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RISK ASSESSMENT OF VITAMIN A DEFICIENCY IN CHILDREN

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ABSTRACT

Assessment of these "*risk indicators" may* provide crucial information for planning and targeting interventions and thus may increase the likelihood of program effectiveness at the community level. However very few studies have been conducted to assess the prevalence of vitamin A deficiency (VAD) in a population based on the ecological and biological indicators. In the present study an attempt has been made to assess the *"risks causing vitamin A deficiency"* of two different communities based on the ecological and biological indicators, by an in depth study of under privileged school children (7-13 years). A socially backward, impoverished environment favors large families with consequent overcrowding that are associated with poor environmental sanitation and personal hygiene. Clustering and unhygienic sanitary conditions, which are important determinants of VAD as suggested by WHO/NUT, were identified as the risk factors in the present study. Since pharmaceutical measures are expensive and short term, nutrition health education and promotion of easily available vitamin rich foods such as drumstick leaves can be done in such communities.

Keywords: Vitamin A Deficiency (VAD), WHO/NUT, Children

INTRODUCTION

Vitamin a deficiency (VAD) is the primary cause of preventable childhood blindness and a major contributor to severe morbidity and mortality. VAD is common in economically deprived population groups. The relatively mild signs of VAD, which include Night blindness and Conjunctival xerosis with or without Bitot's spots, are more frequently

encountered in population surveys among pre-schoolers and older age groups. There are several indicators which are ecological, cultural or economic in origin which influence the attitude and beliefs about food purchase and consumption and may be the root cause of Vitamin A deficiency.

Assessment of these *"risk indicators" may* provide crucial information for planning and targeting interventions and thus may increase the likelihood of program effectiveness at the community level. However very few studies have been conducted to assess the prevalence of vitamin A deficiency in a population based on the ecological and biological indicators **[1]**.

In the present study an attempt has been made to assess the *"risks causing vitamin A deficiency"* of two different communities based on the ecological and biological indicators[5], by an in depth study of under privileged school children (7-13 years).

MATERIALS AND METHOD

Study Area and Study Population

The study was conducted in an urban city of Vadodara, Gujarat, Western India. There are 135 primary schools in urban Vadodara, under the Vadodara Municipal Corporation imparting free education to the underprivileged population mainly living in slums. Most of the schools are coeducational. Out of the total number of primary schools, two schools were purposively selected which catered mainly to children of the lower socioeconomic strata, residing in the nearby slum communities. A total of 105 households with a total of 711 family members were studied for assessing the vitamin A status of the community.

Subject Recruitment and Sample Size

Permissions were obtained from the Chairman of the Vadodara Primary School Board and a written consent was obtained from all the children. A total of 105 boys and girls (7-13 years) were enrolled for the study from standard III of these schools. The name, date of birth and address of these children were obtained from the school attendance register. The details of the parameters along with the methods used are described here.

Tools for Data Collection

A pretested semi-structured questionnaire cum interview schedule was administered to mothers of all the subjects to elicit information of socio-demographic profile, awareness about vitamin A deficiency and knowledge, attitude and practices related to vitamin A rich foods. Information on the family type, family size, religion, and caste, language, mother's educational level, working status, total income, and source of drinking water, toilet facilities, and household assets,

such as radio, television, facilities available at home was collected.

History of XN in the present study was elicited from the subjects by the use of local term "Ratandhanapanu". Clinical examinations for the detection of vitamin A comprise identifying the ocular manifestation. The ocular signs diagnosed in the present study were recorded according to the WHO Classification.

Nutritional status was assessed by anthropometric measurements viz weight and height/length using standard techniques. Malnutrition was classified using the National Center for Health Statistics (NCHS) standards.

The dietary intake of children was assessed using 24-VASQ method (24-hour recall for vitamin A semi quantitatively). The family of each child selected for the dietary survey (which was feasible only on a representative sub-sample) was visited. The mother/guardian was explained the relevance and the need to conduct the diet survey and their cooperation were sought. To begin with there was a general discussion of the number and type of meals consumed the previous day. Then each meal was discussed chronologically from first to last. All raw and cooked foods were recorded meal by meal. The mother was asked to indicate the amount of each raw ingredient, which she used, for a particular dish and the final amount of the cooked dish, using her own household measures. These were converted to standard measures by using standard cups, bowls and spoons. Then the amount of each dish consumed by the target child was also recorded on a standard proforma. From this, the amount of raw food consumed by each child was calculated. Thereafter, the nutrient intake of the child was determined from the food consumption tables **[4]**.

