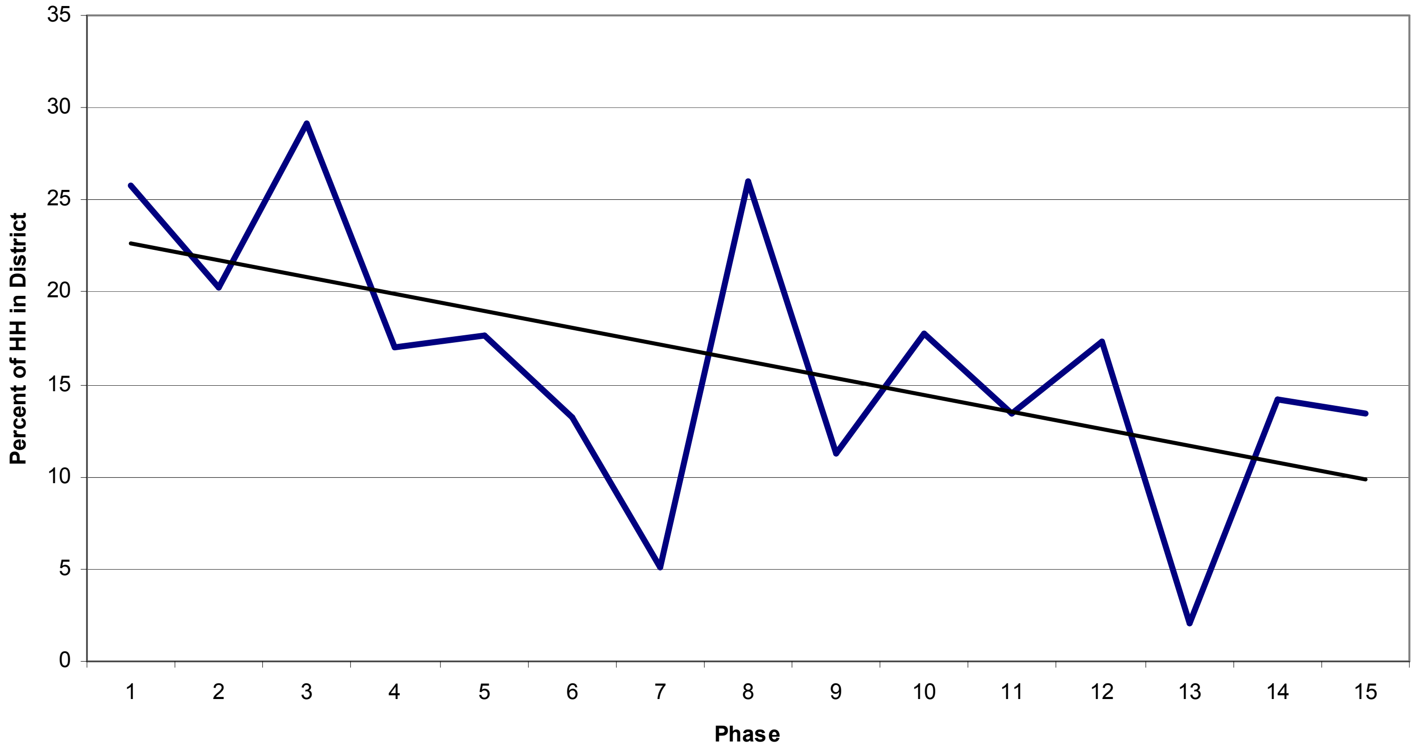


Figure 7. Percent of Women Literate by Program Phase

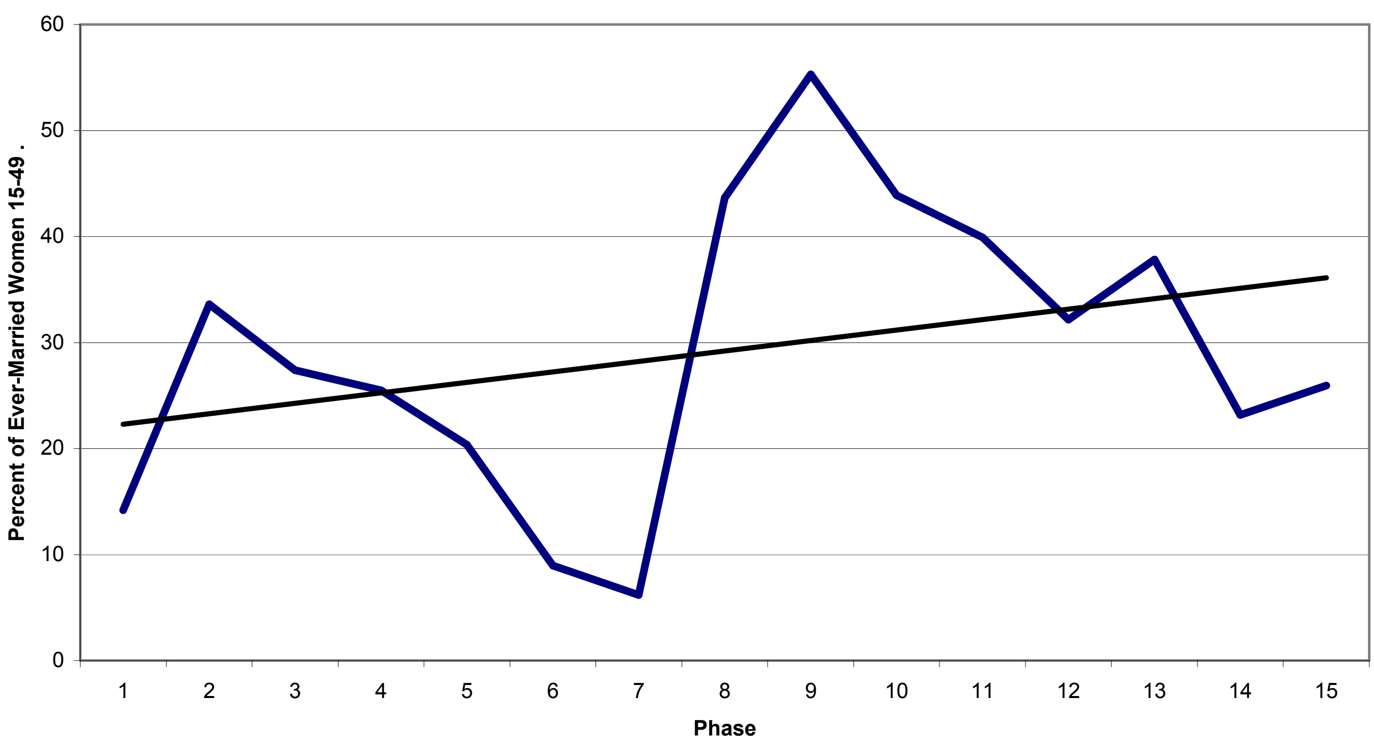


