VITAMIN A NUTRITION STATUS IN SRI LANKA 2006

DR. RENUKA JAYATISSA
DR. M.M. GUNATHILAKA

DEPARTMENT OF NUTRITION
MEDICAL RESEARCH INSTITUTE
MINISTRY OF HEALTHCARE AND NUTRITION
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Dr. Renuka Jayatissa
Principle Investigator
Department of Nutrition
Medical Research Institute
Colombo 08.
renukajayatissa@ymail.com

Research Team

Principal investigator

Dr. Renuka Jayatissa	- Nutrition Specialist

Co-investigator

Dr. M.M. Gunathilaka	- Consultant Chemical Pathologist

Survey team

Mr J M Ranbanda	- Nutrition Assistant
Mr A P Senevirathne	- Public Health Inspector
Mr H K T Wijesiri	- Public Health Inspector
Mr P V N Ravindra	- Public Health Inspector
Mr E G S Kulasinghe	- Public Health Inspector
Mr W A P I Pieris	- Public Health Inspector
Mr Inoke Paranagama	- Public Health Inspector
Mr D S Dabare	- Public Health Inspector
Mrs K H R Shyamalee	- Development Assistant
Mrs W R T S Perera	- Development Assistant
Miss H I K N Hevawitharana	- Development Assistant
Mrs. R.R. Selvarathnam	- Development Assistant
Mrs. O.C. Thilakarathna	- Development Assistant
Mrs. S.M.L.P. Subasingha	- Development Assistant
Mrs. Thilini Heenatigala	- Nursing officer
Mrs. K.M.H.N. Kulathunga	- Medical Laboratory Technologist
Mr. R.A.J.C. Jayasinghe	- Medical Laboratory Technologist
Piyadasa Gamage	- Laboratory Ordely
P.P. Wimalamathie	- Laboratory Ordely
S.P. Priyantha	- Labourer

EXECUTIVE SUMMARY

The objective of this study was to assess the prevalence of vitamin A deficiency (VAD) in children under 5 years in Sri Lanka and to identify the risk factors and the change of strategies to control VAD accordingly.

A cross sectional national survey was conducted in 20 out of 25 districts in Sri Lanka. From each district one to six Medical Officer of Health Areas (MOH) was randomly selected according to the size of the population and one Child Welfare Clinic from each MOH was randomly selected. Altogether 36 child welfare clinics were selected. About 25 children aged 6-60 months were randomly selected in each clinic; a total of 900 children were included in the study. Data on socio-demographic, nutrition and dietary consumption was obtained by interviewing mother or principle caregiver. Blood samples were collected from each child and their mothers. HPLC method was used to analyse serum retinol concentration.

VAD (serum retinol level < 20µg/L) was observed in 29.3% (95% CI: 26.1%-32.5%) children aged 6-59 months, whereas severe VAD (serum retinol level < 10µg/L) was found in 2.3% (95% CI: 1.3%-3.4%) of children. Prevalence of VAD among children between 1-5 years was 29.6% (95% CI: 26.2%-32.9%). The prevalence of VAD in children was significantly higher in the presence of respiratory tract infections during the past 2 weeks prior to the survey. Overall, 66% of mothers reported that their children had received a vitamin A supplement at least once. The prevalence of VAD was 23.9% just after the vitamin A supplementation and 34%, six months after the supplementation. Mean retinol concentration was 24.8µg/L and the highest with the children just after the vitamin A supplementation. In this study 62.3% of the survey population have been consuming vitamin A rich animal food items on more than 4 days per week and 61.3% have been consuming vitamin A rich animal and vegetable food sources on more than 6 days per week. It indicates the average consumption of vitamin A rich food items has not yet reached the acceptable level of 70% which indicates VAD is still a public health problem in this survey population. In non-pregnant women from 15 to 49 years the percentage of women with retinol concentrations < 20µg/L was 14.9% (95% CI: 10.7%-19.4%).

The results of the survey have shown that VAD is still a serious public health problem in children from 6 to 59 months of age in Sri Lanka as 29.3% of children have plasma retinol concentrations ≤ 20µg/L. It is recommended to reduce the gap between two doses of Vitamin A mega dose and to repeat the supplementation every 6 months and to start at 6 months till 5 years. It is necessary to promote the consumption of more vitamin A rich food among children and women.

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INTRODUCTION

Vitamin A is an essential nutrient that is usually acquired by humans through a healthy and balanced diet. Vitamin A Deficiency (VAD) is a public health concern in most developing countries, especially in Africa and South-East Asia. Children and pregnant women in low-income countries are most severely affected by VAD.

Statistics show that, globally, there are between 140 and 250 million children under the age of 5 years who suffer from VAD. They are at increased risk of blindness and complications from diseases associated with VAD such as diarrhoea and measles. As many as 8 million children die from VAD related conditions each year, most of them in their first year of life (WHO 2003).

In pregnant women from high risk backgrounds, VAD is especially prevalent in the last trimester when the demand for vitamin A by the foetus and the mother is at the highest. Deficiency is expressed as night blindness during this period.

An excessive intake of vitamin A, generally from over-supplementation, may be implicated in congenital defects, though further research is needed. It is imperative that supplementation programs be tailored to the needs of the population to avoid toxicity.

GLOBAL PROBLEM OF VITAMIN A

Vitamin A deficiency remains a widespread public health problem among women and children. Over 20 percent of all preschool age children (about 130 million) and nearly six percent of all pregnant women (about 7 million) suffer from vitamin A deficiency and its adverse health consequences (West, 2002; Rice et al, 2004). The majority of vitamin A deficient women and children currently live in South Asia or Sub-Saharan Africa, in the same countries where vitamin A supplementation programmes for children over six months of age have helped reduce high child mortality rates. But while more than 60 countries now have supplementation programmes of preschool age children, only few have launched large scale programmes to address the problem among younger infants and women of reproductive age.

SRI LANKA CONTEXT

Sri Lanka is an island situated in the Indian Ocean, between 5 and 10 degrees latitude in the Northern Hemisphere. The population of 20 million is distributed equitably around the country, which is divided administratively into 9 Provinces and 25 Districts. Sri Lanka is classified as a developing country, with Gross Domestic Product (GDP) per capita per annum at approximately US$ 4000[1]. The reported child (under 5 years) mortality rate is 18 per 1000 live births[2§] and 23% of the country's population is below the age of 15 years.

TRENDS AND INTERVENTIONS CARRIED OUT IN THE PAST IN SRI LANKA

Sri Lanka had reduced the prevalence of Keratomalacia as a cause of blindness in children from 60% in 1930, 44.04% in 1940, 28.6% in 1950, 7% in 1960 and 0.2% in 1970 as results of the various intervention programme carried out in the past (Jayatissa 2005).

In the late 1940s, retinol palmitate added non fat dried milk was freely made available to every child from 1 year to 5 years, to be fed on site or at home, depending on the available services through the Maternal and Child Health (MCH) programme, to protect children against Keratomalacia. Another programme was executed by CARE through the US PL480 programme for all pregnant, lactating women and all primary school children were fed at school or at home. The programme went on for 16 years from the 1950s to 1970 at a cost of a billion (Jayatissa 2005)

In 1962, Vitamin A content of breast milk of lower and middle income lactating mothers at the hospital settings indicated the low retinol level of low income mothers in the 3-5th days of lactation (27.5µg $\pm$ 16.89) and 6-7th day of lactation (16.6µg $\pm$ 8.25) compared with the middle income lactating mothers (45.0µg $\pm$ 17.4 and 44.8µg $\pm$ 25.48 respectively). Of which the difference was found to be significant ($p < 0.05$) on the later part of the week. The availability of vitamin A in the hospital diet was only 43% due to the unavailability of milk and the lactating mothers of the rural poor had an intake of 16%. This was due to low intake of animal foods.

However in the global, local food and fuel crisis in 1970, US PL480 programme was withdrawn and Keratomalacia came back again in 1971. As shown in Table 1.1, 381,079 children 1 – 6 years of age in 4 of the worst affected Provinces were examined for clinical

signs of Vitamin A deficiency and indicated the prevalence of Keratomalacia (>0.01) and Bitot's spots (>0.5) were public health significance (De mel 1970).

Table 1.1
Prevalence of clinical signs of Vitamin A deficiency prior to distribution of Vitamin A Mega dose by provinces in 1971/2

Provinces	No of children aged 13-72 months	Bitot's spots No. (%)	Night Blindness No. (%)	Keratomalacia No. (%)
CENTRAL	100,936	125 (0.1)	23 (0.02)	04 (0.004)
SABARAGAMUWA	101,352	860 (0.8)	313 (0.3)	24 (0.02)
SOUTHERN	130,791	877 (0.7)	235 (0.2)	30 (0.02)
EASTERN	48,000	496 (1.0)	325 (0.7)	1 (0.002)
TOTAL	**381,079**	**2,358 (0.6)**	**896 (0.2)**	**59 (0.02)**

CARE with the Helen Keller Foundation (HKF) provided a Vitamin A mega dose (100,000 IU Vitamin A) for a 2 years period. But as the programme was not a complete success, the first comprehensive island-wide nutrition supplementary food intervention known as the Thriposha program was initiated by the Government in 1973 with CARE & US AID. This step was taken in response to mounting evidence that certain key segments of the population were highly vulnerable to protein-energy malnutrition (PEM) and micro nutrient deficiency of iron, vitamin A and iodine despite the existence of an island-wide food subsidy scheme. Thriposha means triple nutrient as it provides energy, protein and micronutrients as a pre-cooked 'ready-to-eat' cereal legume based food. Thriposha provided the full vitamin A requirements of a child of 3 years (400 µg retinol) with 10 gram of reference protein, 320 kilo calories of energy and all the required minerals and vitamins for daily fed on site or take home of 100g per day.

In 1995/96, national survey was carried out to assess the Vitamin A status in Sri Lanka. This survey revealed 33.3% of children aged 6 months to 72 months were having biochemical deficiency of Vitamin A (serum retinol <20 µg/L) while Bitot's spot, night blindness and Keratomalacia was not a problem of public health significance in the country. Figure 1 shows the prevalence of vitamin A deficiency in different provinces in 1995 (MRI 1998).