The frequency of consumption of vitamin A rich foods by the households was assessed using a simplified food frequency questionnaire as suggested by Helen Keller Food Frequency Method [**5]**. The data was recorded for the foods consumed, daily, 1-2 times a week, 3-4 times a week, fortnightly, occasionally, rarely or never.

Data on household survey of the availability of vitamin A containing foods were also collected. The focus was on green leafy and yellow vegetables, yellow fruits, and vitamin A-rich animal products (e.g. animal liver, whole milk and eggs). Information on food preparation, frequency of consumption in seasons, and usual, portion sizes was collected.

Information about beliefs and attitudes related to food was obtained by interviews with

women and caretakers in the communities surveyed. This included beliefs about and attitudes towards vitamin A-rich foods and their relationship to health in general, as well as for eye health specifically.

Statistical Analysis of Data

The data was analyzed using SPSS 13 software. Mean, standard deviation (SD) and standard error (SE) were calculated for all quantitative parameters. Percent prevalence was calculated for qualitative parameters. Association between qualitative parameters was calculated using the chi-square test (γ^2). Analysis of variance, paired 't' test and students 't' test were also applied while making general comparisons of quantitative parameters.

Table 1: Parameters Were Used to Assess the Vitamin A Status in Relation to Different Factors are Described Below

S. No.	Parameter	Method	Sample	Data Obtained on Boys/ Girls Total
1.	Socioeconomic Status	Pretested Semi Structured Questionnaire and Personal Interviews	All subjects	105
2.	Clinical Examination History of Nightblindness Bitot Spots Conjunctival Xerosis	Personal Interviews WHO Classification, 1982	All subjects	105
3.	Anthropometry Height for age Weight for age Body Mass Index	Jelliffe, 1996, [2] Compared to NCHS Standard, Hamill, *et al.*, 1977, [3]	All subjects	105
4.	Food and Nutrient Intake 24 Hour Dietary Recall Food Frequency	24-VASQ Method,1982 Modified HKI-FFM,1993	All subjects	105
5.	Knowledge, Attitude and Practices	Pretested Semi Structured Questionnaire and Personal Interviews	All subjects	105

RESULTS

Socioeconomic Conditions

Socioeconomic conditions indicated that though the communities had a reasonably good per capita income, mothers were uneducated (71%), had a large family size (48%) and were devoid of basic sanitary conditions and 27% had no toilet facility **(Table 2)**.

Clinical Signs and Symptoms of VAD

Out of 105 subjects examined clinically, 78% were found to be normal and 22% were suffering from clinical manifestations of VAD. Amongst the subjects manifesting clinical ocular signs, conjunctival xerosis (X1A) occurred most frequently showing a higher percent prevalence of 11%. Bitot's spots (X1B), with or without conjunctival

xerosis occurred in 6% of the subjects. Night blindness (XN) occurred in 5% in the entire population **(Table 3)**. No child demonstrated active corneal involvement or corneal scars. Overall prevalence of clinical signs of vitamin A deficiency was higher (30%) in children 10-13 years of age and boys were more affected than girls (24% vs. 20%) It was established that clinical signs were significantly higher (65%) in children of families with a family size of more than or equal to six members.

Clustering has been described primarily based on the occurrence of clinical eye signs. Siblings of children with xerophthalmia in the same households are 7-13 times at risk of developing xerophthalmia as against children in xerophthalmia free households. It is likely to reflect the convergence of several risk factors that lead to depletion of vitamin A stores in the surrounding child population among which a few individuals who have been exposed to additional causal factors have developed clinical deficiency. For this reason severely sub-clinically deficient populations of children up to 5 years of age, based on the distribution of serum retinol levels, are considered to be at as much at risk of severe morbidity and mortality as those populations experiencing clinical deficiency. Moderately sub-clinically affected populations are also likely to be at higher risk but the magnitude of risk is unknown.

