NATIONAL NUTRITION AND MICRONUTRIENT SURVEY

PART II:
IRON, ZINC AND CALCIUM DEFICIENCY AMONG CHILDREN AGED 6-59 MONTHS

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EXECUTIVE SUMMARY

Micronutrient deficiencies are considered important public health problems in Sri Lanka and several national level interventions have been implemented to prevent such problems. However, recent data on important micronutrient deficiencies are limited except for iodine deficiency; hence the need for a comprehensive assessment of the micronutrient status of vulnerable groups is a priority.

A study on micronutrient deficiencies was undertaken to determine the prevalence of anaemia, iron deficiency, zinc and calcium deficiency among preschool children aged 6-59 months and to determine the district level prevalence of these deficiency states. Results of some components of the study have been presented in the report on National Nutrition and Micronutrient Survey 2012.

This report focuses on the findings of the study to determine the iron status, levels of zinc and calcium among preschool children aged 6-59 months at national and district levels and to identify selected factors influencing the levels of these micronutrients.

The study was carried out in a sample of 7306 households representing the 25 districts of Sri Lanka, identified using a multi-stage cluster sampling procedure. Only households with a child aged between 6-59 months were included in the sample. In this component of the study, the study population included preschool children aged 6 – 59 months resident in the selected households. The field level data collection was carried out using a pre tested interviewer administered questionnaire, taking relevant anthropometric measurements and collecting venous blood samples for the biochemical assessments. All precautions were taken to ensure quality of data and the data were weighted using district weights to provide national estimates.

Of the total sample of children, 15.1% were anaemic. Of all anaemic children, 32.7% had haemoglobinopathies, 4.3% had evidence of acute infections (mainly those of the respiratory and gastrointestinal tract) and 52.3% were iron deficient. It was also shown that these conditions were not mutually exclusive.

The overall prevalence of iron deficiency and iron deficiency anaemia were 33.6 % and 7.3 % respectively. Highest prevalence of IDA was present during the second year of life and was more common among male children. Childhood anemia was not found to be related to maternal educational, status, father's occupation and economic status. Overweight children showed the highest prevalence of ID.

There was a wide variation in the prevalence of ID and IDA. Prevalence of ID was highest in Matale (45.4%) and lowest in Mullaitivu (12.9%). IDA was highest in Kilinochchci (12.9%) and lowest in Batticaloa (3.0%).

For the total sample of children, the prevalence of zinc deficiency was 5.1%. The prevalence was not associated with maternal educational status, father's occupation nor with indicators of economic status. Inter district differences in the prevalence of zinc deficiency showed a wide variation with approximately 15% prevalence in the districts of Vavuniya and Mullaitivu and values of approximately 2% reported from Colombo, Mannar, Matara, Hambantota and Ratnapura. Districts of Kurunegala, Ampara were less than one with zero prevalence reported from Puttalam. Prevalence of zinc deficiency was lowest (2.7%) in the overweight group and higher among the wasted children (6.3%) and stunted children (4.9%) .

Several other factors that could have influenced the prevalence of anaemia, iron deficiency and zinc deficiency were investigated. Findings indicate that the children who reported to have had diarrohea within the preceding two weeks reported a higher prevalence of anaemia. The prevalence of anaemia among those who consumed food items belonging to the food groups, grains/roots/tubers, dairy products and meat/fish/organ meats, were less likely to be anaemic. None of the breast feeding practices were significantly associated with ID or IDA. However, those belonging to the categories 'ever breast fed' and 'currently breast fed', had a higher prevalence of anaemia. Children who did not receive vitamin A mega dose at the higher age groups showed a higher prevalence of anaemia. Children for whom micronutrient supplements and deworming facilities were not available also showed a higher prevalence of anaemia. Type of supply of drinking water nor the availability of sanitary means of excreta disposal had an influence any of the deficiency states.

The findings of this study indicate that factors other than iron deficiency are causes of anaemia in this age group, especially haemoglobinopathies. In view of the ongoing preventive programmes focusing mainly on iron supplementation, it is necessary to review these programmes, which need to be supported by in-depth research on the causes of anaemia. The assessment of association between food intake and anaemia has been studied using broad categories, both in terms of food groups as well as the pattern of intake. More in depth studies are necessary to identify practices related to food intake that are beneficial. Inter district variations in iron deficiency, and other contributory factors to anaemia such as prevalence of haemoglobinopathies have to be taken into consideration in developing appropriate interventions at the districts level.

In general, the zinc levels in this population group could be considered as satisfactory indicating that current dietary practices have been satisfactory as far as zinc status in this population group is concerned.

