Original Article

Current status of vitamin A deficiency and the National Vitamin A Control Program in Nepal: results of the 1998 National Micronutrient Status Survey

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The overall objective of the Nepal Micronutrient Status Survey (NMSS) was to assess the distribution and severity of micronutrient malnutrition, and to measure the progress achieved by different interventions. Data presented in this paper concern the prevalence of vitamin A deficiency (VAD) and the outreach and coverage of the National Vitamin A Supplementation activity. A multi-stage cluster sample design was employed that provided statistically representative data for each of thirteen eco-development strata (because of low population density, the West Mountains, Mid-west Mountains and Far-west Mountains were combined into a single stratum). The design allowed for aggregate estimates to be made at the national and ecological zone level. The survey showed a significant improvement in the status of clinical vitamin A deficiency in Nepal. The prevalence of both Bitot's spots and night-blindness among preschool children decreased from levels observed in surveys conducted in the previous twenty years. However, the prevalence of night-blindness was found to be 5% among women, and over 1% among school-aged children, which indicates that the entire population is vulnerable to VAD. These observations support findings from other surveys that have noted a high prevalence of maternal night-blindness in Nepal. Biochemical data collected as part of the survey indicated a high prevalence of low serum retinol (< 0.70 μmol/l), particularly among preschool children. Almost one of every three children (32.3%) and one of every six women (16.6%) had low serum retinol values. Low serum retinol among preschool children was associated with young age (6-11 months), rural location, wasting, presence of night-blindness and Bitot's spots, and residence in the Terai or Mountains. Similarly, sub-clinical VAD in women was associated with age (less than 20 years), pregnancy, the presence of night-blindness and residence in the Terai or Mountains. In the 42 districts covered by the National Vitamin A Programme (NVAP), more than 87% of preschool children were reached with vitamin A capsules. In addition to this, the National Immunisation Day (NID) provided oral polio vaccine drops to an estimated 95.7% of children 12-59 months. Awareness of the importance of vitamin A was, however, much higher in the NVAP districts than in non-programme districts. As would be expected, clinical VAD was most prevalent among children who had not received vitamin A during the most recent vitamin A capsule distribution. Indeed, the data show that vitamin A capsule receipt among children conferred a 59% protective effect for night-blindness and a 51% effect for Bitot's spots. These results point to significant progress having been achieved by the NVAP and NID capsule distribution activities.

Key Words: vitamin A, xerophthalmia, Nepal, serum retinol, dried blood spots, preschool children, infectious disease

Introduction

Vitamin A is an essential micronutrient involved in a number of biochemical activities necessary for normal biological function, including vision and immunocompentence. Vitamin A deficiency is also associated with increased mortality and severity of morbidity from respiratory and gastrointestinal disease. This is due to the weakening of the immune system by the breakdown of resistant barriers at epithelial and mucosal surfaces and the impairment of both humoral and cellular immunity. This results in impaired resistance to becoming infected, as well as inadequate immune response to infection. Thus, the true extent of vitamin A deficiency is often masked by disease in affected communities.

Dietary sources of vitamin A include both animal foods such as eggs, milk, meat (as preformed retinol) and fruits and vegetables (as carotenoids), although vegetable sources of vitamin A are considerably less bioavailable than meat sources. The best source of preformed vitamin A is liver and fish liver oil, but these are not readily available or affordable in Nepal.[1]

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The physiological and metabolic importance of vitamin A in vision has been recognised for some time.[2] The depletion of vitamin A stored in the liver leads to clinical xerophthalmia. Nightblindness and Bitot's spots may be reversed with vitamin A supplementation with limited long-term consequence.[3] While most Bitot's spots will disappear completely within two months, some cases are non-responsive to vitamin A therapy and are irreversible. With the more severe signs of xerophthalmia a reduction of deep corneal tissue results in permanent scars and in the severest cases when left untreated, keratomalacia may lead to a "melting" of the cornea, leading to permanent blindness. Furthermore, as many as 75-90 % of children suffering from keratomalacia who are not treated die within twelve months.[3]