Anthropometric Data

Anthropometric data revealed that 21% children were stunted while 69.5% of all the children were wasted. A significant correlation existed between those who were wasted with respect to their age and sex wherein; a higher prevalence was seen in older children (29%) and in boys (53%) **(Table 4)**. Relationship of the presence or absence of clinical signs of vitamin A deficiency with the nutritional indicators showed that a higher percentage of stunted children (54%) were found to have presence of clinical signs of vitamin A deficiency than those not stunted **(Table 5)**. Similarly, children who were found to be below normal weight for age have shown to have presence of clinical signs of vitamin A deficiency (29%). Both the results were statistically significant. Malnutrition was not found to be associated with deficiency, possibly because mortality rate of malnourished children was very high and could be higher when accompanied with xerophthalmia; secondly the signs of deficiency were not very severe.

Data from the National Blindness Prevention Project in Indonesia suggested that xerophthalmia is more closely associated with stunting (low height for age) than with

wasting (low weight for height). Wasting, however, can be assessed without recourse to age, and is useful in identifying individuals at a particularly high risk of corneal involvement. In Sri Lanka, Bitot's spots were also far more closely related to stunting than wasting. The investigators also reported that VAD a problem of public health significance was prevalent in only 2 out of 15 health districts, Protein malnutrition, defined as a height for age status of < 90% of a reference median, was strongly associated with prevalence of VAD.

Dietary Data

The dietary data as assessed by 24- VASQ method (24-hour recall for vitamin A semi quantitatively) indicated that the intake of all the nutrients was less than 50% of the RDA except for fat (83%) and vitamin C (55%). The mean daily vitamin A intake of children was 541.1±54.07 µgm (only 23% of the RDA for their age) **(Table 6)**.

All the nutrients were less than 50% of RDA except vitamin C and fat. Carotene intake was the lowest (only 23%) in children, whereas iron intake was a third of RDA. The mean intake of other nutrients-calories, protein and vitamin C was in the range of 35% to 55% RDA. Mean intake of fat was found to be 83% in the subjects. This fact is presented better when the intake as per the age and sex is categorized.

The interaction of several nutrients with vitamin A has been well known. The absorption of vitamin A is dependent on several factors, including the amount of carotenoids consumed in the diet, the interactions of the carotenoids, and digestibility with increased protein intake, there is an increased oxygenase available to convert beta-carotene to retinol. Adequate protein also improves activity of lipolytic enzymes needed to hydrolyze fat and produce monoglycerides and lipolytic products to facilitate micellar solubilization of carotenoids before cell uptake. The quantity of fat in the diet is also important for its role in the transport of vitamin A and for the stimulation of bile flow. Physiological conditions, including hormone status, gastrointestinal diseases, and weight changes also affect utilization of carotenoids.

Dietary data of the school children clearly shows that besides vitamin A, there is an overall low intake of all the nutrients. There may be three consequent causes for these:

- Low purchasing capacity of the family due to which a small or a limited amount of food available to the children.

- A very low degree of awareness about balanced diet/right kind of food to be included in the diet of this age group.
- Adaptation by the body, for very small quantities of food over a period of time due to low intake during the rapid growth period from preschool to adolescence.

Data obtained through FFQ **(Table 7)**, revealed that the consumption of cereals and pulses were the least in both the age groups, at least 25% of the RDA. Except for milk and milk products, the intake of all the other food groups i.e. green leafy vegetables and other vegetables, fruits, meat and fleshy foods and staple foods such as cereals and pulses was less than 50% of the RDA. Since vitamin A was of particular interest, as mentioned earlier, the frequency of intake of vitamin A rich and beta–carotene foods as suggested by HKI food frequency method **[5]**, to assess the community risk of vitamin A was used. The results indicated that some vitamin A was through energy and protein giving foods such as cereals and pulses like *bajra, maize, bengal gram, green gram, red gram and lentils* and these were mainly consumed weekly or biweekly. None was consumed daily. However, the staple cereals of the subjects were rice and wheat.