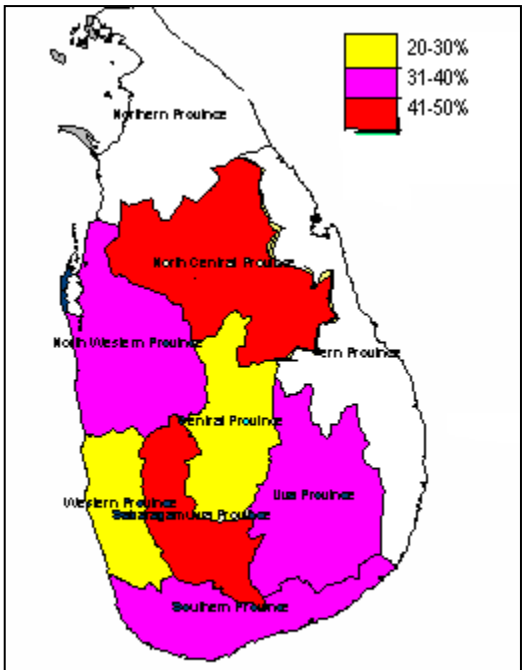


Figure 1: Prevalence of Vitamin A deficiency in Provinces 1996

The National strategy to control VAD as a public health problem was developed in year 2000 in collaboration with UNICEF. As a result Vitamin A mega dose supplementation programme was initiated in year 2001 for children between 6 months to 5 years and primary schoolchildren providing 5 doses of Vitamin A (100,000IU) at the age of 9 months, 18 months, 5 years and 9 years with the postpartum supplementation of 200,000 IU Vitamin A mega dose for all mothers within 4 weeks of delivery. Globally recommended supplementation schedule was not followed due to the fact that Paediatricians have shown great concern about the toxicity with the high dose of Vitamin A mega dose (MOH 1999).

In 2002, presence of Bitot's spots was examined among 6,264 students aged 10-18 years and it was found that there was a prevalence of 0.4% with no significant difference between males and females (Jayatissa et al 2006).

Vitamin A supplementation coverage was assessed in year 2003 and revealed that 95% of children under five years were given mega dose while the postpartum coverage was only 75% due to poor administration from the hospitals and the lack of awareness among them (Jayatissa & Mahamithawa 2003).

By considering following factors this National study was carried out under following objectives:

OBJECTIVES

1. To measure the serum retinol levels among the children of 6-60 months.
2. To assess the magnitude of Vitamin A deficiency in Sri Lanka
3. To assess the morbidity pattern and socio economic status among them.
4. To determine the Vitamin A rich food consumption pattern among children.
5. To find out the relationship between Vitamin A deficiency and morbidity, socioeconomic status and consumption of Vitamin A rich foods.

CHAPTER 2
METHODS

A cross sectional study was carried out and a three-stage cluster sample design was adopted to draw a nationally representative sample of children 6 – 60 months of age in Government child health facilities. In Sri Lanka of the children under 2 years the proportion attending the Government child health facilities is over 90% and of the children between 2-5 years the proportion is about 80% (Family Health Bureau 2007).

Sample size

Sample size was calculated considering 36% prevalence of Vitamin A deficiency among children, 95% confidence interval and 5% error. Design effect was taken as 2 due to clustering effect (MRI 1998). Non respondent rate was taken as 25% due to parental refusal to participate in the study or failure to provide a blood sample for analysis. Calculated sample size was 900 children between 6-60 months of age.

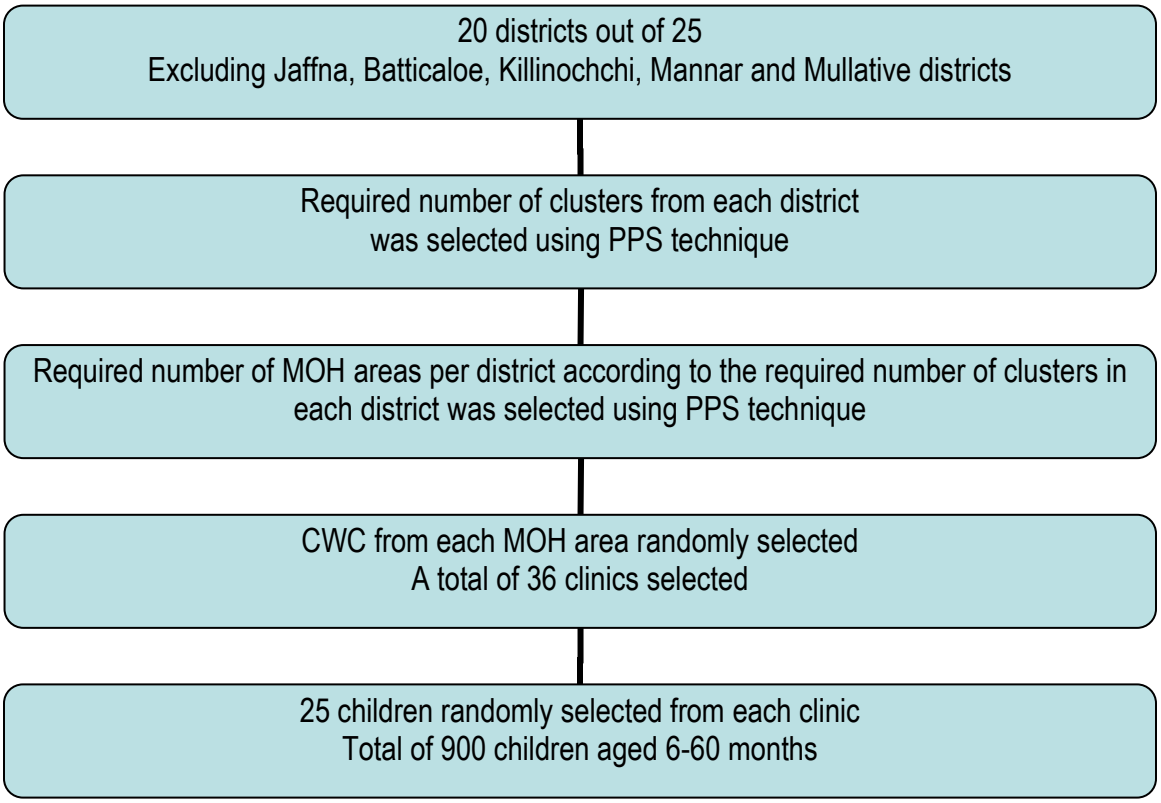
Sampling

Sri Lanka is divided geographically into 25 districts for administrative purposes. Twenty districts out of these 25 districts were considered for the study. Jaffna, Killinochchi, Mullative, Mannar and Batticaloe districts were excluded from the study due to the fact that the conflict affected situation in these districts made accessibility difficult during the data collecting period. It was decided to draw 36 clusters and to include 25 children from each cluster to cover the sample size considering logistics. The first stage-sampling frame contained 20 primary sampling units (PSUs) consisting of districts**.** All selected districts were listed out with the population in each district and numbers of clusters required in each district were selected with probability proportionate to population in size. At the second sampling stage, Medical Officers of Health areas (MOH) from each district were listed out with the population in each MOH area as secondary sampling units and required number of MOH areas per district was selected with probability proportionate to population size. A total of 36 MOH areas were selected. All the selected MOH areas were contacted and a list of Child Welfare Clinics (CWC) together with the average number of clinic attendants per session was obtained from them. The third stage of sampling consisted of randomly selecting the required number of Child Welfare Clinics (CWC) from each chosen MOH. Altogether 36 CWCs were selected (Annex-1). Twenty five children from each selected CWC were

randomly selected by using computer generated random numbers. A total of 900 children were included in the study as shown in Figure 2.1. All mothers or care takers of selected children were made conversant with the procedure and the importance of participation in this study and written consent was obtained from them.

Figure 2.1

Sampling process



DATA COLLECTION

The survey team consisted of 4 members from the staff in the Department of Nutrition. Two were nutrition graduates to administer the questionnaire, one was a Public Health Inspector (PHI) to take anthropometric measurements and the other was a Medical Laboratory Technician (MLT) or nurse to collect blood. All had past experience in participating in nutrition surveys except the nurses. Nurses did the venepunture. PHIs were already trained to detect the Bitot's spot during their basic training. Refresher training was done for PHIs to detect bitot's spot, night blindness, to handle blood and the handling of transport of serum to the Nutrition Laboratory. Three teams worked and each team covered one CWC clinic per day and moved from one district to the other. The distribution of the sample is shown in Figure 2.2 and each dot represents a cluster. Data collection was supervised by the

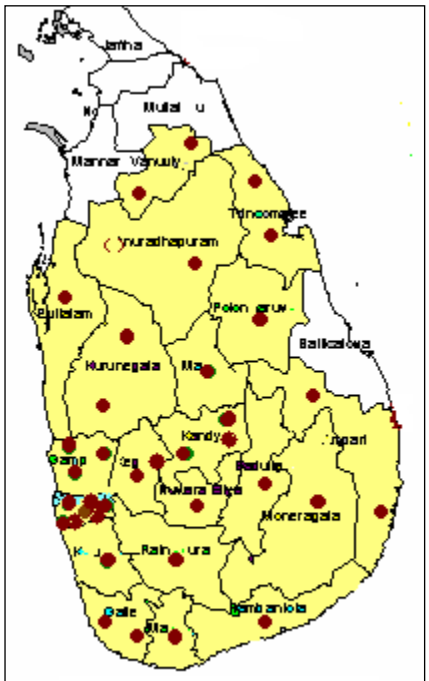


Figure 2: Distribution of clusters

Nutrition Assistant and the Principle Investigator. Data collection period was from November 2005 to January 2006. Ethical approval was obtained from the institution ethical committee and the parental consent too was obtained before enrolment of the child.

Questionnaire: An interviewer-administered questionnaire was used to collect information from the mother of the child or from a responsible caregiver (Annex-2). They were introduced to a pre-tested standardised questionnaire. The following information was gathered: birth day if not age, sex, morbidity, feeding data, access to water, sanitation, educational status of mothers and fathers etc. The questions were pre-tested; after the initial training course then questions were modified to increase practicability, reliability and validity.

Vitamin A rich food consumption: The Helen Keller International Food Frequency Method was used to gather information on how frequently dietary sources of vitamin A were consumed by the children. The Helen Keller Food Frequency questionnaire used in the previous survey carried out in 1995 was adopted and validated. Food items were selected to be included in the questionnaire under four categories. A staple food which is consumed on a daily basis (rice, bread etc), food that is not consumed at all (chillies), Vitamin A rich food (dark green, yellow coloured vegetables, fortified food, liver etc.), protein and fat rich food (milk, liver, meat, fish, eggs, coconut oil etc.). The mothers or caregivers were asked on "how many days within the past seven days did the child eat specified food item?" This question was repeatedly asked for 28 food items (Sommer 1995).

Clinical examination on Bitot's spot and night blindness: All children who had participated in the study were examined for the presence or absence of bitot's spot and ask for night blindness. Impaired dark adaption or night blindness was assessed by careful, detailed history taken from a parent, or guardian. Specific term describing the characteristics of the behaviour of the affected children was used when taking the history for easy

identification. The following local terms were used "*Thamas Andathawaya*" or "*Mandama*". Positives were reassessed by the Nutrition Assistant.

Anthropometric measurements: Anthropometric data were collected by three health personnel who had previous experience of participating in nutritional surveys and they were standardised before the study. Height and weight of the children and the mother were measured using standard techniques described by the World Health Organisation (WHO 1995). Height or length of the child was measured by using height measuring boards and without foot ware. In the case of children under 2 years length was measured and in the case of children over 2 years height was measured. An electronic Seca weighing scale was used to weigh the children with minimum clothing and without foot ware. They were carried by their mothers. Accuracy of the weighing scales was checked every morning using the standard weights. Height and weight of mother's were measured by using height measuring rods and electronic seca weighing scales. The weight and height or length was recorded to the nearest 0.1kg and 0.1cm respectively. The measurer variation was assessed by duplicating the 10% of measurements by the same measurer and repeating the 10% by the Nutrition Assistant. The coefficient variation of measurement error was 0.1 and 0.2 respectively.