In addition to xerophthalmia, one of the most important consequences of both clinical and subclinical VAD is an increased risk of child mortality. Over the past ten years, a number of researchers have investigated the potential impact of vitamin A interventions in reducing the risk of childhood death.[4-6] These studies have been the subject of extensive reviews and meta-analyses, and it has been concluded that, among vitamin A deficient populations, reductions in childhood mortality by as much as 23% may be realised through periodic high-dose vitamin A supplementation.[7,8] It has been estimated that twenty thousand preschool children aged 6-60 months, in Nepal would be at risk of dying annually due to the consequences of vitamin A deficiency in the absence of any intervention to improve vitamin A status.[9]

Vitamin A Deficiency (VAD) has long been a public health problem in Nepal. The Nepal Blindness Survey (NBS) conducted in 1980-81 was the first and only survey that reported the prevalence of clinical VAD on a national scale. Subsequent small-scale surveys have confirmed that VAD remained a significant nutritional disorder.

In addition to the NBS, four controlled field trials that evaluated the impact of vitamin A interventions, primarily supplementation, on child and maternal health and survival have been conducted over the past ten years in Nepal. Evidence linking vitamin A supplementation with early child mortality reduction, which emerged from these studies, has been critical in influencing global policy and establishing vitamin A supplementation as a priority intervention within child survival programmes throughout the world.

His Majesty's Government of Nepal commissioned a national micronutrient status survey (sponsored by the MI and UNICEF) in 1998 to identify the major factors in the etiology of micronutrient malnutrition, to examine the effectiveness of ongoing intervention programs, and to consider appropriate adjustments and modifications to control program strategies. The objectives of the study related to vitamin A status results presented in this paper were: 1) to determine the prevalence of VAD by clinical and biochemical indicators, 2) to estimate the impact of Vitamin A capsule (VAC) distribution on VAD.

Materials and methods

The sample design of the MNSS was aimed to ensure that statistically representative data for each of the country's thirteen eco-development strata were collected. From these data, sub-national and regional estimates could be generated. In order to aggregate data and provide national estimates with the sample design, it was necessary to develop statistical weights to account for the fact that equal samples were collected from each of the thirteen eco-development strata. Because the actual population living in each of these strata varies considerably, it was necessary to adjust the relative contribution of individual records to the national figures based on the proportion of the national population living in each stratum. These weights were added to each individual record in all of the databases, and were applied to all statistical analyses of national and ecological zone level parameters.

A two-stage cluster sampling procedure was followed in order to characterise the situation in each of 13 distinct eco-development strata. In the first stage, all wards within each strata were listed and thirty wards were selected by PPS and were treated as the primary sampling units, or 'clusters'. Within each selected cluster, forty households were selected systematically after a random start. The eligibility criteria for a household to be considered for selection was the presence of a woman with at least one preschool child between 6 and 59 months of age. Households not meeting this criterion were excluded from the survey. A total of forty households were sampled within each cluster to meet minimum sample size requirements of 40 mothers and 45 preschool children (6-59 months). Two preschool children were selected from five households while a single preschool child was selected from the remaining 35 households.

A sub-sample of 25 percent of the women and 25 percent of the preschool children were asked to provide blood samples, while urine samples were collected from the mothers and from 25 percent of the school-aged children. A clinical examination was performed on all eligible mothers, preschool children and school-aged children. Dry blood samples were collected from thirty clusters per ecological zone, e.g. Terai, Hills, and Mountains, to give a total of 90 clusters. Within each of the randomly selected clusters per ecological zone, dry blood spots were collected from the same ten mothers and ten preschool children in households already included in the sub-sample for biological specimens. In turn, data on serum retinol are only representative at the national and ecological zone levels.

For the preparation of dried blood spots, 5-10 drops of blood were dropped onto a filter paper matrix (Schleicher and Schuell #903), spread evenly, allowed to dry in the air, and then stored in low gas permeable, zip-closed plastic bags with silica gel. The bags were immediately placed in vaccine carriers for transport to local cold stores used by the EPI program. From the point that the blood spots were dried, they were stored at a maximum of –10°C.