With regard to GLV's, only about 1% of the overall consumed daily, while 30% of them consumed them once in fifteen days. The highest intake of GLV's was in winter season as also reported by **[6]**. However, despite the fact that the survey was done in the winter season, several children said that they did not consumed GLV's at all, or that consumed them only once in fifteen days or occasionally.

Although it was seen that intake of leafy vegetables, such as coriander and *limbdo* was 95%, these were consumed in very negligible quantities and that too for seasoning. Drumstick leaves a very rich source of beta carotene though available were not consumed. Fruits like papaya, oranges, carrots, and others were not consumed daily and only once in fifteen days. Though tomatoes were consumed daily (93%), however these mostly contain lycopene with no vitamin A activity. Milk was usually consumed daily (95%), but the intake was very low and was mainly used for preparing tea. The consumption of animal foods (meat, chicken and eggs) was only once in fifteen days by a majority (63%) even by the non-vegetarian population of the study, indicating as these are expensive foods and are not affordable for daily use **(Table 7)**.

Little or currently unused vitamin A rich food: Since this effort on community

assessment on natural food sources of vitamin A was focused on assessing their potential risk to vitamin A deficiency, it was of vital importance to identify all possible local resources of vitamin A that were unused or were not consumed. Wild foods, particularly local leafy green vegetables and fruits that are generally rich sources of provitamin A, are often overlooked in dietary surveys. In the present study there were several foods including GLVs (drumstick leaves), orange vegetables (pumpkin) and fruits (papaya), which were not used by the people in spite of the availability

- These foods are considered "old fashioned" by the current generation, perhaps a greater influence of the western culture
- These foods are mainly for the animals and not consumed by humans
- These foods are not good for health esp. papaya which is thought to have the capacity to induce abortions during pregnancy
- Not allowed by the religion eg suran
- Never consumed by any of the family members

Some elderly though gave a positive attribute to vitamin A rich foods, however, since the majority of the family members did not like or, it was never purchased or eaten by the household. Our study shows that no indigenous foods was used by the community under the study and a very few vitamin A rich foods were used daily.

This data also supported the very low intake of vitamin A seen for the school children under the study and emphasized the fact that the community was ignorant about the importance of vitamin A rich foods and thus need to be educated using appropriate communication methods.

Perceptions About Vitamin A Rich Foods

Perceptions about a particular type of food are very important prior promoting those foods in the community. Only half of the children studied could give a positive attribute towards GLVs (54%) and a the others were unable to respond or gave a negative attribute (46%). The children did not like pumpkin, a rich source of beta-carotene.

The main positive qualities or attributes children recognized in vitamin A rich foods were:

- Tasty "*swad game*"
- Strength giving/give energy "*shakti aape*"
- Filling stomach "*paet bharay*"
- Healthful "*sharir mate saroo*"
- Prestigious " *mota loko khay*"
- Purify the blood "*lohi shudh kare*"

- Good for the eyes *"aankho mate saro"*
- Give iron *"loha tatva aape"*

The main negative attributes or perceptions about the GLVs, orange and yellow fruits and vegetables were:

- Hate it *"chid chade"*
- Feel like vomiting when I see them *"ulti jevu thay"*
- Expensive *"bahu moonghu che"*
- Eat for the sake of eating *"khava mate khaeye"*
- Tasteless *"swasd nathe gamato"*
- Do not know about its value because we are not educated *"bhanela nathe etle nathe khabar"*

From the above results, data on the amount of food consumed, its vitamin A content and the frequency of consumption was known. Simple frequency forms for summarizing community data and estimating percentages of risk for those who consume food groups (for example, dark green, leafy vegetables or foods of animal origin) in frequency categories (for example, greater than or less than 3 times/week) can be prepared from brief household surveys **[1]**. From the present study, it can be concluded that the population under the study is at a potential risk of vitamin A deficiency.

Form of Consumption of Vitamin A Rich Foods and Recipes Used

The results of the key informant interviews indicated that the cereals like bajra and maize were generally roasted and made into a preparation called 'rotlas'. However with regard to pulses and legumes, most of the households (73%), used a pressure cooker to make 'dal'. Recipes like 'bhajiya' and 'puda' were practiced occasionally. The intake of GLV's by the children was dependent in the form in which they were presented. Most mothers reported that open pan cooking followed by sauteing was the method most commonly used for the preparation of greens, but children generally unaccepted the GLV's in the form of 'bhaji'. Fruits were generally consumed raw (95%) and about 2% reported of using open pan cooking for the preparation of 'sabji' made out of raw papaya. Milk was prepared in very diluted form as tea and was ocassionally used for making other preparations like ghee, kheer and makhan. Animal sources of vitamin A were prepared in an open pan followed by sauteing.