The study also shows the relatively high prevalence (47.6%) of calcium deficiency with a wide inter district variation ranging from 23.1% in Badulla district and 70.3% in Matale district . Lowest prevalence was seen in the 6 – 11 months old children and the prevalence was not associated with any of the economic indicators nor with the maternal educational level nor the occupational status of the father. This is an area which needs further attention.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Available data on nutritional status at the community level in Sri Lanka indicate that micronutrient deficiencies (the 'hidden hunger') may be a more serious problem to consider than energy deficiency.

A survey conducted by Medical Research Institute (MRI) in 2009 reported that acute under nutrition was present in 11.7% of children under 5 years and that this rate has not shown much change since 1973 and the prevalence of chronic under nutrition was present in 19.2% of the children in this age group. Limited data available on the level of iron-deficiency or iron-deficiency anaemia in children and women in the childbearing age in Sri Lanka indicate that anaemia continues to be an important nutritional problem in Sri Lanka. Results of the same study shows that 25.2% of children under five in Sri Lanka were anaemic. Anaemia is associated with impaired physical and cognitive development in children, poor mental and physical performance in adults, increased risks of infectious diseases, and numerous other problems.

Data on vitamin A deficiency are available from two studies, one reported in 1998 and the other in 2006. The earlier study reported that vitamin A deficiency is an important public health problem in Sri Lanka with 36% of children under five showing serum vitamin A concentration of less than 20 micrograms per decilitre. Results of a study carried out in 20 out of the 25 districts in Sri Lanka among children under five years reported in 2006/07 reported that serum retinol levels of less than 20 micrograms per decilitre were seen among 29% of the children included in the study. Vitamin A mega dose supplementation at 6 months intervals is a part of the national child health programme and the effectiveness in reducing the prevalence of vitamin A deficiency needs to be assessed.

1.2 RATIONALE

In Sri Lanka, data on micronutrient deficiencies in recent years are limited to those described above. Taking into consideration that there is a paucity of recent data on the micronutrient status of women and children and the effectiveness of the interventions carried out, the need to make a national level assessment of the micronutrient status among these groups in Sri Lanka was identified.

Such data were to be used in controlling micronutrient deficiencies and as a baseline for monitoring on-going nutrition intervention programmes aimed at such control.

1.3 OBJECTIVES

Objectives of the study on which this report is based were:

i. To determine the iron status, levels of zinc and calcium among preschool children aged 6-59 months at national and district levels.

ii. Identify selected factors influencing the levels of iron, zinc and calcium.

CHAPTER 2

METHODS

A cross-sectional survey design was chosen to collect data to make inferences about a given population at one point in time. This provides a snapshot of the prevalence and attributes of problems in specific target populations.

2.1 SAMPLING

2.1.1 SAMPLE SIZE

Sample size was calculated based on the estimated prevalence rate of zinc deficiency (40%)[1]. The sample is estimated to have a 95% confidence interval and a 5% margin of error. A 10% non-response rate was also considered. The design effect of 1.5 was used to finalize and fix the overall sample size. The sample size calculated was 300 children of 6-59 months from each district, a total of 7,500 children in 25 districts Please mention if all the districts were sampled or only a few. Justify the criteria for sample selection. After considering household composition and field resources available, a sample size of 22,500 households was selected as a sufficient number of households to cover sample size of 7,500 children.

The entire sample of 22,500 households was to include a sample size of 900 from each district. Considering the need of district representative data, equal sample size (300 children) was drawn from each district. After fixing the sample size at district level, further distribution of 30 primary sampling units (PSUs) in each district was made proportionately. The distribution of households and children of the districts is indicated below:

Table 1: Sample size and allocation plan

District	No. of households	No. of children
Each district	900	300
Total for 25 districts	**22,500**	**7,500**

1 Hettiarchchi M, Liyanage C, Zinc status of children

2.1.2 SAMPLING METHOD

Selection of primary sampling units (PSUs): The sampling frame was the list of Grama Niladari (GN) divisions in each district, obtained from the Census and Statistics Department, Sri Lanka. The GN division is the smallest administrative unit in the district, and consists of approximately 1,000 population. There were approximately 14,022 GN divisions spread out within the 25 districts, and a GN division was considered the primary sampling unit (PSU). As the first stage of sampling, in each of the 25 districts, 30 GN divisions to be included were identified using the population proportion to sampling technique, enabling identification of a total of 750 GN divisions to be included as clusters.