The samples were then transported to the Public Health Research Laboratory at the Institute of Medicine in Kathmandu where they were stored in a deep freezer at -70°C before being transported to the United States for analysis at Craft Technologies, Inc. (North Carolina).[10,11]

In order to validate the retinol data analysed from the survey and to establish recovery/adjustment factors, a special study was conducted which compared the retinol data using the dry blood spot technique to plasma retinol from the same individuals using conventional collection and HPLC methods. The validation study entailed collection of blood by both techniques from preschool children selected randomly from an outpatient clinic at Kanti Hospital, Kathmandu. All parents and children (where appropriate) were informed of the objective of the study and were asked to provide consent for participation.

The sensitivity of the dry blood spot retinol was 76.4%, while the specificity of the method was 97.3% in estimating the retinol values as measured by traditional venous samples from 54 children at Kanti Hospital, Kathmandu. The correlation was 0.837, and a linear regression equation developed to predict the venous serum retinol values from the observed retinol collected using the dry blood spot technique (Fig. 1).μ

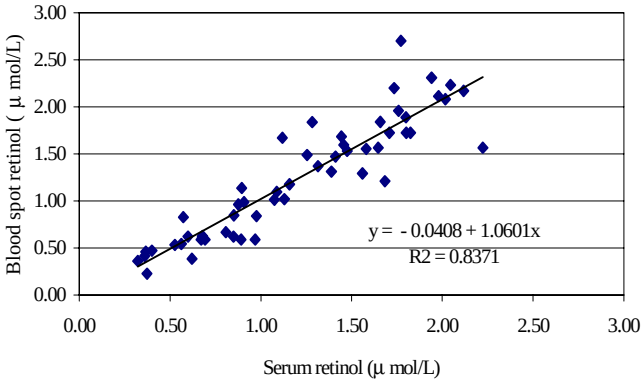

Figure 1. Correlation between serum retinol from venous blood samples and Dried Blood spots in Nepal

Results & Discussion

Clinical Vitamin A Deficiency

The NMSS provided estimates of the current status of clinical vitamin A deficiency for three age groups; preschool children, school-aged children and mothers. For the mothers of preschool children, aged 6 to 59 months included in the survey, current maternal night-blindness status and night-blindness status during their previous pregnancy were recorded. Clinical examination of Bitot's spots and recall of night-blindness was undertaken among preschool and school-aged children.

Table 1 presents the prevalence of night-blindness (XN) among women. The overall prevalence of current XN among mothers was 4.7% with pregnant women having a higher rate (6.1%) than non-pregnant women (4.5%). The prevalence of XN among women at some point during their previous pregnancy was much higher (16.7%) regardless of their current pregnancy or night-blindness status.[1] The prevalence of current XN among women was highest in the Terai, with the East Terai showing an alarmingly high rate of 13.4%, and among older women.

Data on the current prevalence of clinical VAD among preschool children are summarised in Table 2. Among preschool children, aged 12-59 months of age, the prevalence of XN was 0.27%, while among children aged 6-59 months old, the prevalence of Bitot's spots (X1B) was 0.33%. Both of these levels are below WHO cut-off points to designate a significant public health problem (1.0% for XN and 0.5% for X1B) indicating progress towards the goal of VAD elimination at the national level. However, the X1B rates among preschool children in the Terai zone, which has long been considered to be most vulnerable to VAD, exceeded the WHO cut-off implying the need for continued, if not greater, attention. Still, the prevalence of X1B and XN observed in the NMSS are significantly lower than earlier estimates.