Form of consumption of vitamin A rich foods forms an essential part of the data on vitamin A intake. The results of the key informant interviews indicated that the intake of GLVs by the children was dependent in the form in which they were presented. Most mothers

reported that open pan cooking followed by sautéing was the method most commonly used for the preparation of greens, but children generally unaccepted the GLVs in this form.

Form of consumption of vitamin A rich foods forms an essential part of the data on vitamin A intake. Since plant foods are rich sources of carotenoids whose vitamin A activity is often lowered due to exposure to high or low pH, elevated temperatures, light and oxidation, the amount of carotene retained at the point of consumption is not necessarily the same as the amount of carotene estimated in the laboratory **[7]**. The acidic pH can convert the trans to cis isomer, ultraviolet light and oxygen can convert the carotene into oxygenated derivatives and lipooxidases present in foods can generates free radicals that can destroy beta carotene. Also there are several factors, which may affect the stability of carotenoids during cooking, which may affect its bioavailability.

These results indicate that the community did not have any knowledge about how to make appealing recipes with the inclusion of the vitamin A rich plant foods and thought that such recipes (as usually shown in the cookery shows) could only be expensive. Thus a monotonous diet, lack of knowledge and negative attitude towards vitamin A rich foods can be another reason for a very low consumption of vitamin A in the present community.

Data on species of vitamin A-rich foods that are culturally acceptable and available, their seasonality, methods of preservation and preparation, and barriers to their use due to cost, health beliefs, or other reasons of accessibility are very few. Only when these factors are known will agricultural, food processing, social marketing, and public health education programs have a sustained impact on behavior change and in improving dietary modification for vitamin A.

It has been reported that when the intakes of the nutrients were compared in children with and without vitamin A deficiency signs, a significant relationship was found between the children having lower protein and iron intake as compared with presence of clinical signs of vitamin A deficiency indicating that RBP synthesis is impaired in VAD and anemia may be a secondary complication of the deficiency. Studies have also indicated that the school children with low intakes of iron and vitamin A correspond with the high prevalence of deficiencies of these micronutrients as indicated by biochemical data.

An interesting array of data exists which support the conclusion that anemia can be a

secondary complication of vitamin A deficiency. As a logical next question, one might wonder if an increased vitamin A intake by a community low in this nutrient would have a beneficial impact on iron status. Mejia and Arroyave, 1982, have sought such information from the data generated in evaluation of a national programme of vitamin A fortification conducted in Guatemala from October ’72 to Nov’77. The authors proposed the following interpretation of their results. The initial response to improved vitamin A nutriture was mobilization of liver iron attributable to increased transferring synthesis. This is consistent with current hypothesis on the molecular function of vitamin A as a cofactor for glycoprotein synthesis or as a stimulator of transcription. After meeting the initial demands for hematopoiesis, iron stores were rebuilt and serum indicators of iron status stabilized at a new and improved level. These data add strength to the proposition that anemia may be a secondary outcome of a primary deficient of vitamin A which in turn contributes to defective iron transport. Therefore future studies should be directed in this direction to assess the impact and bioavaiability of vitamin A rich foods such as GLVs, which are also rich in iron, on the nutriture of vitamin A as well as iron.

In the present study, when the intakes of the nutrients were compared in children with and without vitamin A deficiency signs, a significant relationship was found between the children having protein intake less than 50% as compared with clinical signs of vitamin A deficiency **(Table 8, 9)**. No significant differences were found with respect to carotene intake. However, among those who manifested clinical signs, a higher percentage of children consumed less than 50% of RDA for carotene. Only 3% and 4% of children were able to meet >50% of the RDA, for calories and iron respectively.