2.1.3 SELECTION OF HOUSEHOLDS

As the first step, on a transparency sheet, a grid was prepared giving 1 cm squares. From this grid, thirty 'blocks' were selected randomly and they were numbered from 1- 30. This grid was then superimposed on a map of a GN division and the square corresponding to the number allocated to the GN division was identified on the map. This point was considered as the 'starting point' for identification of households to be included in the survey, for a given GN division (a cluster). Taking this point as the 'centre', a list of 30-35 households were prepared. Thirty five households were numbered from the starting point by the investigators and a number between from 1 to 35 was selected by drawing lots. Investigators visited the selected household as the first household to be visited and if there was a child between 6-59 months, it was included in the survey. A household was defined as a group of people who share a common cooking pot and an eligible household was defined as a household with a child aged between 6-59 months.

As the second step, the investigators continued to walk to the next household which was the one whose front door was closest to the first household. This was repeated until they were able to identify 10 eligible households.

The field level data collection was carried out using a pre tested interviewer administered questionnaire, taking relevant anthropometric measurements and collecting venous blood samples for the biochemical assessments. All precautions were taken to ensure quality of the data. Data collection included birth weight of the child and feeding practices of the young child.

Detailed information on survey teams and their training, field level implementation data collection at household level (administration of questionnaires, anthropometry, data entry and, plans for data analysis) are presented in Part I of this report.

2.1.4 COLLECTION OF BLOOD SAMPLES

During the visit to the household, the field investigators arranged for all children 6-59 months of age to be available for collection of venous blood samples, at a given venue on a specific date after obtaining the written consent of the mother or father or immediate caregiver. Consent for extended storage of the blood samples for future testing of additional micronutrient levels was also obtained. Details of tests used for the assessment of the micronutrient levels and reference ranges are given in Tables 2 and 3[2].

Table 2: Details of analytical methods

Test	Testing methods	Quality assurance
Haemoglobin	Haemoglobin iso-thiocyanate method (HICN)	Samples giving high/ low values were measured in duplicate and internal control samples were run with each batch of samples
Ferritin	Enzyme-Linked Immunosorbent Assay (ELISA) technique Multiscan Ex	
Zinc	Atomic absorption spectrophotometry (AAS) Shimadzu 70600	
Calcium	Atomic absorption spectrophotometry (AAS) Shimadzu 70600	
C-reactive protein	Latex agglutination method	Quality control samples were analysed with each batch of samples
Haremoglobinopathies	High Performance Liquid Chromatography (HPLC)	Internal Quality Control samples of 2 levels were run with each batch of Samples. Monthly participate to international External Quality Assurance prorogramme for Thalassaemia Diagnostic tests.

Medical officers or trained nurses attached to each team collected venous blood samples using disposable syringes and needles. In each district, a temporary field laboratory was set up at a central site such as a local

2 Gorstein J, Sullivan KM, Parvanta I, Begin F. Indicators and Methods for Cross-Sectional Surveys of Vitamin and Mineral Status of Populations. The Micronutrient Initiative (Ottawa) and the Centers for Disease Control and Prevention (Atlanta), May 2007

hospital, school, pharmacy, health centre or other location which has essential facilities for the technologist to immediately centrifuge the samples brought in from the field and aliquot the serum into appropriate appendorff.

In order to obtain adequate amount of serum, at least 5 ml of venous blood was collected in two containers. First container was a metal free red top gel tube with a non-rubber stopper to separate serum for the biochemical assessments. Second container was an EDTA tube with green top to assess haemoglobin (Hb) levels. After collection of blood, the blood tube was placed in a cool box and allowed to clot. All samples were processed within <2 hours of collection.

Blood in the second container EDTA (green top) tube was to be used for the assessment of haemoglobin and haemoglobinopathies. Haemoglobin was assessed on the same day in the field laboratory. If the haemoglobin is <11.0g/dL, remaining EDTA samples were centrifuged and stored at -20° C with serum samples to be send to central laboratory to perform the HPLC testing to detect haemoglobinopathies. Laboratory facilities were not available to test transferrin receptors.

Table 3: Reference values used in the analysis

Test	Reference range
Haemoglobin* (adjusted for altitude)	Severe deficiency (<7 gm//dL) Moderate deficiency (7 - 10.99 gm./dL) Normal (>= 11 gm./dL)
Ferritin**	Low Ferritin (<12 µg/dL) Normal (>=12 µg/dL)
Zinc***	Deficient (<65 µg/dL) - in the morning Deficient (<57 µg/dL) - in the afternoon Non-deficient (>=65 µg/dL) - in the morning Deficient (>=57 µg/dL) - in the afternoon
Calcium**** The calculated calcium levels were not adjusted for serum albumin.	Hypocalcaemia (<8.4 mg/dL) Normocalcaemia (8.4 - 10.2 mg/dL) Hypercalcaemia (>10.2 mg/dL)
C-reactive protein****	Acute phase of infections (>= 6.0) No acute phase of infections (< 6.0)

Sources:

* Gorstein J, Sullivan KM, Parvanta I, Begin F. Indicators and Methods for Cross-Sectional Surveys of Vitamin and Mineral Status of Populations. The Micronutrient Initiative (Ottawa) and the Centers for Disease Control and Prevention (Atlanta), May 2007.