Table 1. Prevalence of night-blindness (XN) among women

Background Characteristic		Current XN status		XN in last pregnancy	
	N	Cases	%	Cases	%
Ecological zone[a]					
Terai	7256	398	5.5	1399	19.3
Hills	7076	274	3.9	932	13.3
Mountains	1204	54	4.5	241	20.4
National[a]	15536	726	4.7	2572	16.7
Pregnancy status[a]					
Pregnant	1598	97	6.1	265	16.7
Not pregnant	13750	622	4.5	2269	16.6
Age group[a]					
< 20 years	847	15	1.8	112	13.3
20-29 years	8771	309	3.5	1303	14.9
30-39 years	4790	289	6.0	923	19.4
> 40 years	1085	112	10.3	227	21.2
Location[a]					
Urban	1708	15	0.9	97	5.7
Rural	13828	710	5.1	2475	18.0

[a] Sample sizes are weighted to account for sample design - based on analysis at ecological zone level.

Table 3 presents data on clinical VAD among school-aged children. What is particularly striking is the similar geographic distribution of VAD cases among the three age groups surveyed, with the highest rates seen in the East Terai. Figure 2 displays the age-specific prevalence of XN and X1B among children under ten years of age.

Table 2. Prevalence of nightblindness (XN) and Bitot's spots (XIB) among preschool children

Background	Nightblindness[b]			Bitot's Spot		
Characteristic	N	Cases	%	N	Cases	%
Ecological zone[a]						
Terai	7253	33	0.45	8148	47	0.58
Hills	6899	7	0.10	7953	9	0.11
Mountains	1155	2	0.17	1354	1	0.07
National[a]	15307	42	0.27	17455	57	0.33
Age group[a]						
6-11 months	NA	NA	NA	1995	0	0.00
12-23 months	4457	3	0.07	4534	2	0.04
24-35 months	4305	8	0.19	4348	10	0.23
36-47 months	3455	18	0.52	3470	21	0.61
48-59 months	3084	14	0.45	3102	24	0.77
Sex[a]						
Male	8025	18	0.22	9144	36	0.39
Female	7282	24	0.33	8312	22	0.26
Location[a]						
Urban	1681	0	0.00	1906	3	0.16
Rural	13626	42	0.31	15550	55	0.35

[a] Sample sizes are weighted to account for sample design - based on analysis at ecological zone level.

The prevalence of Bitot's spots among school-aged children was higher than that for preschool children as seen in Figure 2. As observed in surveys conducted in other countries, the prevalence of mild xerophthalmia, XN and X1B, increases with age not only through the preschool period, but also into early adolescence.[12,13] This is likely due to the fact that the typical Nepali diet is inadequate in vitamin A[14], and does not meet the increasing requirements with age. However, these data must be interpreted with caution since the assessment of Bitot's spots in older children may be overestimated. It is possible that some of the observed Bitot's spots may not reflect current vitamin A deficiency, but rather be a permanent ocular manifestation of a previous episode of VAD that did not respond to vitamin A therapy. It has been estimated that as much as 35% of all Bitot's spots observed in older children may be non-responsive and as such cause an overestimation of the current situation.[15] Nonetheless, the fact that 1.2% of the school-aged children did report having night-blindness at the time of the survey shows that vitamin A deficiency exists as a public health problem in older children of Nepal. This finding calls for consideration of interventions to improve vitamin A status of older children.

Subclinical VAD among women

Among women, the overall prevalence of subclinical VAD (serum retinol < 0.70 µmol/l) was 16.6% with the prevalence among women living in the Terai and Mountains being twice that of women in the Hill zone (Table 4). The prevalence was greater than 30% among currently pregnant women and less than 15% among non-pregnant women.

The highest preva-lence of subclinical VAD was among women below 20 years (19.5%) and the lowest among women aged 30-40 years (13.3%). The under 20 age group includes adolescents who could be at a higher risk of VAD due to child bearing while they are still growing themselves. There were no significant differences in serum retinol by nutritional status as measured by Body Mass Index (BMI).