DISCUSSION

A socially backward, impoverished environment favors large families with consequent overcrowding that are associated with poor environmental sanitation and personal hygiene. Clustering and unhygienic sanitary conditions, which are important determinants of VAD as suggested by **[1]**, were identified as the risk factors in the present study. These were supported by the presence of clinical signs and low dietary intake of vitamin A rich foods.

Ecological, cultural, and economic factors that influence food availability, cost, and consumption patterns, as well as attitudes and beliefs about food and feeding behaviors need to be defined and incorporated into programs,

as these are often the underlying causes of the deficiency in a community **[8-11]**. These indirect indicators do not replace biological indicators and cannot be used alone for determining any particular nutrient's status of populations or to define whether a population has a deficiency problem of public health significance. A composite based on them can be used to corroborate biological criteria to determine if there is a public health problem. . This data was further supported by low frequency of consumption of vitamin A rich foods; both plant as well as animal foods, by children and by the households. Extremely inadequate consumption of GLV's (nearly one-third) was reflected in the poor intake of micronutrients by the children, in particular with β-carotene. This is cause for concern as during the period of rapid growth; physical and physiological changes make additional demands on the nutritional requirements. Nutritional status, which is often poor during early life (especially in the under privileged population), tends to worsen as the adolescent spurt begins. Dietary data of the school children clearly shows that besides vitamin A, there is an overall low intake of all the nutrients. The data also emphasized the fact that the community did not had any knowledge about how to make appealing recipes with the inclusion of the vitamin A rich plant foods and thought that such recipes could only be expensive.

[12] have reported data on the micronutrient deficiency status, based on biochemical analysis on a sample of total 328 middle-income children from a residential school and have reported vitamin A deficiency (<0.7micromol/L plasma) was present in 44-66% children. Assessment of clinical signs of micronutrient deficiencies in the same population confirmed the presence of micronutrient deficiencies.

CONCLUSION

Lack of knowledge and negative attitude towards vitamin A rich foods can be another reason for a very low consumption of vitamin A in the present community. A very low intake of vitamin A was seen among the school children as well as the community indicating that both the slum communities were at risk of VAD, of suffering from mild to moderate form of VAD and emphasizing the fact that the community was ignorant about the importance of vitamin A rich foods and needs to be educated about it. Simple steps such as nutrition health education and promotion of drumstick leaves can be done in such communities **[13-19]**.

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Table 2: Socioeconomic Profile

Socioeconomic Indicators	Total (N=105) %
Total Family Income (Rs/month)	
<2000	**34 (36)**
2001-4000	**40 (42)**
≥4001	**26 (27)**
Per capita income (Rs)	
≤300	**34 (36)**
301-600	**40 (42)**
≥601	**26 (27)**
Type of Family	
Joint	**18 (19)**
Nuclear	**82 (86)**
Food Habit	
Vegeterian	**39 (41)**
Non-vegeterian	**61 (64)**
Mother's Education	
Primary School	**18 (19)**
Above Primary school	**11 (11)**
Non literate	**71 (75)**
Mother's occupation	
Working	**21 (22)**
Non working	**22 (23)**
Type of House	
Pucca (concrete roof and floor)	**22 (23)**
Semi Pucca (either concrete roof or floor)	**69 (72)**
Kuccha (both roof and floor are not concrete)	**10 (10)**
Access to Water Facility	
Pipe Water	**78 (82)**
Ground Water	**22 (23)**
Access to Toilet Facility	
Flush Toilet	**3 (3)**
Pit Toilet	**70 (73)**
No Facility	**27 (29)**
Access to Fuel Facility for Cooking	
Wood	**12 (12)**
Kerosene	**57 (60)**
Gas	**31 (33)**

NOTE: Figures in Parentheses Indicate Number of Subjects

Table 3: Prevalence of Clinical Ocular Signs of VAD in the School Children Selected For the Present study (N=105)

	Clinical Ocular Signs of VAD (Percent Subjects)			
	Present 21.9% (N=23)			Absent 78.1% (N=82)
	Night blindness (XN)	Bitot spots (XIB)	Conjunctival xerosis (XIA)	
School-1 (N=56)	0 (0)	3.8 (4)	3.8 (4)	45.8 (48)
School-2 (N-48)	4.8 (5)	1.9 (2)	7.6 (8)	32.3 (34)
Overall (N=105)	4.8 (5)	5.7 (2)	11.4 (12)	78.1 (82)
WHO/ 1996 criteria to detect population at VAD as Public Health Problem	≥0 - <1% mild ≥1-<5% moderate ≥5% severe	>0.5%	>0.5%	