** Iron deficiency anaemia: assessment, prevention and control. A guide for programme managers. Third Edition. Geneva, World Health Organization, 2007.

*** ZiNCG. Assessment of the risk of zinc deficiency in populations and options for its control. Food Nutr Bull, 2004;25:S94-S203

**** National Nutrition survey 2011, Government of Pakistan

At the end of each day, a drop of whole blood was used to test for C-reactive protein and remaining whole blood was centrifuged and the serum was aliqoted into at least four cryovials by pipetting, using a disposable pipette. Each aliquot of approximately 500µl was for the analysis of ferritin, zinc and, calcium. Sample ID tag was applied on each of the cryovials. The serum was stored in a freezer (-20°C or colder). Aliquoted samples of the same cluster were kept in boxes with a label of the same cluster on the box. In this way, the laboratory could easily identify, which particular clusters are to be tested in a batch and thus minimizing the possibilities of increasing freeze/thaw cycles. A sample record/handover form was filled up indicating ID number, PSU number, and type of analysis to be done. The samples were carried to the laboratory in the Department of Nutrition, Medical Research Institute (MRI) in Colombo in dry cool boxes. Samples were received at the laboratory and stored in a -70°C freezer and analysed to estimate the blood parameters.

When the blood samples were inadequate (difficulties in collection, clotting of samples) testing were prioritised as follows: all available samples were subjected to estimation of haemoglobin and serum ferritin, next in the order of priority was the estimation of zinc levels followed by the levels of calcium. Due to this reason, the numbers of the blood samples assessed for the different micronutrients varied.

In each cluster, the research team visited all selected households and conducted interviews in eligible households, carried out anthropometric measurements and collection of the biological samples at a defined location for each cluster. All interviews, measurements and collection of biological specimens within a cluster were completed before moving to another cluster.

2.2 MANAGEMENT OF DATA

The filled-in questionnaires were first desk-edited at the field sites for completeness and checked for major errors by the Nutrition Assistant. Once this was complete, the questionnaires were sent to Department of Nutrition, MRI in Colombo, where 3 development assistants received the survey questionnaires, maintained log registers and checked for completeness. Where there were inconsistencies or missing responses, they flagged the errors/omissions and consulted the team leaders for clarification. Before data entry, all questionnaires were coded for open-ended responses. Data was entered by the 3 data entry operators supervised by the Principle Investigator. A unique ID number was used for each child. Data was entered using the EPINFO-6 software package. Range and consistency checks as well as skip patterns were built in the data entry program to minimize entry of erroneous data. Analysis of data was undertaken using Statistical Package for Social Sciences (SPSS) version 15.

2.3 DATA ANALYSIS

2.3.1 DESCRIPTIVE STATISTICS

Distribution of categorical variables was computed and frequencies and percentages were reported along with the means and standard deviations of quantitative variables. Disease Prevalence was provided with 95% of confidence intervals (CI).

2.3.2 UNIVARIATE ANALYSIS

In univariate analysis, the association of nutritional status and micronutrient deficiencies with selected dependent variables was assessed. Variables were categorized into biologically and socially meaningful categories, wherever required. Data were weighted using district weights to provide national representation.

2.4 ETHICAL ISSUES

Approval was obtained from the ethical review committee of the Medical Research Institute (MRI), Ministry of Health.

The investigators obtained informed consent from all representatives of the communities involved in this study. Prior to implementation of the field work relevant to the study, all aspects of the study were discussed with the Provincial and District Director of Health Services and their approval obtained.

Informed consent (written) was obtained from parents or principal care giver of the child who participated in the study. The consent form explicitly outlines the aims and objectives of the study along with ensuring strict confidentiality of the data obtained from participants.

Survey duration

Data collection began in August 2012 and was completed in December 2012

CHAPTER 3

RESULTS

Part I of this study published in “National Nutrition and Micronutrient Survey 2012” (MRI and UNICEF 2012) presented the following in detail:

- Description of the study sample
- Nutritional status of children aged between 6 – 59 months and influencing factors.
- Prevalence of anaemia, low birth weight and their influencing factors,
- Nutritional status of primary school children, non-pregnant women in the age group 18 – 59 years and men aged between 6 – 59 months.