Biochemical assessment: Venous blood (5cc) samples were collected from both non-pregnant women and her child. If the mother was pregnant and principle care giver was present in the absence of the mother, only a sample from the child was collected. Blood samples were collected for serum Vitamin A analysis by the Nursing officers under sterile condition by using disposable vacutainers not exposing to the sunlight and samples were labelled including cluster number and serial number. Blood samples were protected from light, stored in cool boxes and centrifuged for 10 minutes within 4-6 hours after collection (at end of the day) in the closest laboratory under dark environment by the Medical Laboratory Technicians (MLT) in the particular laboratory. Serum samples were stored in the appendarf and deposited in the big plastic box by batches and stored at -4°C till the samples transport to the Medical Research Institute (MRI) for up to 4 days (at the end of the week). All plastic boxes with serum samples were transported for a maximum of 6 hours in a cool box before it was stored at the -20°C in the Nutrition Laboratory of MRI, where the samples were analysed. The serum sample were analysed for retinol using High-performance Liquid Chromatography (HPLC) by using a Supelco c18 Vitamin A column under a strict quality

control protocol and 0.1ml of serum was used for the analysis. HPLC/UV-visible detection-vitamin A method and training manual for assessing Vitamin A status by Dr.Harrold Furr;Lowa State University; U.S.A (1992) was used for the analysis. Standards and quality control samples were used to ensure the accuracy of test results. The method was linear for measuring retinol in the range 5-200µg/dL. Samples with results <5µg/dLwere re-analyzed to confirm the result and samples with results >200µg/dL were diluted 2-fold and re-tested. The limit of detection for the method was 0.8µg/dL. All–trans Retinal (retinaldehide) Sigma Chemicals: U.S.A was used as vitamin A standard. Spectrophotometer was used to determine the standard concentration. MLTs who performed the serum analysis were trained by the Chemical Pathologist and they had previous experience in performing Vitamin A assays. Internal (in-house) Quality Control (QC) program for the vitamin A method was run in every vitamin A assay one level and replicates twice. QC results were monitored using limits developed within laboratory. Levey–Jennings and Shewartz rules for acceptance and rejection QC were used to determine the acceptability of the QC results, and the consequent acceptance or rejection of the assays. The laboratory was participated in an external QC program with CDD Laboratory in Atlanta.

DATA ANALYSIS

Data was entered in Epi6 package and the analysis was carried out by using SPSS software package. Age was calculated from the subject's birthday taken from the Child Health Development Record (CHDR). Anthropometric data was calculated by using ANTHRO 2005 (WHO) software. The WHO standard (2005) data for height and weight was used to estimate prevalence of stunting (height-for-age <-2SD), prevalence of wasting (weight-for-weight<-2SD) and prevalence of underweight (weight-for-age <-2SD).

Serum retinol concentration of <20µg/dl was used as cut-off point for VAD and serum retinol concentration <10µg/dl as the cut-off point for severe VAD, in accordance with international definitions.

The following cuts off values were used to determine the vitamin A deficiency using food frequency questionnaire in accordance with Helen Keller definitions. The mean number of days of consumption of animal sources of vitamin A less than or equal to four or mean number of days of total consumption of animal sources of vitamin A and one sixth consumption of plant sources of vitamin A (considering the conversion factor of β carotene

to retinol – 6:1) less than or equal to six was taken as adequate consumption of Vitamin A rich food.

Cluster sample analysis was carried out by using Epi-Info 6.0 software package. Prevalence of VAD was presented with 95% confidence intervals. Anova, chi square test and odds ratios was calculated using SPSS software package. The level of significance was taken at 0.05.

CHAPTER 3
DEMOGRAPHIC CHARACTERISTICS

A total of 900 children aged 6-60 months were included in the study. Only 768 blood samples (85.3%) were analysed for serum retinol level due to inadequate samples or haemolysis of the samples (9.6%) and blood was not collected from 42 (4.7%) children due to refusal of mothers. Altogether non response rate was 14.7%.

Majority of caregivers who were interviewed were mother of the child (95.3%) as shown in Table 3.1.

Table 3.1
Socio-demographic characteristics of the interviewee (n=900)

Principle caregiver	No.	%
Mother	857	95.3
Father	21	2.3
Others (grand mother etc)	22	2.4

Educational status of mothers

Mothers or care givers were asked the highest level of education attained by the mother. Of the 898 children in the sample, 2.1% of mother's had not received formal education. Majority had (71.2%) undergone secondary school education (grade 6-11) and 7.1% had attained primary level education. Just over 19% were educated to tertiary level and only 0.8% had completed higher education at university level (Table 3.2).

Table 3.2
Educational level attained by the mother (n=898)

Educational level	No.	%
No schooling	19	2.1
Primary (grade 1-5)	64	7.1
Secondary (grade 6-11)	639	71.2
Tertiary (grade 12-13)	169	18.8
University / postgraduate	7	0.8

Household characteristics of the sample

Among those interviewed, the majority had 1-2 children in the family (76.5%) and less than six members in the family (85.3%). One third (34.6%) of fathers were employed and drawing

a monthly salary and 1.6% fathers were unemployed. Around 70% of fathers have undergone the secondary level of education and only 1.9% had not attended school at all (Table 3.3).

Table 3.3
Household characteristics of the sample (n=900)

Characteristics	No.	%
No of children in the family		
1 – 2	684	76.5
> 2	210	23.5
No of members in the family		
1 - 5	768	85.3
> 5	132	14.2
Fathers occupation (n=892)		
Agriculture	154	17.3
Fisheries	19	2.1
Trade	154	17.3
Job with Monthly salary	309	34.6
Job with daily salary	242	27.1
No job	14	1.6
Father's Education (n=891)		
No schooling	17	1.9
Primary (grade 1-5)	85	9.5
Secondary (grade 6-11)	621	69.7
Tertiary (grade 12-13)	163	18.3
University / postgraduate	5	0.6

Age distribution of the children

Table 3.4 shows the age distribution of the children. Majority of the children (27.7% and 26.4%) belonged to the 12-23 and 36-47 months of age groups. Only 10% of the children were belonged to 6-11 months age group because of the narrower age range. The low percentage of children in the 24 to 35 and 48 to 60 months age groups may be due to low coverage of clinic attendance of these groups. Among the children selected for the study, 51.7% were boys and 49.3% were girls.

Table 3.4

Age and sex distribution of the sample (n=900)

Age in months	Male		Female		Total	
	No.	%	No.	%	No.	%
6 – 11	45	9.7	44	10.1	89	9.9
12 – 23	126	27.1	123	28.3	249	27.7
24 – 35	83	17.9	86	19.8	169	18.8
36 – 47	128	27.5	110	25.3	238	26.4
48 - 60	83	17.8	72	11.6	155	17.2
Total	**465**	**51.7**	**435**	**49.3**	**900**	**100.0**

Age distribution of mothers

Out of the 900 interviewed, the age distribution of 891 mothers is presented in Table 3.5. The majority (51.1%) were between 20-29 years of age and the mean age of the mothers was 29.5 (±5.7) years.

Table 3.5
Age distribution of mothers (n=891)

Age groups in years	No.	%
< 20	17	1.9
20 – 29	455	51.1
30 – 39	376	42.2
40 – 49	43	4.8

CHAPTER 4
VITAMIN A STATUS IN CHILDREN

In this study clinical assessment and biochemical assessment was performed to assess the Vitamin A status in children.

Clinical assessment

All the children included in the sample did not have night blindness or Bitot's spot.

Biochemical assessment

The cut-off value of <0.70 µmol/L (20 µgram/dl) was taken to identify the low Vitamin A status (WHO/UNICEF, 1994). When the serum retinol levels were < 20 µg/dl those children were identified as Vitamin A deficient and the serum retinol level was <10 µg/dl those children were identified as severe Vitamin A deficient.

Serum retinol concentration in children

Serum retinol was measured in all selected children after obtaining permission for a blood sample to be taken from caregiver. Figure 3.1 indicates the distribution of serum retinol levels in children. Mean serum retinol level was 23.8µg/dl (SD=7.6)