Table 4: Growth Profile as Compared with Age and Sex of the Study Subjects (N=105)

Weight for Age (<80% of NCHS standard)			
Age (years)	Wasted Percent subjects	Normal Percent subjects	Chi square
7-9 (82)	71 (52)	94 (30)	6.59 *
10-13 (23)	29 (21)	6 (2)	
Overall (105)	70 (73)	30 (32)	
Weight for Age (<80% of NCHS standard)			
Sex	Wasted Percent subjects	Normal Percent subjects	Chi square
Boys (55)	53 (39)	50 (30)	0.1 *
Girls (50)	47 (34)	50 (2)	
Overall (105)	70 (73)	30 (32)	

Figures in Parentheses Indicate Number of Subjects. *Significant at P≤0.05

Table 5: Comparison of the Presence or Absence of Clinical Signs of Vitamin A Deficiency with the Nutritional Indicators

Height for Age (< 90% of NCHS standard)			
Clinical Signs of vitamin A deficiency	Stunted N=22 Percent subjects	Non stunted N=83 Percent subjects	Chi square
Not Present (N=82)	46 (10)	87 (72)	17.33 S*
Present (N=23)	54 (12)	13 (11)	
Total (N=105)	21 (22)	79 (83)	
Weight for age (< 80% of NCHS standard)			
Clinical Signs of vitamin A deficiency	Wasted N=73 Percent subjects	Non wasted N=32 Percent subjects	Chi square
Not Present (N=82)	71 (52)	94 (30)	6.59 S*
Present (N=23)	29 (21)	6 (2)	
Total (N=105)	70(73)	31 (32)	

NOTE: Figures in Parentheses Indicate Number of Subjects; *Significant at P≤0.05

Table 6: Nutrient Intake of the Subjects as Compared to the RDA for Indians

Nutrient Intake	Boys			Girls		
	7-9 Years (n=43)	10-13 years (n=12)	Total (n=55)	7-9 years (n=39)	10-13 years (n=11)	Total (n=50)
Energy (Kcal)	26.84 ±3.20	37.26 ±3.50	28.44 ±2.69	26.68 ±3.50	36.25 ±2.77	28.79 ±2.84
Proteins (gm)	36.53 ±5.05	41.89 ±4.12	37.70 ±4.05	37.92 ±5.72	36.19 ±4.10	37.54 ±4.53
Fat (gm)	51.67 ±7.55	94.67 ±13.56	61.05 ±6.98	46.84 ±6.56	92.50 ±15.51	56.89 ±6.64
Iron (mg)	17.88 ±2.38	20.10 ±2.60	18.37 ±1.94	19.75 ±2.92	56.98 ±22.60	27.94 ±5.74
Carotene (mcg)	74.98 ±17.34	65.12 ±6.72	72.83 ±13.61	50.07 ±10.57	75.59 ±14.00	55.68 ±8.87
Vitamin C (mg)	45.46 ±7.05	52.41 ±11.82	46.97 ±6.05	32.02 ±5.87	71.53 ±17.13	40.71 ±6.28

Table 7: Frequency of Consumption of Vitamin A Rich Foods by the Households as Assessed by Food Frequency Method (N=105)