This report, part II of the micro nutrient survey focuses on presenting information on the status of iron, zinc and calcium among children aged between 6 -59 months.

Table 4: Distribution of children enrolled and numbers tested for different assays, by district

Province	District	No. of targeted children	Number of children enrolled	No. of children tested for :			
				Hb	Ferritin	Zinc	Calcium
Western	Colombo	300	288	275	246	242	112
	Gampaha	300	286	272	209	135	129
	Kalutara	300	278	273	220	210	141
Central	Kandy	300	287	278	263	240	108
	Matale	300	288	279	262	168	64
	Nuwara eliya	300	286	271	221	221	97
Southern	Galle	300	272	259	185	213	98
	Matara	300	294	279	231	78	106
	Hambantota	300	295	290	195	146	136
Northern	Jafna	300	298	291	242	185	123
	Mannar	300	298	279	261	227	133
	Vavuniya	300	292	281	222	213	143

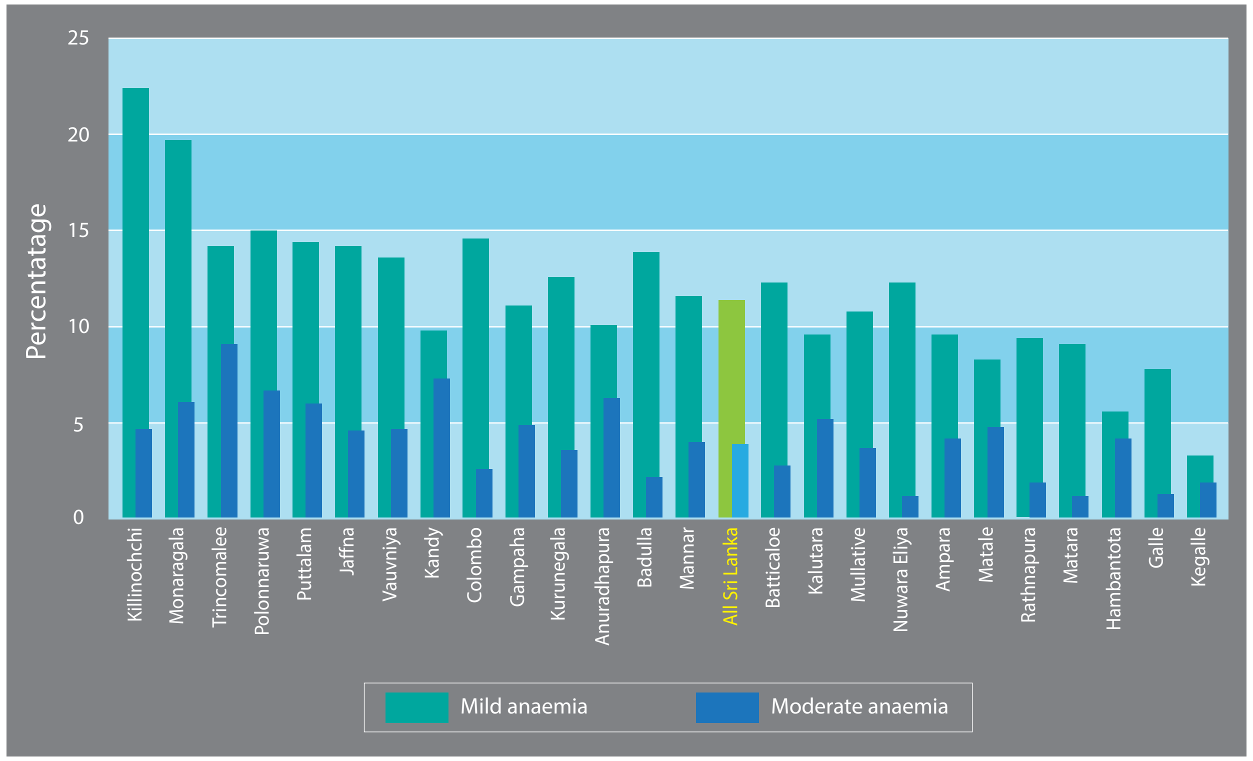
Province	District	No. of targeted children	Number of children enrolled	No. of children tested for :			
				Hb	Ferritin	Zinc	Calcium
	Mullaitivu	300	295	280	262	258	132
	Kilinochchi	300	298	283	256	281	182
Eastern	Batticaloa	300	297	295	197	160	187
	Ampara	300	300	295	140	198	154
	Trincomalee	300	293	290	264	98	152
North western	Kurunegala	300	296	288	266	120	186
	Puttlam	300	292	286	273	128	86
North central	Anuradha-pura	300	297	291	257	147	96
	Polonnaruwa	300	297	288	237	117	138
Uva	Badulla	300	292	289	252	188	130
	Moneragala	300	295	281	182	159	103
Sabaragamuwa	Rathnapura	300	297	280	190	136	123
	Kegalle	300	295	283	208	209	78
All Sri Lanka		7,500	7,306	7,050	5,997	4,477	3,127
% coverage			97.4	94.0	80.0	59.7	41.7

Table 4 shows the number of targeted children and total number of children enrolled in the study with the distribution pattern of testing of each biochemical test in each district.