Figure 8. Vitamin A Foods by Program Phase

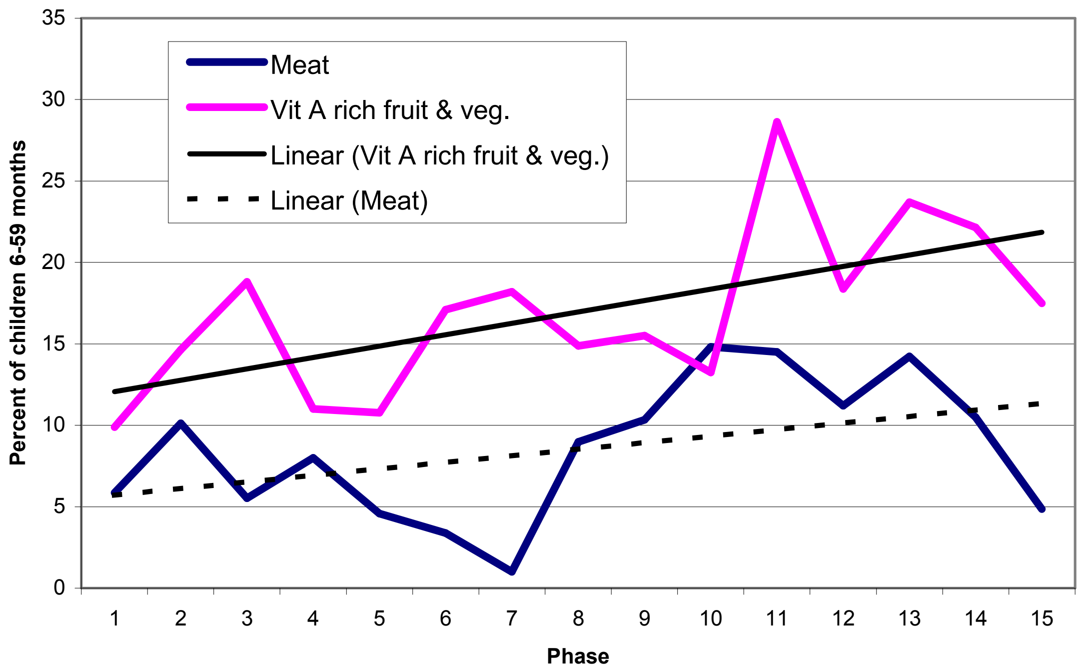
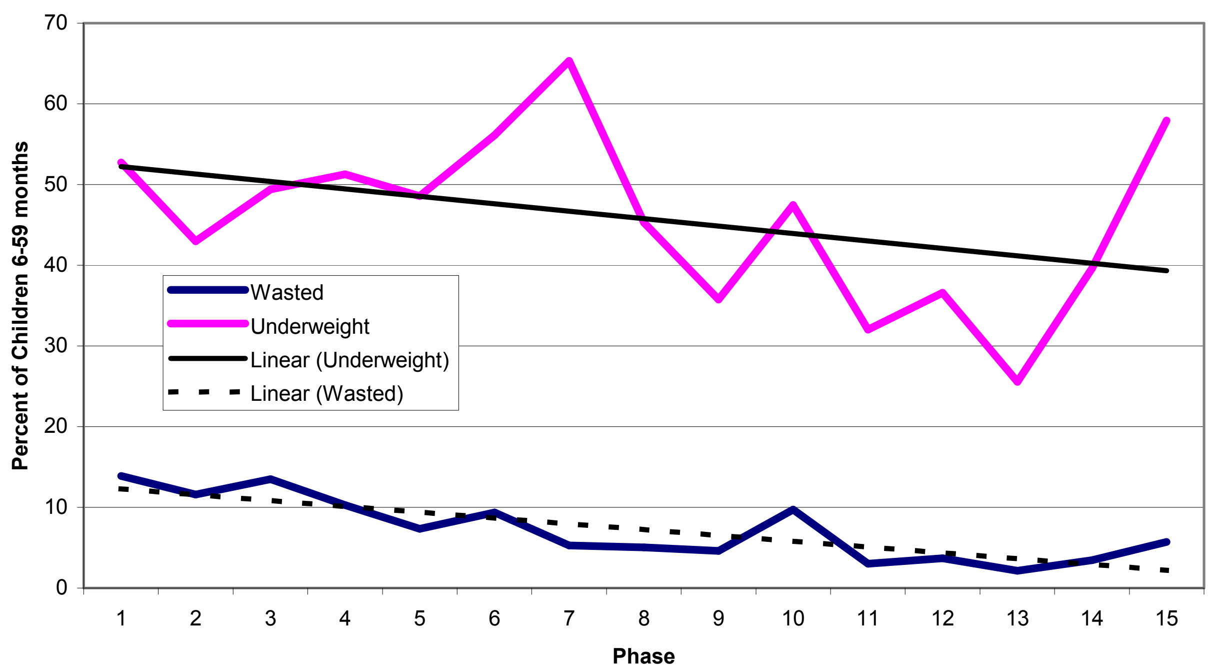