Figure 3.1
Distribution of serum retinol level in children

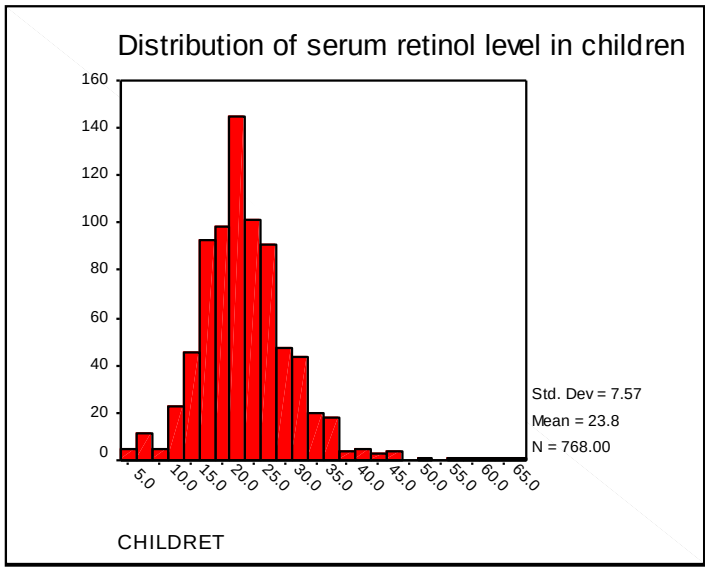


Figure 3.2

Vitamin A deficiency in children year 2005/6

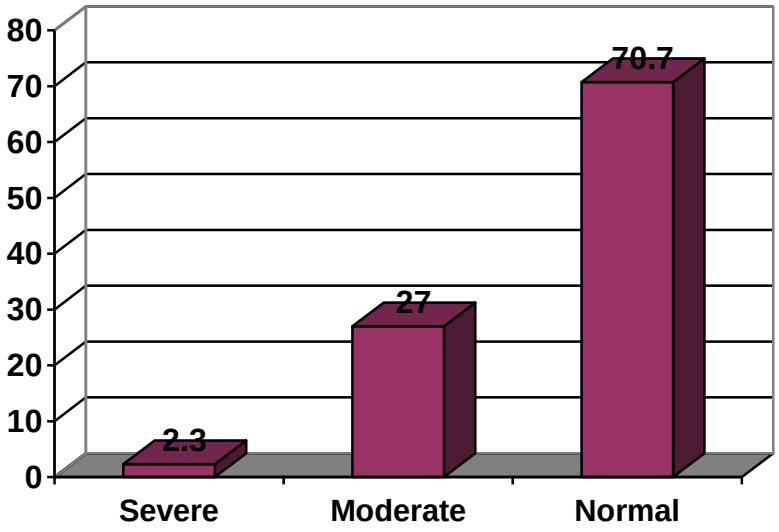


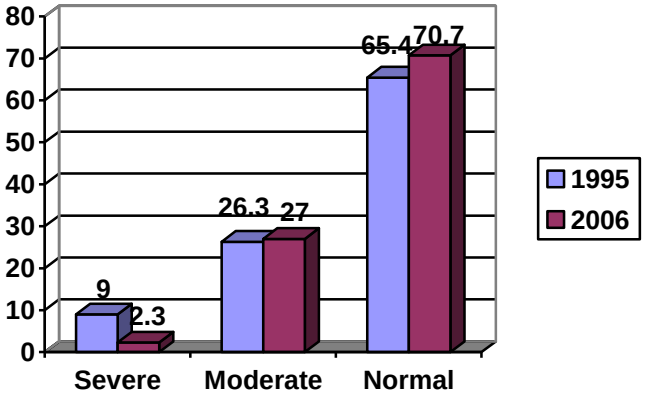
Figure 3.2 shows 29.3% (95% CI: 26.1%-32.5%) children aged 6-60 months were having the Vitamin A deficiency and 2.3% (95% CI: 1.3%-3.4%) of them were having severe Vitamin A deficiency. According to the global recommendations, when the prevalence level of 29.3% compares to assess the seriousness of the Vitamin A deficiency as a public health problem which indicates it is still a severe public health problem in Sri Lanka. Prevalence of VAD among children between 1-5 years was 29.6% (95% CI: 26.2%-32.9%).

Comparison of vitamin A deficiency in children with 1995 survey results

The results of this study showed that there is an overall improvement of vitamin A deficiency compared with the 1995 results (Figure 3.3).

Figure 3.3

Comparison of Vitamin A deficiency with 1995 survey data

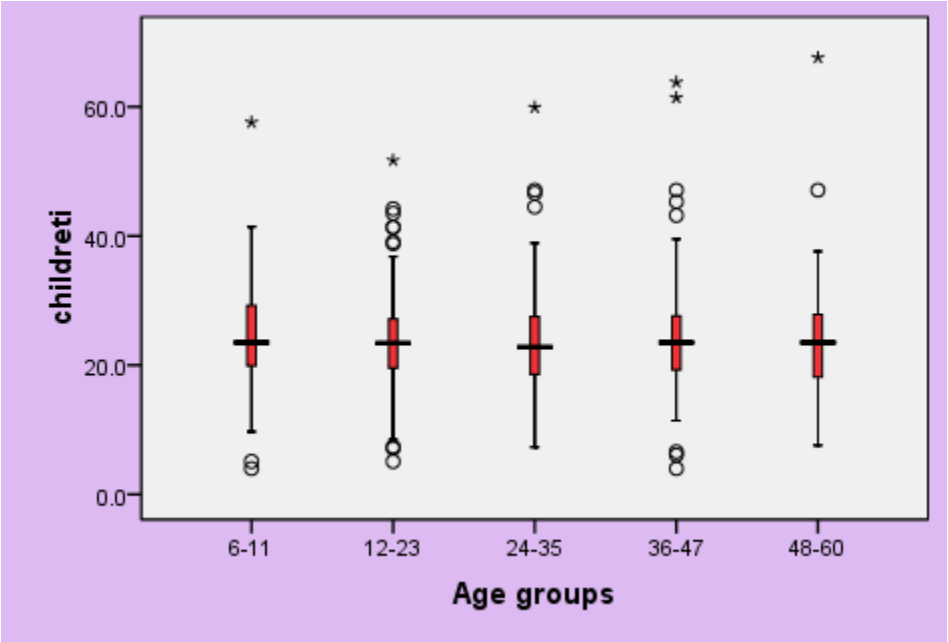


However, the prevalence of severe VAD, defined as a serum retinol concentration < 10 µg/dl which was 9% in 1995 and it was reduced to 2.3% as shown in this survey. But the moderate deficiency is still maintained the same level.

Figure 3.4 shows that the mean retinol concentration between different age groups which varies from 23.4 – 24.7 µg/dl and the difference was not statistically significant. Children in all age groups maintained the serum retinol levels very close to the cut-off value of 20 µg/dl.

Figure 3.4

Distribution of serum retinol level within age groups



The highest prevalence of severe Vitamin A deficiency was observed in children aged 6-11 months and the highest prevalence of overall Vitamin A deficiency was with the children aged 24-35 months (Table 3.6). Girls were more affected than boys with severe and moderate deficiencies. VAD has increased with increasing age till the age of 35 months. After that there is a slight drop of the prevalence and then increased again between 48-60 months. Though the district prevalence was not representative it shows a wide variation from 12% of VAD in Matara district to 40.4% in Vavuniya district.

Table 3.6

Prevalence of Vitamin A deficiency by age, gender and district

Age groups in months	Vitamin A deficiency No. (%) (95% CI)			≥20µg/dl (normal)	Total
	<10 µg/dl (severe)	10-19.9µg/dl (moderate)	Global (95% CI)		
6 - 11	3 (4.0%)	16 (21.3%)	20 (26.7%) (16.7-36.7)	56 (74.7%)	75
12 - 23	5 (2.5%)	50 (24.5%)	56 (27.5%) (21.3-33.6)	149 (73.0%)	204
24 - 35	3 (2.1%)	44 (31.0%)	48 (33.8%) (26.0-41.6)	95 (66.9%)	142
36 - 47	3 (1.4%)	55 (26.1%)	60 (28.4%) (22.3-34.5)	153 (72.5%)	211
48 - 60	4 (2.9%)	36 (21.5%)	41 (30.1%) (22.4-37.9)	96 (70.6%)	136
Sex					
Male	5 (1.2%)	100 (24.9%)	109 (27.2%) (22.8-31.5)	296 (72.8%)	401
Female	13 (3.5%)	101 (27.5%)	116 (31.6%) (26.8-36.4)	253 (68.4%)	367
District					
Colombo	1 (1.1%)	26 (28.6%)	27 (29.7%) (20.1-34.5)	64 (70.3%)	91
Gampaha	3 (5.7%)	13 (24.5%)	16 (30.2%) (17.6-44.6)	37 (69.8%)	53
Kalutara	0 (0.0%)	5 (23.8%)	5 (23.8%) (5.6-42.0)	16 (76.2%)	21
Kandy	1 (1.8%)	19 (33.3%)	20 (35.1%) (15.9-41.2)	37 (64.9%)	57
Matale	1 (4.0%)	3 (12.0%)	4 (16.0%) (1.6-30.4)	21 (84.0%)	25
NuwaraEliya	0 (0.0%)	4 (16.0%)	4 (16.0%) (1.6-30.4)	21 (84.0%)	25
Galle	2 (2.0%)	12 (24.0%)	14 (28.0%) (15.5-40.5)	36 (72.0%)	50
Matara	0 (0.0%)	3 (12.0%)	3 (12.0%) (-0.7-24.7)	22 (88.0%)	25
Hambantota	0 (0.0%)	5 (20.0%)	5 (20.0%) (4.-34.4)	20 (80.0%)	25
Vavuniya	7 (14.9%)	12 (25.5%)	19 (40.4%) (20.8-59.2)	28 (59.6%)	47
Ampara	3 (4.1%)	15 (30.6%)	18 (36.7%) (13.7-50.3)	31 (63.3%)	49
Trincomale	1 (2.0%)	17 (34.0%)	18 (36.0%) (19.1-44.9)	32 (64.0%)	50
Kurunagala	0 (0.0%)	11 (22.0%)	11 (22.0%) (10.5-33.5)	39 (78.0%)	50
Puttulum	1 (4.0%)	5 (20.0%)	6 (24.0%) (5.6-42.0)	19 (76.0%)	25
Anuradapura	0 (0.0%)	9 (36.0%)	9 (36.0%) (19.1-52.2)	16 (64.0%)	25
Polonnaruwa	0 (0.0%)	10 (40.0%)	10 (40.0%) (20.8-59.2)	15 (60.0%)	25
Badulla	0 (0.0%)	5 (20.0%)	5 (20.0%) (4.3-30.7)	20 (80.0%)	25
Monaragala	0 (0.0%)	8 (32.0%)	8 (32.0%) (13.7-50.3)	17 (68.0%)	25
Ratnapura	1 (4.0%)	6 (24.0%)	7 (28.0%) (10.4-45.6)	18 (72.0%)	25
Kegalle	0 (0.0%)	14 (28.0%)	16 (32.0%) (19.1-44.9)	34 (68.0%)	50
Total	**18 (2.3%)**	**201 (26.2%)**	**225 (29.3%) (26.1-32.5)**	**549 (71.5%)**	768

(CI=Confidence Interval)

CHAPTER 5
MORBIDITY AND NUTRITONAL STATUS

Risk factors associated with Vitamin A status include undernutrition, measles, respiratory infection, and diarrhoeal disease. In Sri Lanka, coverage of measles vaccination was above 95%. Therefore information on morbidity pattern and nutritional status was gathered.

Morbidity pattern

Each care giver was asked whether their child had suffered from cough or cold with or without fever (defines as respiratory tract infections) or diarrhoea (more than 3 loose stools per day) during the 2 weeks prior to and including the day of the survey. Table 3.7 indicates that the highest prevalence of respiratory tract infections (RTI) was observed in children above 48 months and diarrhoea was in children aged 6-11 months.

Table 3.7
Prevalence of cough or cold with or without fever and diarrhoea in the 2 weeks prior to the survey, reported for children

	Morbidity		Total
Age in months	**Cough / cold with or without fever**	**Diarrhoea**	
6-11	51 (57.3%)	28 (31.5%)	89
12.0-23	140 (56.2%)	62 (24.9%)	249
24.0-35	96 (56.8%)	26 (15.4%)	169
36.0-48	99 (41.6%)	33 (13.9%)	238
>48	86 (63.5%)	11 (7.1%)	155
Total	**472 (52.6%)**	**160 (17.8%)**	**900**

Overall, it was reported that 52.6% of children were reported to have had RTI, and that 17.8% had experienced a bout of diarrhoea in the 2 weeks prior to the survey (Table 3.8). Altogether 60% of children suffered from either diarrhoea or RTI.

Table 3.8
Prevalence of cough or cold with or without fever and diarrhoea in the 2 weeks prior to the survey, by Vitamin A status

	Vitamin A status			
Morbidity	**Severe**	**Moderate**	**Overall VAD (95% CI)**	**N**
Cough / cold with or without fever				
Yes	13 (3.3%)	112 (28.6%)	128 (32.7%) (28.1-37.4)	391
No	5 (1.3%)	89 (23.6%)	97 (25.7%) (21.3-30.1)	377
Diarrhoea				
Yes	5 (3.8%)	35 (26.9%)	40 (30.8%) (22.8-38.7)	130
No	13 (2.0%)	166 (26.0%)	185 (29.0%) (25.5-32.5)	638
Total	**18**	**225**	**543**	**768**

Table 3.6 shows that more children with VAD have had respiratory infections than children without VAD. But the proportions of children with or without VAD were similar among children with or without diarrhoea. However, children with diarrhoea had more severe VAD than the children without diarrhoea.