Subclinical VAD among preschool children

Table 5 shows that the overall prevalence of subclinical VAD among preschool children was 32.3%; one out of every three children. Similar to the pattern seen among women, children in the Terai and those in the Mountains showed high prevalences (40.0% and 35.5% respectively). The prevalence of subclinical VAD among the youngest age groups, 6-11 and 12-23 months, was alarmingly high, possibly due to a com-bination of decreasing breastfeeding frequency, insufficient vitamin A from complementary foods, high rates of infection, or low exposure to vitamin A capsule supplementation.

Table 3. Prevalence of nightblindness (XN) and Bitot's spots (XIB) among school-aged children

Background	Nightblindness			Bitot's Spots		
Characteristic	N	cases	%	N	cases	%
Ecological zone[a]						
Terai	7234	108	1.5	7256	193	2.7
Hills	7077	61	0.9	7089	82	1.2
Mountains	1196	10	0.8	1203	21	1.7
National[a]	15507	179	1.2	15548	296	1.9
Age[a]						
6 years	3262	36	1.1	3278	52	1.6
7 years	3033	23	0.8	3044	45	1.5
8 years	3018	40	1.3	3026	62	2.0
9 years	2348	24	1.0	2348	49	2.1
10 years	2235	31	1.4	2244	56	2.5
11 years	1599	25	1.6	1600	33	2.1
Sex[a]						
Male	7575	102	1.3	7594	167	2.2
Female	7930	77	1.0	7954	130	1.6

[a] Sample sizes are weighted to account for sample design - based on analysis at ecological zone level.

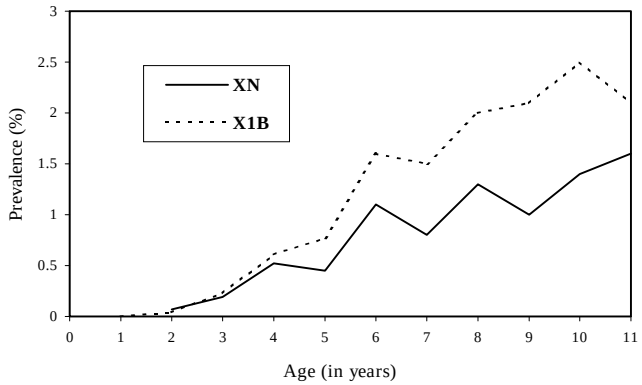

Figure 2. Prevalence of mild xerophthalmia among children 1-11 years of age (XN = nightblindness; XB = Bitot's spots)

Table 4. Prevalence of subclinical VAD among women

Background Characteristic	N	Prevalence of subclinical VAD (marginal serum retinol) % < 0.35 µmol/l	% < 0.70 µmol/l	Mean µmol/l	S.D.
Ecological zone[a]					
Terai	375	2.4	20.8	0.97	0.37
Hills	362	0.3	10.5	1.23	0.46
Mountains	105	1.9	22.9	1.17	0.70
National[a]	842	1.4	16.6	1.11	0.48
Age group[a]					
<20 years	41	0.0	19.5	1.08	0.46
20-29 years	489	1.8	18.2	1.09	0.48
30-39 years	265	0.8	13.3	1.15	0.47
>40 years	46	0.0	17.4	1.13	0.56
Current XN[a]					
No	786	1.5	16.3	1.11	0.48
Yes	56	0.0	21.4	1.11	0.43
Body Mass Index[a]					
<18.5	221	0.0	15.8	1.03	0.41
>18.5	621	1.8	16.9	1.13	0.50
Pregnancy status[a]					
Pregnant	89	0.0	31.5	1.00	0.48
Not pregnant	740	1.6	15.0	1.12	0.48
Location[a]					
Urban	112	0.9	10.7	1.22	0.53
Rural	732	1.5	16.0	1.09	0.47

[a] Sample sizes are weighted to account for sample design - based on analysis at ecological zone level.