Food Items	Frequency of Consumption (Percent Subjects)				
	Daily	1-2 times a week	3-4 times a week	Once in 15 days	Never
1. Bajra	-	-	9.5	45.7	44.8
2. Bengalgram whole	-	-	-	94.3	5.7
3. Bengalgram dal	-	-	1.9	92.4	5.7
4. Greengram whole	-	1.9	1.9	82.9	13.3
5. Greengram dal	-	-	3.8	83.8	12.4
6. Masoor	-	1.9	1.0	86.7	10.5
7. Peas (Dry Fresh)	-	-	2.9	89.5	7.6
8. Redgram Dal Tender	1.9	12.4	43.8	40.0	1.9
9. Maize (dry,tender)	-	-	6.7	48.6	44.8
10. Methi	1.0	2.9	52.4	42.9	1.0
11. Palak	1.0	2.9	47.6	46.7	1.9
12. Shepu	-	1.0	8.6	75.2	14.3
13. Tandalja	1.0	1.9	12.4	75.2	9.5
14. Muli	3.8	1.0	6.7	82.9	4.8
15. Coriander	93.3	-	1.0	5.7	-
16. Luni	-	1.0	1.0	33.3	64.8
17. Arvi	1.0	-	-	37.1	61.9
18. Limbdo	97.1	-	-	-	2.9
19. Lila Mircha	99.0	-	-	1.0	-
20. Kolu	1.9	-	1.0	48.6	48.6
21. Tomatoes	93.3	-	-	4.8	1.9
22. Suran	1.9	1.0	1.0	41.0	55.2
23. Papaya	-	1.9	1.0	92.4	4.8
24. Santra	-	6.7	1.9	89.5	1.9
25. Gajar	-	6.7	-	90.5	2.9
26. Saragvo leaves	-	-	-	2.9	97.1
27. Kamrakh	-	-	-	7.6	92.4
28. Karela	-	-	1.0	91.4	7.6
29. Lilu lasan	2.9	3.8	1.0	79.0	13.3
30. Onion stalks	2.9	2.9	1.0	78.1	15.2
31. Ajma	-	-	-	1.9	98.1
32. Mint	1.9	4.8	1.0	15.2	77.1
33. Mango	1.0	8.6	1.9	88.6	-
34. Sakkarteti	-	6.7	3.8	88.6	1.0
35. Saragvo sticks	-	1.0	2.9	94.3	1.9
36. Meat and poultry	1.9	-	1.9	61.9	34.3
37. Egg	1.9	-	7.6	56.2	34.3
38. Milk	95.2	-	-	4.8	-
39. Curd	5.7	1.0	22.9	68.6	1.9
40. Butter (Makhan)	6.7	-	1.0	25.7	66.7
41. Ghee	46.7	1.0	-	46.7	5.7

Table 8: Comparison of the Presence or Absence of Clinical Signs of Vitamin A Deficiency with the Nutritional Indicators

Height for Age			
Clinical Signs of vitamin A deficiency	**Stunted N=22**	**Non stunted N=83**	**Chi square**
Not Present (N=82)	**46 (10)**	**87 (72)**	**17.33 S***
Present (N=23)	**54 (12)**	**13 (11)**	
Total (N=105)	**21 (22)**	**79 (83)**	
Weight for age			
Clinical Signs of vitamin A deficiency	**Wasted N=73**	**Non wasted N=32**	**Chi square**
Not Present (N=82)	**71 (52)**	**94 (30)**	**6.59 S***
Present (N=23)	**29 (21)**	**6 (2)**	
Total (N=105)	**69 (73)**	**31 (32)**	

NOTE: Figures in Parentheses Indicate Number of Subjects; *Significant at P≤0.05

Table 9: Comparison of Presence or Absence of Clinical Signs of VAD With Respect to Nutrient Intake as Percent of Recommended Dietary Allowances in the Study Subjects (N=105)

Nutrients Percent RDA	**Clinical Signs of VAD Percent Subjects**		**Chi-square value**
	Not Present N=82	**Present N=23**	
Energy			
<50%	**89 (73)**	**87 (20)**	**0.08 NS**
>50%	**11 (9)**	**13 (3)**	
Proteins			
<50%	**61 (50)**	**83 (19)**	**3.73 S***
>50%	**39 (32)**	**17 (4)**	
Iron			
<50%	**95 (78)**	**96 (22)**	**0.01 NS**
>50%	**5 (4)**	**4 (1)**	
Carotene			
<50%	**57 (47)**	**57 (13)**	**0.004 NS**
>50%	**43 (35)**	**43 (10)**	
Vitamin C			
<50%	**70 (57)**	**61 (14)**	**0.61 NS**
>50%	**30 (25)**	**49 (9)**	

NOTE: Figures in Parentheses Indicate Number of Subjects; *Significant at P≤0.05