Nutritional status

Wasting increases with the age as shown in Table 3.9 and overall wasting was 19.8% and the highest prevalence was observed among children above 48months (27.9%).

Table 3.9

Nutritional status in children in relation to age

	<-2SD of WHO Standard			Total
Age in months	**Weight-for-height (wasting)**	**Height-for-age (stunting)**	**Weight-for-age (Underweight)**	
6-11	12 (14.3%)	11 (13.1%)	13 (15.5%)	84 (9.6%)
12.0-23	41 (16.7%)	39 (15.8%)	52 (21.1%)	246 (28.2%)
24.0-35	28 (16.9%)	30 (18.1%)	43 (25.9%)	166 (19.0%)
36.0-47	53 (22.4%)	31 (13.1%)	60 (25.3%)	237 (27.1%)
≥48	39 (27.9%)	24 (17.1%)	50 (35.7%)	140 (16.0%)
Total	**173 (19.8%)**	**135 (15.4%)**	**218 (24.9%)**	**873**

The prevalence of stunting was 15.4% and the highest prevalence was observed in the age group of 24-35 months (18.1%). Overall prevalence of underweight was 24.9% and the highest prevalence of underweight was reported from children above 48months (35.7%).

Table 3.10
Prevalence of wasting, stunting and underweight by Vitamin A status

Nutritional status	Vitamin A status			
	Severe	Moderate	Overall VAD	N
Wasting				
Yes	2 (1.3%)	43 (27.7%)	46 (29.0%)	155
No	15 (2.5%)	153 (25.8%)	173 (29.3%)	593
Stunting				
Yes	2 (1.8%)	32 (28.8%)	34 (30.6%)	111
No	15 (2.4%)	163 (25.7%)	185 (29.1%)	638
Underweight				
Yes	4 (2.1%)	52 (27.1%)	56 (29.2%)	192
No	13 (2.3%)	144 (25.9%)	163 (29.2%)	557
Total	**17**	**196**	**539**	**748**

Table 3.10 shows there was no difference of Vitamin A deficiency irrespective of their nutritional status. This observation was similar with wasting, stunting and underweight.

CHAPTER 6
CHILD FEEDING HISTORY

Current breastfeeding practices, age of stopping breastfeeding and age of starting complementary feeding was obtained.

Breastfeeding practises

About 57% of children are currently being breastfed. It is interesting to note that 93.3% children aged 6-11 months were breastfed and 11.6% of children above 48 months were also breastfed (Figure 3.5).

Figure 3.5

Current breast feeding status in relation to the age

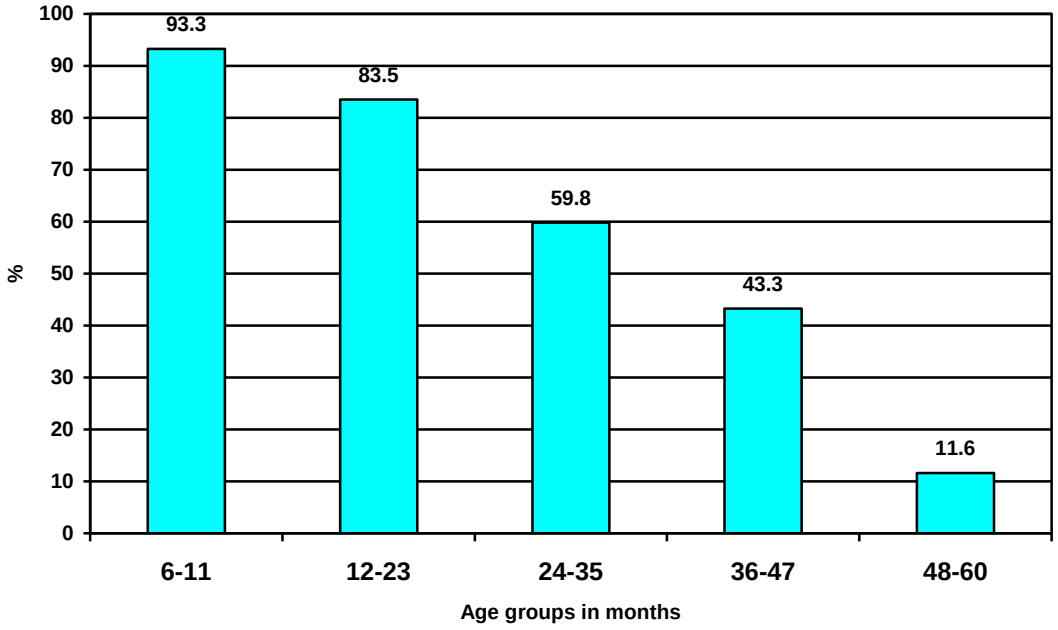


Figure 3.6 shows the age at which breastfeeding was stopped. Only 8.6% mothers discontinued the breastfeeding when the child was less than 6 months and 5.5% were never breastfed. One third (31.1%) discontinued the breastfeeding when the age of the child was between 24-35 months.

Figure 3.6

Age of the child at discontinuation of breastfeeding

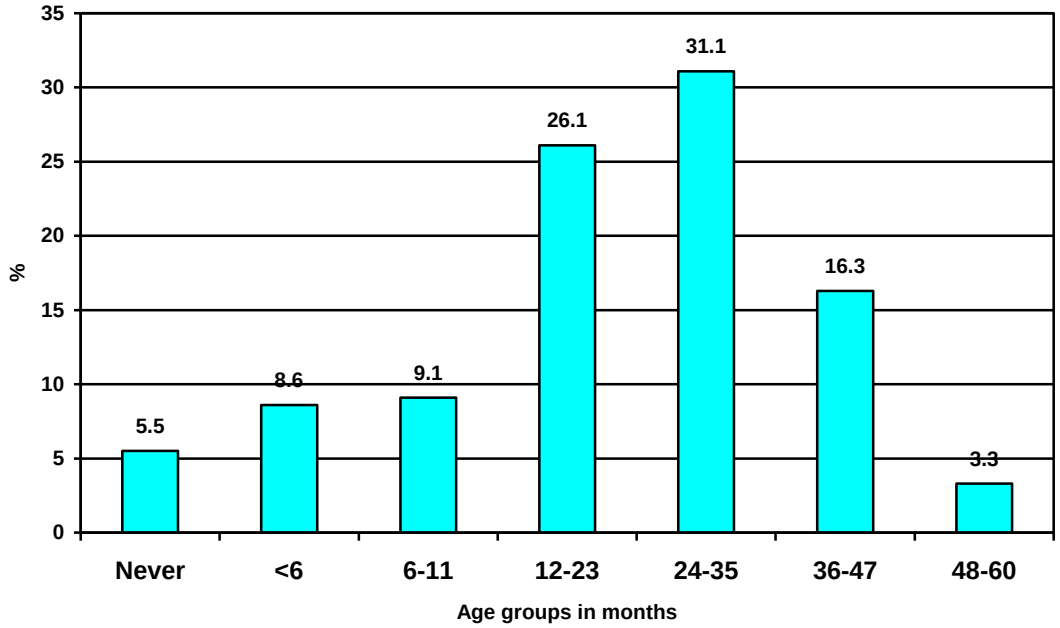


Table 3.11

Distribution of serum retinol level within status of currently breast feeding

Age in months	Mean serum retinol level (SD)		No. of children
	Currently breastfed	Currently not breastfed	
6 – 11	25.1(8.3)	18.3 (4.4)	75
12.0 – 23	26.6 (6.6)	23.7 (6.9)	204
24.0 – 35	23.5 (6.9)	24.2 (9.0)	142
36.0 – 47	24.8 (8.9)	23.5 (6.9)	211
≥ 48	25.6 (5.0)	23.1 (8.2)	136
Total	**24.1 (7.4)**	**23.4 (7.7)**	**768**

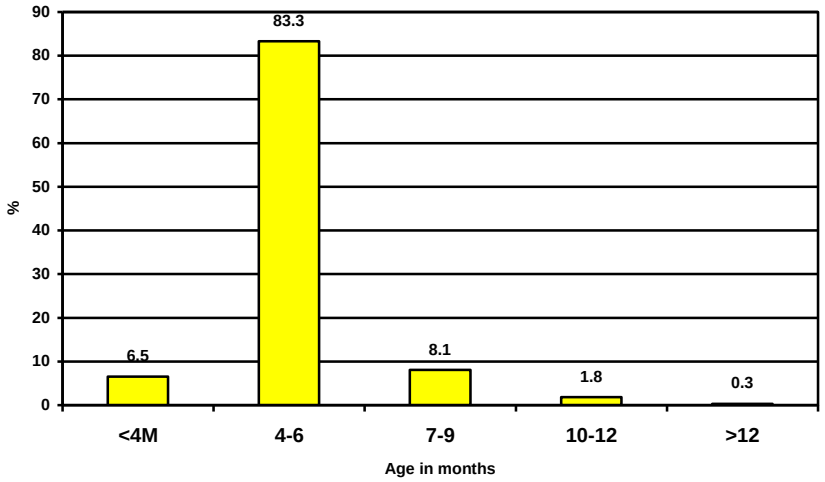
Children between 6 – 23 months who were breastfed had higher serum retinol level than non breastfed children and the difference was more marked with the children between 6-11 months of age. But the difference was not marked with the children above 24 months.

Complementary feeding

Though WHO has recommended initiating the complementary feeding from the age of six months, Sri Lanka followed up the strategy of initiating complementary feeding from 5 months onwards up to year 2006. Global recommendation has been adopted by the Ministry of Health since year 2006 which was after the collection of data for this study.

Figure 3.7

Age of starting complementary foods



Majority of mothers, 83.3% have started complementary feeding between 4 to 6 months of age, whereas 6.5% gave complementary food before 4 months and 8.1% reported that they had given complementary food between 7-9 months of age (Figure 3.7).

CHAPTER 7
VITAMIN A SUPPLEMENTATION

In general, vitamin A supplementations were given during child welfare clinic sessions and recorded on child health development records (CHDR). Each caregiver was asked if their child had been given Vitamin A mega dose supplementation and the last date of supplementation. The information given by the caregivers was confirmed by checking the CHDR. Sixty five percent of children had received Vitamin A mega dose at least once. Table 3.12 revealed that 76.3% children aged between 12-23 months had received Vitamin A megadose supplementation. The lowest coverage of supplementation was observed among children above 48 months (60.6%). This may be the fact due to the Vitamin A mega dose supplementation strategy in Sri Lanka.