While underweight (low weight-for-age) and stunted (low height-for-age) children did have higher rates of subclinical VAD than children with normal nutritional status, the differences did not reach statistical significance. However, there was a strong association with wasting (low weight-for-height), with almost half of all wasted children suffering from subclinical VAD. Children in rural areas had a higher prevalence of subclinical VAD, including severely low serum retinol levels, which may be related to differences in dietary patterns and higher rates of infection than children in urban settings. There was no significant sex difference although the slightly higher prevalence among boys is consistent with observations from other countries. Conditions such as fever and infection (particularly measles) can cause transient changes in serum concentration unrelated to changes in vitamin A stores, therefore the VAD status in children should be analysed with respect to morbidity status.

Vitamin A Capsule Distribution

In order to address the problem of VAD, HMG/Nepal has established the National Vitamin A Programme (NVAP), which aims to improve the vitamin A status of the population. One of the most critical components of the NVAP is the strategy of supplementing children aged 6-59 months with high-dose vitamin A capsules twice a year. The NVAP was launched in 1993 with the first round of vitamin A capsule distribution taking place in October 1993. Since that time, there has been a systematic expansion of the vitamin A capsule supplementation activity by including 4-6 new districts at each round of distribution with the intention eventually to cover all districts by the year 2001.

The NVAP provides extensive training to health workers at all levels of the government health infrastructure from the district level to the community level. In communities, it is the Female Community Health Volunteer (FCHV) who is the primary person responsible for the delivery of vitamin A supplements to all eligible children in her catchment area. The biannual rounds of distribution are carried out as campaigns with intensive promotion of the 'event' taking place immediately prior to each round, along with logistical management to ensure that adequate supplies are made available to each FCHV. As new districts are added to the programme, refresher training is provided to the FCHVs through the regular MOH programme in established NVAP areas in order to replenish capsule supplies and maintain high levels of awareness among health workers.

Initial emphasis was given to districts considered to be most vulnerable to VAD, which were covered in the first seven rounds between October 1993 and October 1996. At the time of the NMSS the programme was covering a total of 42 districts. Because the programme had yet to cover all areas of the country, it was critical to clearly distinguish between the programme and non-programme districts in order to properly assess progress achieved by the NVAP.

Among the 17,496 children included in the survey sample, 10,211 (58.4%) were located in areas covered by the NVAP. In the Terai zone, all children except those located in Chitwan district (Central Terai) resided in NVAP districts. All children located in the Far-west Hills and 97% of the sampled children in the All-west Mountains were in districts included in the NVAP. The East and Central Hills and East and Central Mountains had not been covered by the NVAP, while the remaining eco-development strata were partly covered by the time of the survey.

Efforts to estimate the vitamin A capsule coverage of the NVAP are ongoing. Mini-surveys conducted by the Nepal Technical Assistance Group (NTAG) following each round of capsule distribution have consistently found coverage rates between 86-90%.[16] The first external evaluation of the NVAP, carried out in 1996 by New ERA in the districts located in Karnali Administrative Zone, found an overall vitamin A capsule coverage of 88.5 percent. [17]

The 1996 Nepal Family Health Survey estimated the national vitamin A capsule coverage to be 32% among children age 6-35 months. However, the data did not distinguish between areas covered and not covered by the programme and hence did not provide an accurate picture of the vitamin A capsule coverage of the NVAP.

In order for the NMSS to provide valid estimates of vitamin A capsule coverage in NVAP areas, an algorithm was developed to verify that accurate data were collected. The respondent was initially asked whether she knew about the recent NVAP distribution 'event', when vitamin A capsule were distributed to children. If the respondent did not know about the NVAP distribution then a second person in the household who may have known about the event was asked. Children from households where nobody knew about the event were considered to have not received vitamin A capsules in the analysis. Only those children who were at least six months of age at the time of the vitamin A capsule distribution were included in the coverage and impact analysis.