Figure 9. Nutritional Status by Program Phase



Appendix Table 1. Program Phase for Districts

Phase	District	Program Year	Phase	District	Program Year	Phase	District	Program Year
1	BARA	1993	6	ACHHAM	1996	11	BHOJPUR	1999
1	DHANUSHA	1993	6	BAJHANG	1996	11	DHANKUTA	1999
1	MAHOTTARI	1993	6	BAJURA	1996	11	ILAM	1999
1	NAWALPARASI	1993	6	DARCHULA	1996	11	KHOTANG	1999
1	PARSA	1993				11	PANCHTHAR	1999
1	RAUTAHAT	1993	7	HUMLA	1996	11	THERATHUM	1999
1	SAPTARI	1993	7	JUMLA	1996			
1	SIRAHA	1993	7	KALIKOT	1996	12	OKHALDHUNGA	1999
			7	MUGU	1996	12	PYUTHAN	1999
2	JHAPA	1994				12	SANKHUWASABHA	1999
2	MORANG	1994	8	ARGHAKHANCHI	1997	12	SOLUKHUMBU	1999
2	SARLAHI	1994	8	BAGLUNG	1997	12	TAPLEJUNG	1999
2	SUNSARI	1994	8	DAILEKH	1997	12	UDAYPUR	1999
			8	GULMI	1997			
3	DANG	1994	8	PARBAT	1997	13	BHAKTAPUR	2000
3	KAILALI	1994				13	KATHMANDU	2000
3	KANCHANPUR	1994	9	KASKI	1998	13	LALITPUR	2000
3	KAPILBASTU	1994	9	LAMJUNG	1998	13	NUWAKOT	2000
			9	MYAGDI	1998	13	RASUWA	2000
4	BAITADI	1995	9	PALPA	1998			
4	BANKE	1995	9	SYANGJA	1998	14	DOLAKHA	2000
4	DOTI	1995				14	KAVREPALANCHOK	2000
4	RUPANDEHI	1995	10	CHITWAN	1998	14	RAMECHHAP	2000
			10	MAKWANPUR	1998	14	SINDHULI	2000
5	BARDIYA	1995	10	TANAHUN	1998	14	SINDHUPALCHOK	2000
5	DADELDHURA	1995						
5	SURKHET	1995				15	DHADING	2001
						15	GORKHA	2001
						15	SALYAN	2001