Table 3.12

Distribution of serum retinol level within status of currently breast feeding

Age in Months	Viatmin A megadose supplementation		No. of children
	% Received	% Not received	
6 – 11	40.4	59.6	89
12.0 – 23	76.3	23.7	249
24.0 – 35	67.5	32.5	169
36.0 – 47	67.2	32.8	238
≥ 48	60.6	39.4	155
Total	**66.0**	**34.0**	**900**

Figure 3.8

Mean retinol concentration in relation to the interval between the last Vit A dose and the survey (n=499)

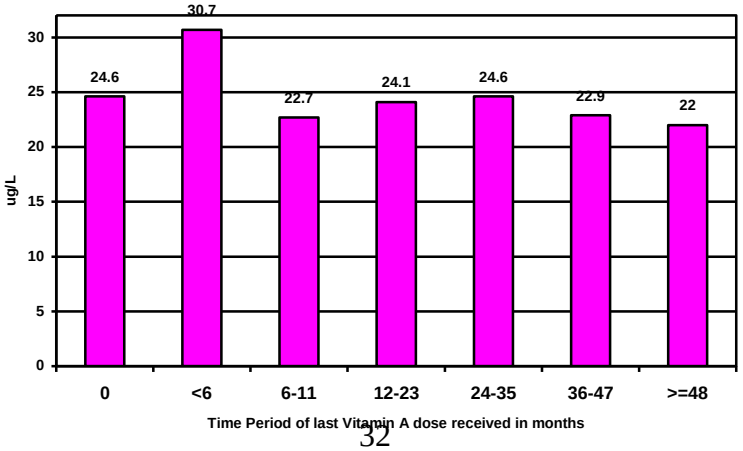


Figure 3.8 shows that highest prevalence of serum retinol level was observed among the children who received Vitamin A mega dose 6 months before the day of the data collection which was 30.7µg/L. The lowest retinol concentration was reported from the children who had received Vitamin A mega dose more than 48 months ago (22.0µg/L).

The prevalence of VAD in children aged 6 to 59 months was 23.9% just after the vitamin A supplementation of children and about 34% within 6 months of the supplementation. After 6-11 months or 12-23 months or more than 24 months after the received of last dose of vitamin A supplementation the prevalence of VAD was 32.2%, 28.3% and 31.3% respectively.

Table 3.13

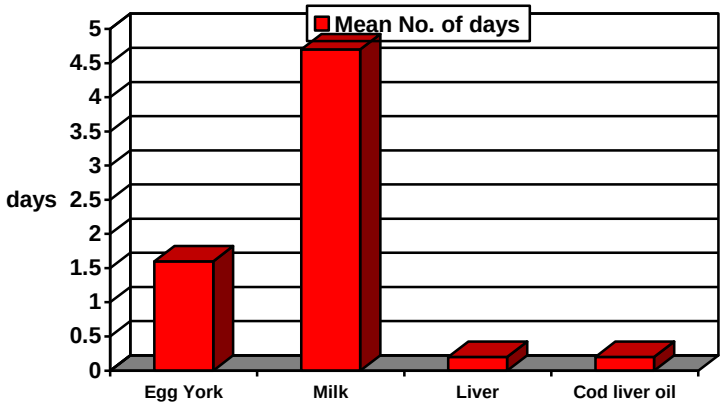
Distribution of VAD within status of Vitamin A supplementation

Vitamin A supplementation	VAD		No. of children
	Yes	No	
0	23.9%	76.1%	46
<6	34.0%	66.0%	53
6 – 11	32.2%	67.8%	199
12 – 23	28.3%	71.7%	53
≥ 24	31.3%	68.7%	67
Total	**30.9%**	**69.1%**	**418**

CHAPTER 7
VITAMIN A RICH FOODS CONSUMPTION

An effort was made to estimate what vitamin A rich foods had been eaten by children in the period adopting the Hellen Keller (HK) Food Frequency Questionnaire of the past 7 days.

Figure 3.9
Mean consumption of animal source of Vitamin A rich food during previous week



Mean days of consumption of Vitamin A rich animal source food varied from 0.2 to 2.5 days. Majority had consumed Milk and then egg York (Figure 3.9).

Consumption of greens rich in Vitamin A varied from 0.5 – 1.6 days as shown in Figure 3.10.

Figure 3.10
Mean consumption of Vitamin A rich Green Leaves during previous week

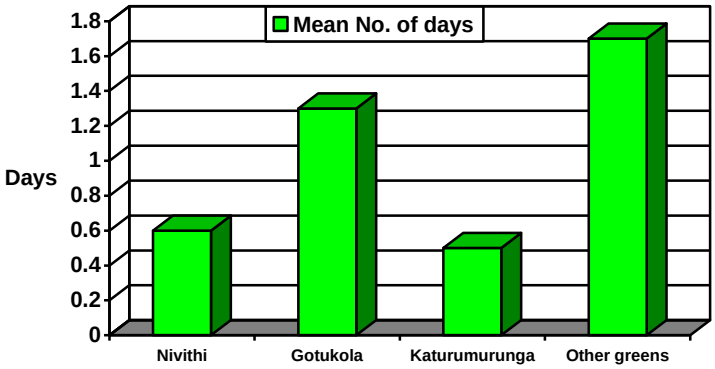
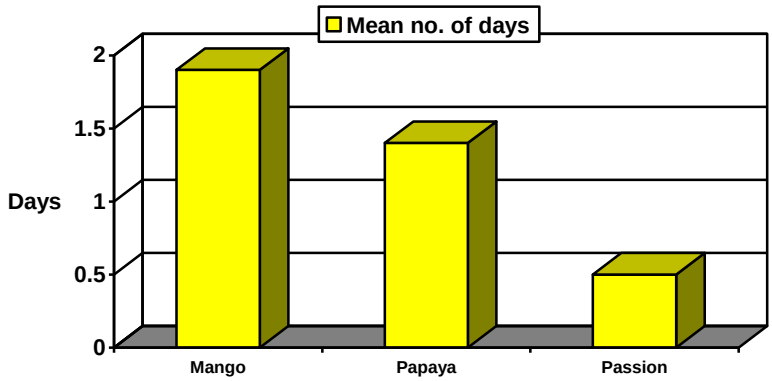
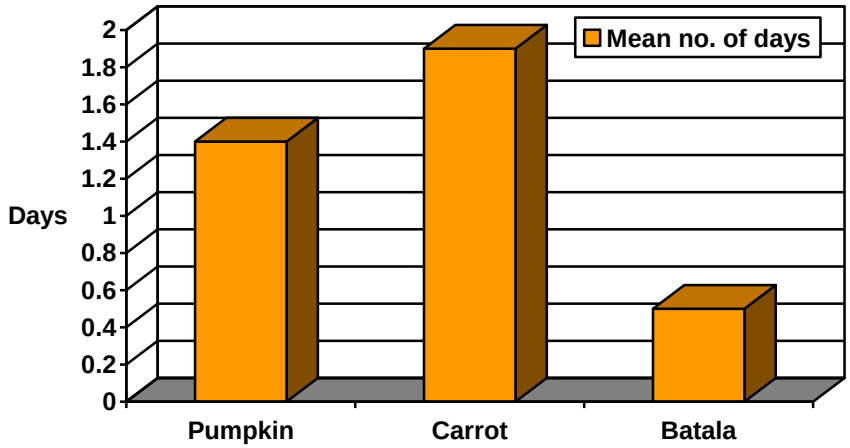


Figure 3.11
Mean consumption of yellow coloured fruits during previous week



As shown in Figure 3.11, consumption of fruits rich in Vitamin A varied from 0.5 – 2 days and the highest consumption was reported as mango (2 days per week).

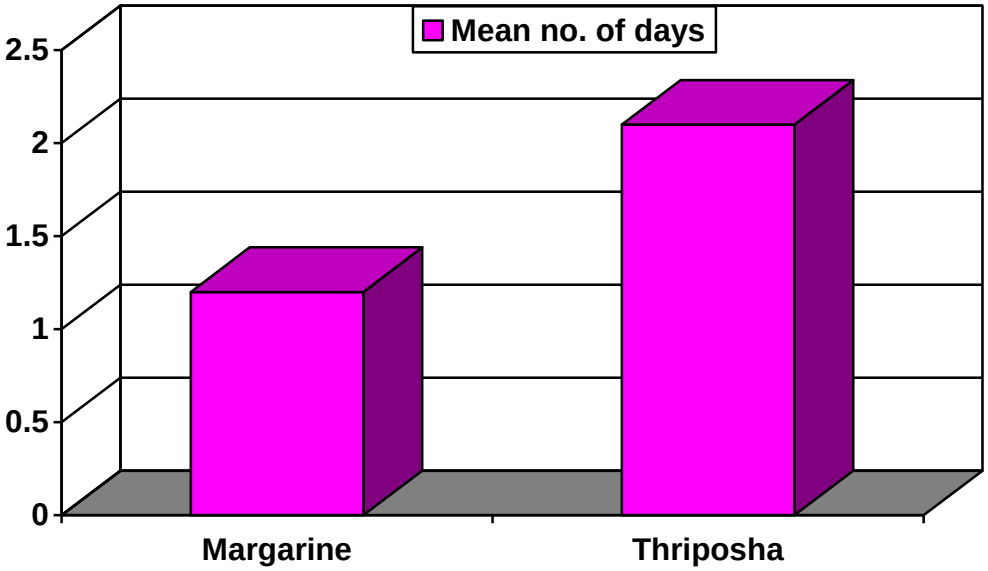
Figure 3.12
Mean consumption of yellow coloured vegetables



Consumption of yellow coloured vegetables rich in Vitamin A varied from 0.4 – 1.8 days. The highest consumption was reported as carrot (Figure 3.12).

Figure 3.13

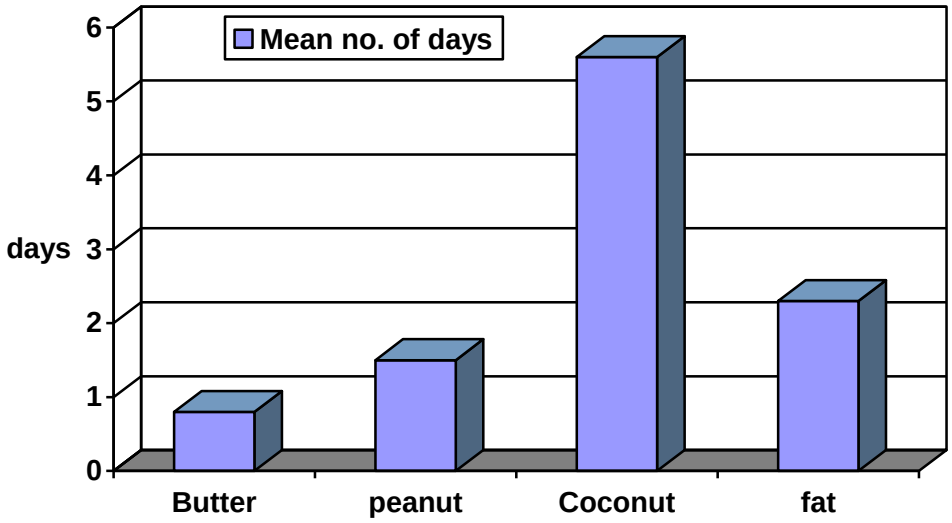
Mean consumption of vitamin A fortified foods during previous week



Mean consumption of food fortified with Vitamin A varied from 1.2 – 2.2 days per week as shown in Figure 3.13. The food which was consumed the most was Thriposha.