Table 5. Prevalence of subclinical VAD among preschool children

Background Characteristic	N	Prevalence of subclinical VAD (marginal serum retinol) % < 0.35 µmol/l	% < 0.70 µmol/l	Mean µmol/l	S.D
Ecological zone[a]					
Terai	375	3.7	40.0	0.82	0.31
Hills	363	1.1	23.4	0.93	0.31
Mountains	105	3.8	35.5	0.99	0.77
National[a]	843	2.6	32.3	0.89	0.40
Age group[a]					
6-11 months	124	1.6	41.9	0.85	0.46
12-23 months	240	4.2	37.1	0.89	0.44
24-35 months	225	3.6	29.4	0.87	0.38
36-47 months	130	0.0	27.7	0.90	0.37
48-59 months	122	1.6	23.7	0.92	0.34
Sex[a]					
Male	443	2.7	34.8	0.85	0.38
Female	400	3.0	29.8	0.93	0.44
Location[a]					
Urban	111	0.0	26.1	0.91	0.31
Rural	733	3.1	33.3	0.88	0.42
Wasting[a]					
Wasting	47	8.5	48.9	0.89	0.66
No wasting	788	2.4	31.5	0.89	0.38
Stunting[a]					
Stunting	439	3.4	33.5	0.88	0.44
No stunting	393	1.8	31.1	0.90	0.36
Underweight[a]					
Underweight	398	3.3	35.0	0.88	0.46
Not nderweight	444	2.0	29.9	0.89	0.35

[a] Sample sizes are weighted to account for sample design

While efforts were taken to gain the most accurate data on vitamin A capsule coverage, there were a few limitations in the methodology. In NTAG's monitoring experience, it has been necessary to prompt caretakers to recall the distribution. Once prompted with some general description of the distribution, most caretakers are able to describe the activity in more precise detail, including description of the capsule and the location of the distribution. Even if the caretaker did not recall the distribution, most often some family member or neighbour had taken the child in question to the vitamin A capsule distribution. However, due to time constraints, the survey enumerators did not prompt. Therefore, it was not possible to determine whether the children of caretakers who did not recall the event had in fact received or not received capsules. These children are treated as non-receipt in analysis (9.2%, n=879), thus avoiding a positive bias in the coverage figure. This in turn suggests coverage data may be slightly underestimated based on previous experience with the algorithm by NTAG.

There were 24 cases for which no response at all was received for the question regarding the event, and these cases were excluded from the analysis. Thus, from the total sample living in NVAP districts who were at least six months of age at the time of the last vitamin A capsule distribution, 9,576 children were included in the analysis. Of this total, 87.4% of the children were reported to have received a vitamin A capsule in the previous round (Table 6).

Table 6. Percentage of children, 6-59 months who received vitamin A capsules in the last distribution round in the NVAP areas

Background Characteristic	VAC Coverage N[c]	%
Ecological zone[a]		
Terai	7299	87.3
Hills	1744	87.3
Mountains	533	89.1
National[a]	9576	87.4
Age group[a]		
6-11 months[b]	507	74.2
12-23 months	2618	88.2
24-35 months	2567	88.4
36-47 months	2133	89.2
48-59 months	1752	86.2
Sex[a]		
Male	5048	88.0
Female	4530	86.7
Location[a]		
Urban	687	67.1
Rural	8890	89.0

[a] Sample sizes are weighted to account for sample design - based on analysis at ecological zone level.

[b] Only children who were above 6 months of age at time of vitamin A capsule distribution are included.

[c] A total of 879 respondents who did not know of the event were counted as not having received vitamin A capsule. An additional 24 others did not provide responses were counted as 'missing' and were excluded from the analysis.

Those who reported that their child did not receive a capsule often indicated either that they believed their child was too old or too young for the programme, or that there may have been an inadequate supply of capsules. Vitamin A capsule coverage varied most with respect to age. The youngest children targeted by the programme, e.g. ages 6-11 months, had a coverage of 74.2%, which was lower than that of the older cohorts.

Another important characteristic of coverage was the location of households, with coverage being significantly higher in rural areas than in urban areas (89.0% to 67.1%). Otherwise, the rates varied little with respect to eco-development strata, ecological zones or gender. These results are consistent with the mini-surveys conducted by NTAG and provide external verification of the accuracy of their results.