3.1 PREVALENCE OF ANAEMIA IN THE STUDY POPULATION

As shown in Figure 1, of all children included in the study, 15.1% were anaemic, of whom 11.3% belonged to the 'mild' category with 3.8 % to the moderate category. There were no children with severe anaemia in the study population.

Figure 1: Prevalence of mild and moderate anaemia in each district



Prevalence of mild anaemia varied from a low value of 3.2 % in Kegalle to the value of 22.3% in Kilinochchi. The prevalence of moderate anaemia was lowest in Matara and Nuwara Eliya (1.1%) and highest in (9.0%) in Trincomalee.

3.2 IRON DEFICIENCY

Serum ferritin was analysed in 5,997 children as shown in Table 5. After excluding the children with acute infections (CRP≥6.0), 5766 children were included in the final analysis for iron deficiency. Criteria used to identify iron deficiency and iron deficiency anaemia were as follows:

Iron Deficiency	Low Ferritin (<12 µg/dL) with normal CRP (<6.0)
Iron Deficiency Anaemia	Low Hb (<11g/dL) with Low Ferritin (<12 µg/dL) and normal CRP (<6.0)

3.2.1 PREVALENCE OF IRON DEFICIENCY AND IRON DEFICIENCY ANAEMIA BY SELECTED DEPENDENT VARIABLES

As shown in table 5, the overall prevalence of iron deficiency and iron deficiency anaemia were 33.6 % and 7.4 % respectively. Thus, 26.2% of the iron deficient children were not anaemic.

Table 5: Prevalence of iron deficiency (ID) and iron deficiency (IDA) among children, by background characteristics

Background characteristic	Total No of Children investigated	% of Children with ID [CI]	P-Value	% of Children with IDA [CI]	P-Value
Age of the child in months					
6-11	434	45.6 [39.7,51.6]	0.00	19.7 [15.4,25.0]	0.00
12-23	1285	47.2 [43.8,50.6]		13.6 [11.5,16.3]	
24-35	1376	33.6 [30.6,36.7]		5.9 [4.5,7.7]	
36-47	1284	28.3 [25.3,31.5]		4.5 [3.3,6.3]	
48-59	1387	22.0 [19.4,24.8]		1.5 [0.9,2.6]	
Sex of the child					
Male	2902	36.1 [33.9,38.3]	0.00	8.5 [7.3,9.9]	0.01
Female	2864	31.0 [28.9,33.1]		6.2 [5.2,7.4]	
Mother's education					
No schooling	28	23.5 [11.6,41.8]	0.01	1.6 [0.2,10.9]	0.36
Primary	204	32.4 [25.5,40.1]		11.4 [7.3,17.3]	
Secondary	1128	29.5 [26.5,32.7]		7.3 [5.8,9.3]	
Passed O' Level	3858	35.4 [33.5,37.4]		7.3 [6.3,8.4]	
Higher education	284	32.0 [25.5,39.3]		7.5 [4.3,12.9]	
No information	264	27.6 [21.7,34.3]		5.9 [3.2,10.4]	
Father's employment					
Managerial	84	35.9 [22.9,51.4]	0.71	4.9 [1.0,20.2]	0.71
Professional	139	36.3 [26.8,46.9]		7.8 [3.5,17.2]	
Clerical	149	26.7 [17.9,37.8]		5.4 [2.0,13.4]	
Sales and related	951	33.1 [25.6,42.2]		7.4 [3.0,13.3]	
Security forces	646	34.7 [27.4,37.1]		8.4 [6.1,11.3]	
Skilled worker	1859	35.0 [30.0,38.1]		8.1 [3.5,17.2]	
Unskilled worker	452	32.0 [27.2,37.3]		5.1 [2.6,7.7]	
Other	1486	32.3 [29.1,36.8]		7.0 [5.1,9.4]	
No of members in household					
≤ 3	1380	37.3 [34.2,40.5]	0.02	8.8 [7.1,10.9]	0.12
4-6	4029	32.5 [30.7,34.4]		6.8 [5.9,7.8]	
≥7	357	30.6 [25.0,36.9]		8.2 [5.3,12.5]	
Sri Lanka	**5766**	**33.6 [32.0,35.1]**		**7.4 [6.5,8.3]**	

Highest prevalence of iron deficiency was seen among the 12 – 23 months old children, with a significant trend of decreasing prevalence with increasing age. Prevalence of iron deficiency anaemia also shows a clear declining prevalence with increasing age which was statistically significant. Males showed a higher prevalence compared to the females.