Figure 3.14

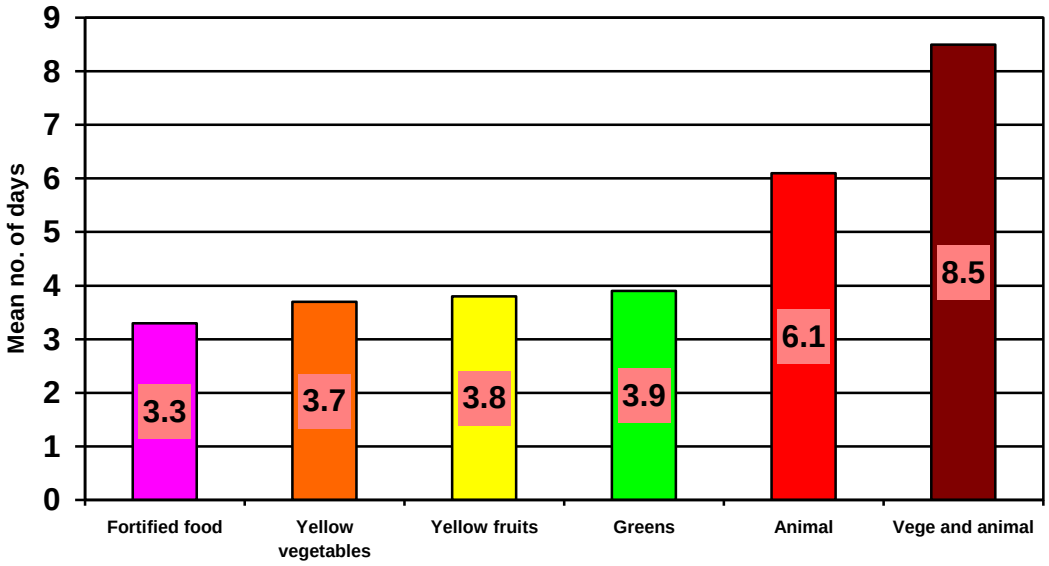
Mean consumption of foods containing fat during previous week



Fat is necessary to absorb Vitamin A. Consumption of food containing fat was taken and it varied from 0.5 – 5.6 days and coconut was the most consumed food item (Figure 3.14).

Figure 3.15

Mean consumption of Vitamin A rich food during previous week (n=900)



Mean days of the consumption of greens rich in Vitamin A, yellow coloured vegetables, Yellow coloured fruits, Vitamin A rich animal food and Vitamin A fortified food during previous week was 3.9, 3.7, 3.8, 6.1 and 3.3 days. Milk was left out when calculating the animal sources of food. Hellen Keller International (HKI) justifies this on the assumption that animal milk as served to the children is too diluted and that breast milk is a minor source of vitamin A after the first year.

For each questionnaire the total frequency of consumption of animal sources are added with the total frequency of consumption of vegetables divided by 6, and the weighted total consumption (animal + vegetables) was taken. Average scores were calculated. This study revealed that mean frequency of consumption of animal sources of food was 6.1 days, animal and vegetable sources of vitamin A were 8.5 days. A community is considered to have a vitamin A deficiency problem if it falls below either of two threshold values: 4 days per week for mean frequency of consumption of animal sources of vitamin A, or 6 days per week for mean frequency of weighted total consumption of animal and vegetable sources of vitamin A. In this study 62.3% of the survey population was above the threshold value in relation to the consumption of animal food sources and 61.3% was above the threshold value to the consumption of both animal and vegetable sources of vitamin A.

CHAPTER 8
FACTORS AFFECTING PLASMA RETINOL LEVELS OF CHILDREN

One third of the children with mothers who attained primary schooling had VAD compared to other mothers as illustrated in Figure 3.16. It is revealed that higher the educational level of the mothers VAD has decreased.

Figure 3.16
Vitamin A deficiency of children in relation to the mother's education

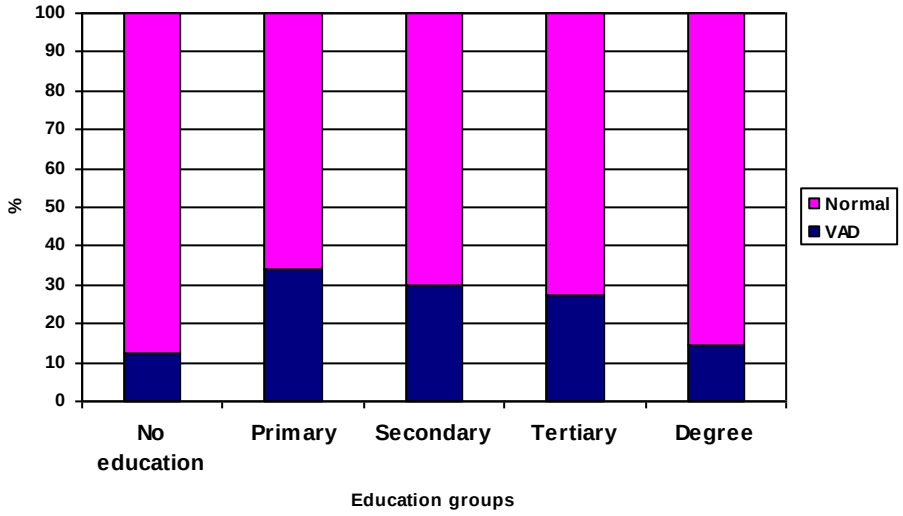


Table 3.17 indicates the factors associated with VAD in children. Child with RTI has significantly associated with VAD and all other factors studied such as diarrhoea, being a girl, vitamin A supplementation, being a low birth weight baby, currently breastfed and mean consumption of vitamin A rich food sources during last 7 days were not significantly associated with VAD.

Table 3.17

Factors affecting vitamin A deficiency among children aged 6-59 months

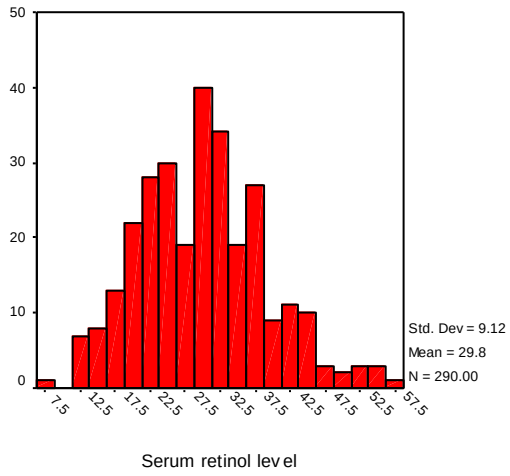
Factors	VAD	Confidence Interval	Statistics test
Morbidity			
Cough / cold with or without fever	128 (32.7%)	28.1-37.4	X^2=4.5; **P=0.04**
Diarrhoea	40 (30.8%)	22.8-38.7	X^2=0.2; P=0.7
Sex			
Male	109 (27.2%)	22.8-31.5	X^2=0.2; P=0.7
Female	116 (31.6%)	26.8-36.4	
Received Vit. A supplementation	148 (29.7%)	25.6-33.7	X^2=0.1; P=0.8
Low birth weight	36 (27.9%)	20.2-35.7	X^2=0.2; P=0.8
Currently breastfed	118 (27.7%)	23.4-31.9	X^2=1.2; P=0.3
Mean days of consumption of vitamin A rich food (SD)			
Green coloured vegetables	3.9 (3.6)		F=0.7; P=0.4
Yellow coloured fruits	3.9 (3.6)		F=0.2; P=0.6
Yellow coloured vegetables	4.4 (10.0)		F=3.0; P=0.08
Total vegetable sources	2.5 (3.1)		F=0.01; P=0.9
Vitamin A fortified	3.3 (3.4)		F=0.03; P=0.9
Animal including fortified	6.4 (5.1)		F=0.02; P=0.9
Total animal and vegetable	8.9 (6.4)		F=0.01; P=0.9

CHAPTER 9

VITAMIN A STATUS IN WOMEN

A total of 350 blood samples were obtained from the mothers to analyse the serum retinol concentration. Final number of samples were only 290 (82.9%) due to haemolysis of the samples. Figure 3.19 indicates the distribution of serum retinol levels in mothers. Mean serum retinol level was 29.8µg/dl (SD=9.1) and Vitamin A deficiency among mothers was 14.9% (95% CI: 10.7%-19.4%).

Figure 3.19
Distribution of serum retinol level in women (n=290)



Nutritional status of Women

One fourth of mothers (21.1%) were underweight, 21.1% were overweight and 5.4% were obese as shown in Figure 3.20.

Figure 3.20

Nutritional status in women

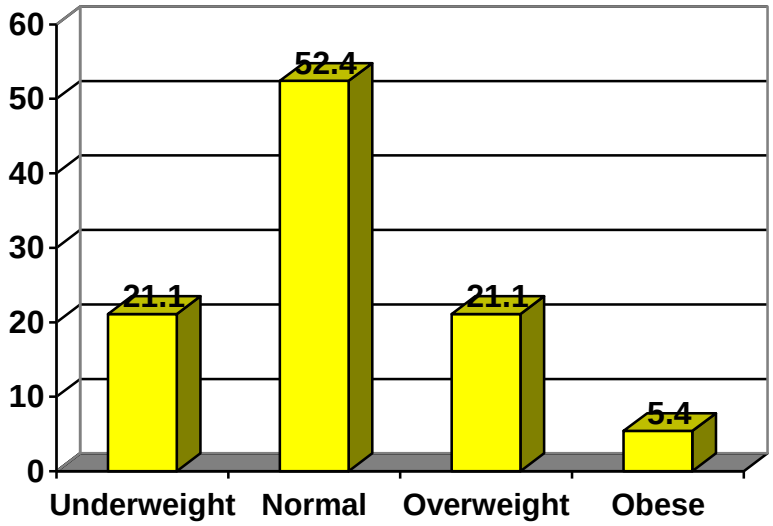


Table 3.19 shows the VAD among mothers in relation their nutritional status. The highest VAD prevalence was observed among mothers with adequate nutritoional status and the lowest among obese mothers.