In other countries there has often been reported inequity in programme outreach for vitamin A capsule distribution with children from impoverished families and who have limited access to health services being less likely to be covered by the programme. Hence, it is interesting to note that further analysis of the characteristics of children who received vitamin A capsules during the previous round of the NVAP shows that in Nepal, the most vulnerable children were more likely to be covered by the programme as intended. Indeed, children with lower nutritional status were significantly more likely to have received capsules than children with better nutritional status. Based on the coverage rates measured in the survey, it is evident that the NVAP has been very successful in providing almost universal vitamin A capsule coverage of preschool children in the districts where the programme has been implemented.

The National Immunisation Day (NID) in Nepal has been a very impressive undertaking of the Ministry of Health, and has worked well to provide vitamin A during the annual NID in conjunction with oral polio vaccine in those districts not yet covered by the NVAP. As part of the NMSS, information was collected only on whether children received polio vaccine during the most recent round of NID (December, 1997). Results are presented only for those children who were at least twelve months of age at the time of the NID since this was the target group for VA supplementation. An overall polio coverage rate of 95.7% was observed. Unfortunately, it was not possible to clearly determine what proportion of these children also received vitamin A. However, a national immunisation coverage survey, which evaluated NID found that during the December 1997 NID, over 97.3% of children received polio, and 86.7% received vitamin A indicating that there was very good outreach of vitamin A in the non-NVAP districts. Thus, it is likely that a large proportion of children did indeed receive vitamin A in the non-NVAP areas.

Nonetheless, it is very important to distinguish the two strategies of providing vitamin A. On one hand, the NVAP provides two doses of vitamin A to children, ages 6 to 60 months, each year as part of an ongoing programme. On the other hand, the NID is a temporary programme, which aims to establish immunity to polio, and will only remain in place for 2-4 more years until polio is eradicated. Furthermore, in districts where vitamin A is provided as part of the NID, only a single dose is given annually to children aged 12-59 months. Still, the NID has provided an opportunity to supply some vitamin A in populations that would otherwise not receive any, and together with the NVAP has helped ensure that virtually all children in Nepal receive at least one dose of vitamin A per year.

Because the survey collected clinical and sub-clinical data and status of vitamin A capsule receipt, it is possible to estimate the impact of vitamin A supplementation on reducing signs of vitamin A deficiency among the national sample of preschool children. Table 7 details the rates of XN, X1B and low serum retinol between children receiving and not receiving vitamin A capsules. Again, these data are presented only for those children who were eligible to have received a vitamin A capsule during the previous distribution round. In addition to the prevalence rates between the two groups of children, odds ratios are presented which specify the protective effect of vitamin A capsule supplementation on reducing xerophthalmia and prevalence of low serum retinol.

Table 7 shows that VAD is more prevalent among children not receiving capsules than among those having received a capsule in the previous round of distribution. Indeed, the data show a 59% protective effect for XN, a 51% effect for X1B, and a14% effect for low serum retinol although this does not reach statistical significance. Multi-variate analysis, which controlled for potential confounding factors influencing VAD and vitamin A status in Nepal revealed that vitamin A capsule supplementation is indeed a key intervention for VAD control.

Table 7. Association between vitamin A capsule receipt and indicators of VAD among preschool children

Vitamin A status	Prevalence of VAD by status of vitamin A capsule receipt [a]						
	Receive capsule			Not receive capsule			Odds Ratio (95% C.I)
	Cases	N	%	Cases	N	%	
XN	32	13190	0.24	8	1356	0.59	0.41 (0.19 , 0.89)
X1B	45	1356	0.33	10	1502	0.67	0.49 (0.25 , 0.98)
Low serum retinol	208	668	31.3	19	55	34.5	0.86 (0.48 , 1.53)

Note: The percentage is derived from the weighted estimates.

[a] Only children who were eligible to have received VA during the previous distribution are included.

Data on dietary intake of vitamin A indicates that the diet is inadequate, therefore continuation and expansion of vitamin A capsule supplementation programme is a rational strategy, and needs to be in place until alternative intervention approaches become adequate for the long-term, sustained control of VAD.

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