The number of mothers belonging to different educational categories varied widely with a limited number in the 'no schooling' group. Data on iron deficiency and iron deficiency anaemia in relation to the education level of the mothers shows that the highest prevalence levels were seen among the children of mothers who belonged to the category 'passed OL'. Even though there is no clear pattern seen in the prevalence of iron deficiency with increasing or decreasing levels of education, the differences observed were statistically significant.

There is not much variation in the prevalence of iron deficiency among the children of fathers belonging to different occupational groups, except for the lower values seen among the children of those employed in clerical grades. Similarly, there is no consistent pattern seen in the prevalence of iron deficiency anaemia among the children of fathers of different occupational groups.

The prevalence of iron deficiency decreases significantly with increasing number of members in the household. However, no such clear trend is observed in the prevalence of iron deficiency anaemia.

Table 6: Prevalence of iron deficiency and iron deficiency anaemia among children, by economic indicators

	Total No of Children investigated	% of Children with iron deficiency	P-Value	% of Children with iron deficiency anemia	P-Value
Monthly household income					
<9000	517	28.8[25.0,33.0]	0.08	8.2[6.1,11.0]	0.91
9000-13999	1012	31.4[28.3,34.8]		6.6[5.1,8.5]	
14000-19999	1244	33.8[30.6,37.2]		7.1[5.5,9.1]	
20000-31,999	2198	35.6[33.0,38.3]		7.4[6.0,9.0]	
≥ 32,000	648	31.8[27.2,36.8]		8.1[5.6,11.7]	
No information	146	39.0[29.9,48.9]		8.1[3.9,16.1]	
Wealth index quintile					
Lowest	1,198	32.4[29.6,35.3]	0.33	8.6[7.0,10.5]	0.26
Second	1,125	33.3[30.0,36.8]		7.7[5.9,10.0]	
Middle	1,181	36.8[33.4,40.3]		7.9[6.1,10.1]	
Fourth	1,171	32.4[29.0,36.0]		5.7[4.2,7.7]	
Highest	1,091	32.8[29.2,36.7]		6.9[5.1,9.2]	
Sri Lanka	**5766**	**33.6[29.2,36.7]**		**7.4[6.5,8.3]**	

As shown in table 6, there was no clear pattern in the prevalence of anaemia with different household income levels and wealth quintiles, even though the highest percentage of iron deficiency was seen in the lowest income group and the lowest wealth quintile.

3.2.2 IRON DEFICIENCY AND IRON DEFICIENCY ANAEMIA BY NUTRITIONAL STATUS

With the exception of the children who were overweight who showed the highest prevalence of iron deficiency, there were no major differences in the prevalence seen between the children belonging to different nutritional status categories (Table 7). Prevalence of iron deficiency anaemia was also highest in the overweight group even though there was no major differences seen between the other nutritional categories.

Table 7: Prevalence of iron deficiency and iron deficiency anaemia among children by the nutritional status of the children

Nutritional status	No. of children*	ID		IDA	
		% with ID	% without ID	% with ID	% without ID
Wasting	1128	32.3 [29.0,35.8]	67.7 [64.2,71.0]	6.0 [4.5,8.0]	94.0[92.0,95.5]
Stunting	760	32.1 [28.3,36.1]	67.9 [63.9,71.7]	7.2 [5.3,9.8]	92.8[90.2,94.7]
Underweight	1354	32.7 [29.7,35.8]	67.3 [64.2,70.3]	7.0 [5.5,8.8]	93.0[91.2,94.5]
Overweight	124	41.1 [30.4,52.6]	58.9 [47.4,69.6]	10.7 [5.4,20.2]	89.3[79.8,94.6]
Normal	3,839	33.8 [31.9,35.7]	66.2 [64.3,68.1]	7.7 [6.7,8.9]	92.3[91.1,93.3]

*There were some children who belonged to more than one nutritional status category