Table 3.19

Distribution of Vitamin A deficiency of mothers in relation to Their nutritional status

Nutritional Status	VAD (%)		No. of mothers
	Yes	No	
Underweight	12.1	87.9	58
Normal	19.0	81.0	142
Overweight	8.3	91.7	60
Obesity	7.1	92.9	14
Total	**14.6 (CI=10.7-19.4)**	**85.4**	**274**

CHAPTER 10
KEY FINDINGS AND DISCUSSION

The main finding of this study was that there is a prevalence of VAD of 29.3% including 2.3% of severe VAD in children aged 6-59 months and prevalence of VAD of 29.6% in children aged 1-5 years. A community is defined as having a problem of public health significance when 15% of the child populations between 1 and 5 years of age have a serum retinol level of < 20µg/L as recommended by the International vitamin A Consultative Group (IVCG). The plasma retinol results from this study shows that VAD is still a significant public health problem in Sri Lankan children aged 12 to 59 months and in non-pregnant women from 15 to 49 years of age, there is a less risk of VAD as a public health problem as the percentage of women who had retinol concentrations < 20µg/L was 14.9% in this study. There has been no previous study in Sri Lanka within this age group for comparison.

Although severe VAD has been reduced to 2.3%, part of the apparent failure of the vitamin A supplementation programme may be attributable to the high levels of sub-clinical infection present in the population, and poor eating pattern of vitamin A rich food may be one contributor. Overall coverage of Vitamin A supplementation was poor at 66%. When the interval between the last dose of vitamin A supplementation was wide the mean concentration of serum retinol was also low which indicates it is necessary to narrow the gap between doses and to extend the supplementation till 5 years. Currently Sri Lanka is adopting a schedule which provides Vitamin A supplementation at 3 years and then provides a dose at the age of 5 years. The children between 3-5 years do not receive Vitamin A megadose in Sri Lanka.

5.1. Morbidity in children

It appears that VAD or marginal Vitamin A status is often worsened by infectious disease and reciprocally, that poor Vitamin A status is likely to prolong or exacerbate the course of illness. The presence of infections such as cough, fever or diarrhoea was associated with a significant decrease in plasma retinol concentration due to inhibiting the synthesis of retinol-binding protein (RBP), the carrier protein for retinol, reducing the circulating vitamin A and so potentially affects the supply of vitamin A to the tissues during infection (Baeton *et al,* 2004). This study shows high prevalence of RTI (52.6%), diarrhoea (17.8%)

and wasting (19.8%) among children studied. Children with pre-existing mild VAD maybe more prone to severe respiratory infection and diarrhoeal disease than children who are no Vitamin A deficient (Sommer 1995). The prevalence of VAD in children with respiratory infections in this study was significantly higher (32.7%) than those without RTI (25.7%). But there was no association between the children with diarrhea and poor nutritional status.

5.2 Vitamin A supplementation of children

Results of this study show that 66% of children attended the CWC received a vitamin A supplement. Data from the 2001 coverage survey in Sri Lanka reported the overall coverage of vitamin A supplementation was 67% overall, However, there was variation among the provinces with the rate of supplementation being lowest in the Eastern Province (52%) and highest (83%) in the province.

The prevalence of VAD in children aged 6 to 59 months was 23.9% just after the vitamin A supplementation and about 34% within 6 months of the supplementation. In addition, the mean plasma retinol concentration was higher 6 months within the last dose of vitamin A supplementation compared with other periods. Even after 12-23 months (24.1 µg/L) or 24-35 months (24.6 µg/L) of receiving vitamin A supplementation, there was no difference between the plasma retinol concentrations in just after the supplementation (24.6 µg/L). Possible explanations are: The interval between high-dose supplement was too wide or the dose of supplement is not adequate maintain high serum retinol levels.

5.3 Child feeding and vitamin A rich food

Exclusive breastfeeding for the first 6 months and nutritionally adequate complementary foods with continued breastfeeding up to 2 years of age or beyond is known to help in protecting the children from infection, enabling the children to build up more vitamin A liver stores to help them through the vulnerable weaning period (Miller *et al* 2002). Based on this study, 56% of children were currently breastfed.

This study revealed that the mean frequency of consumption of animal sources of food was 6.1 days, animal and vegetable sources of vitamin A were 8.5 days. A community is considered to have a vitamin A deficiency problem if it falls below either of two threshold

values: 4 days per week for mean frequency of consumption of animal sources of vitamin A, or 6 days per week for mean frequency of weighted total consumption of animal and vegetable sources of vitamin A. In this study 62.3% of the survey population is above the threshold value in relation to the consumption of animal food sources and 61.3% were above the threshold value to the consumption of animal and vegetable sources of vitamin A. If at least 70% of the surveyed communities are not above both threshold values, then VAD is likely to be a public health problem in the entire survey area. Therefore in this survey population is considered VAD as a public health problem with regards to the consumption of vitamin A rich food.

CHAPTER 11
Conclusions and recommendations

Following the dissemination of the results from this vitamin A study, a round table discussion was held in Family Health Bureau, Colombo. The discussion was attended by experts of Ministry of Health, College of Paediatricians and UN organisations. Results from the vitamin A study were discussed and recommendations for the future were proposed:

Vitamin A supplementation programme

- To initiate the vitamin A supplementation from 6 months of age
- To reduce the gap between 2 doses and to provide supplementation every 6 months till 5 years, altogether 10 doses of vitamin A megadose
- To continue the same dose of 100,000IU and repeat the study after one year
- To strengthen the implementation of supplementation at CWC at community and district level, there is need to
    1. Improve coverage of vitamin A supplementation in all districts,
    2. Use advocacy to improve the supplementation programme through public health staff during clinic and home visits.
- Explore high dose (200,000 IU) vitamin A supplementation, as a way of ensuring an adequate supply of vitamin A to children in emergency settings by linking to routine immunization.

Infection

- To reduce exposure to infection and improve both vitamin A status, education about reducing exposure to infection should be promoted (e.g. use of bednets, hand washing etc.).
- Other public health interventions should be encouraged (e.g. clean water, sanitation).

Dietary diversification

- Consumption of vitamin A–rich foods is one of the long-term strategies that can improve vitamin A status, therefore, the promotion, production and consumption of vitamin A–rich foods, such as papaya, pumpkin and mangoes, should be encouraged.

Women

- Improve the postpartum vitamin A capsule supplementation programme to reduce the deficiency among them.

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Annex-1

Province, District and Cluster Numbers		
Province No.	**District No.**	**Cluster No.**
1. Western	1. Colombo	1. New Bazar
		2. Modara
		3. Bokundara
		4. Kolonnawa
		5.Kaduwela
		6.Homagama
		7. Negambo,
	2. Gampaha	8. Gampaha
		9. Mahara
		10. Wattala
	3. Kalutara	11. Wallalawita
2. Central	4. Kandy	12. Galagedara
		13. Yatinuwara
		14. Kadugannawa
	5. Matale	15. Ukuwela
	6. NuwaraEliya	16. Walapane
3. Southern	7. Galle	17. Bentota
		18. Yakkalamulla
	8. Matara	19. Dickwella
	9. Hambantota	20. Tissamaharamaya
4. Northern	10. Vavuniya	21. Vavuniya North
		22. Vavuniya South
5. Eastern	16. Ampara	23. Ampara
		24. Kalmune
	17. Trincomale	25. Trincomale
		26. Kantale
6. North Western	18. Kurunagala	27. Narammala
		28. Nikaweratiya
	19. Puttulum	29. Karuwalagaswewa
7. North Central	20. Anuradapura	30. Galnewa
	21. Polonnaruwa	31. Lankapura
8. Uva	22. Badulla	32. Haliela
	23. Monaragala	33. Monaragala
9. Sabaragamuwa	24. Ratnapura	34. Ebilipitiya
	25. Kegalle	35. Aranayaka
		36. Ruwanwella

Annex 2

Assessment of Vitamin A deficiency in Sri Lanka – 2005/6

Date (dd/mm/yy) ☐☐ ☐☐ ☐☐ Team ☐

1	Province No ☐	2	District No ☐☐
3	MOH No. ☐☐	4	Cluster No ☐☐☐
5	Child No ☐☐☐☐	6	Child's name _____
7	Respondent: 1 Mother 2 Father Or 3 Caretaker ☐	8	Current address
9	Child's birthday (dd/mm/yy) ☐☐ ☐☐ ☐☐	10	Child's gender 1=male 2=female
11	Number of children ☐☐	12	Number of members in family ☐☐
13	Mother's education (completed years) ☐☐	14	Father's occupation ☐☐ 1 Agriculture 2 Fishery 3 Busineess 4 Monthly paid job 5 Daily paid job 6 Unemployed 99 No response
15	Father's education (completed years) ☐☐		

	Health Status	
16	miq.sh i;s fol ;=, orejdg mdpk frda.h je,oqkdo@ 1=yes 2=no	
17	miq.sh i;s fol ;=, orejdg iajik frda. je,oqkdo@ 1=yes 2=no	
	Access to Health Services	
18	Tfí orejdg úgñka ta wêud;%dj ,ndoqkakdo@ 1=yes 2=no	
19	úgñka ta wêud;%dj ,ndoqka oskh:	
	Caring Capacity	
20	Tfí orejdg uõlsrs ,nd fokafkao@ 1=yes 2=no	
21	Tfí orejdg uõlsrs l=uk jhila olajd ,ndoqkakdo@ ^udi& 88=currently breast fed	
22	fjk;a wdydr fyda mdk ,ndoSu mgka .;af;a l=uk jhil oSo? ^udi&	
	Food Consumption	
23	miq.sh meh 24 ;=,oS Tnf.a orejdg lS jdrhla wdydr oqkakdo@ 1=once 2=twice 3=3-4 times 4=5 or more times 99=no answer	
24 miq.sh osk 7 ;=,oS Tnf.a orejdg my; i|yka wdydr j¾. ,ndoqkakdo@ fldmuk osk .kklao@ No. of days eaten per week		
1.	Rice / Wheat Flour / Bread / Wheat flour preparations / Maize=	
2.	Food with hot Chillies	
3.	Greens	
4.	Milk (except breastmilk)	
5.	Beetroot	
6.	Riped mangoes	
7.	Dark yellow or orange pumpkin	

8.	Spinach	
9.	Ripe papaya	
10.	Noodles	
11.	Eggs with york	
12.	Small fish (liver intact)	
13.	Peanuts (or other legumes)	
14.	Yellow sweet potatoes	
15.	Chicken or other fowl (or other meat or legumes)	
16.	Gotukola (or other GLV)	
17.	Any kind of liver	
18.	Katurumurunga leaves	
19.	Beef, pork, mutton or other meat	
20.	Butter	
21.	Dhal (other legumes or meat)	
22.	Cod liver oil	
23.	Fried food	
24.	Passion fruit	
25.	Coconut (or other oil)	
26.	Vitamin A added fortified foods (Biscuits)	
27.	Margarine vitamin A added	
28	Thriposha / CSB	
Biochemical and Anthropometry		
55	Child's Height / length (in cm)	
56	Child's weight (in kg)	
57	Bitot's spot 1= present 2= no	
58	Night blindness 1= present 2= no	
59	Child's Venous blood taken (yes / no)	
60	Child's Serum Retinol Level (micro gram/ L)	
61	Mother's Height (in cm)	
62	Mother's Weight (in kg)	
63	Mother's Venous blood taken (yes / no)	