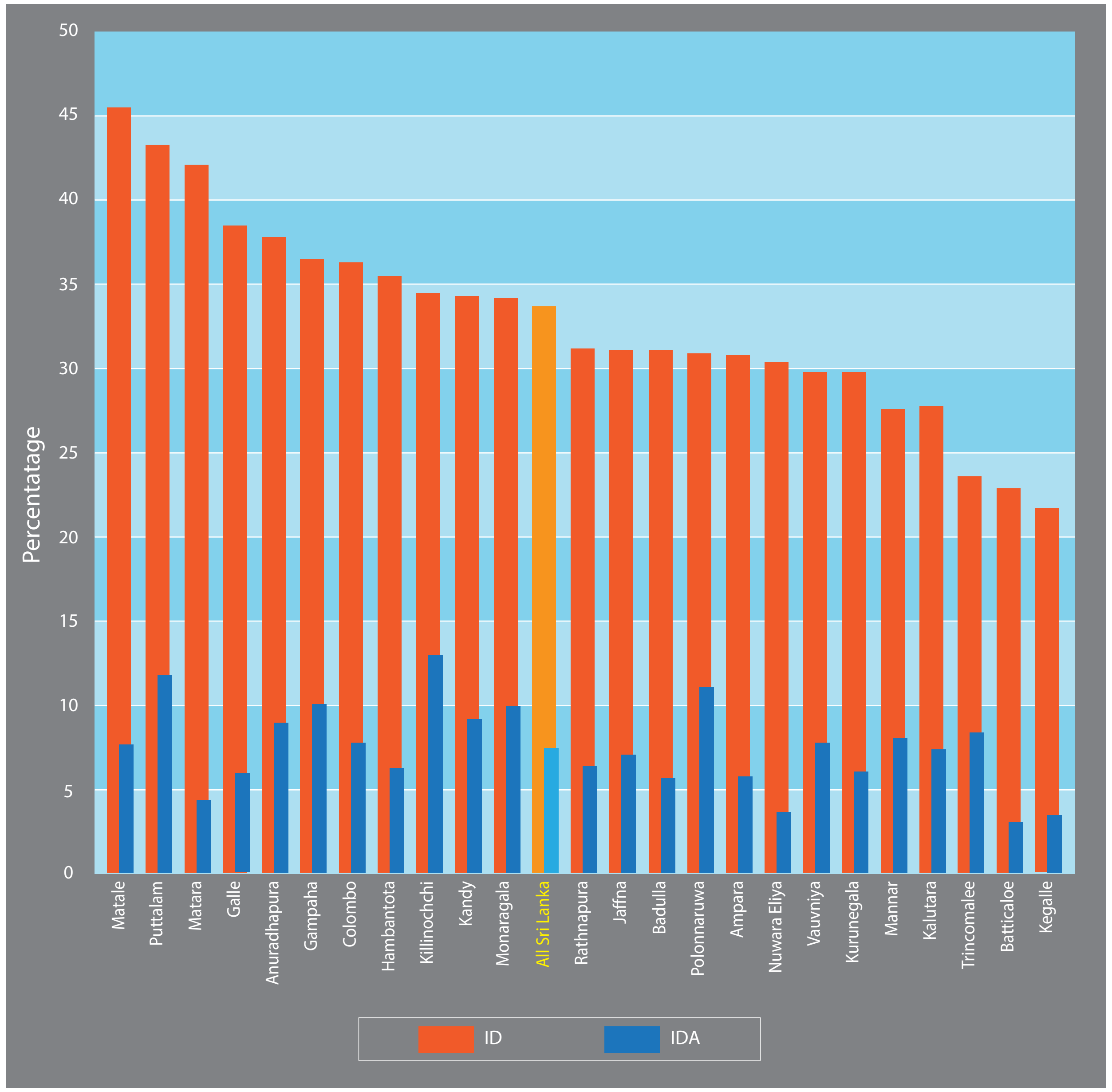
3.2.3 PREVALENCE OF IRON DEFICIENCY AND IRON DEFICIENCY ANAEMIA BY DISTRICTS

As shown in Figure 2, the prevalence of iron deficiency varied widely between districts with the lowest prevalence (19.1%) reported from Mullaitivu and the highest from Matale (45.4%). Further analysis showed that there was only one district (Mullaitivu) that had a prevalence less than 20% with another 2 districts showing prevalence between 20% and 25%. Nine districts reported prevalence between 30% and 35%, in addition to which there were 5 districts with prevalence between 35% and 40% and 3 districts, with prevalence higher than 40%.

Prevalence of iron deficiency anaemia also showed variation between districts with a lowest value of 3% in Batticaloa and highest of 12.9% in Kilinochchci. Of the districts, 5 had prevalence less than 5% with a majority, 16 having prevalence between 5% and 10% and 4 districts, with prevalence higher than 10%.

Detailed information of the prevalence of ID and IDA by districts are given in **annex 1.**

Figure 2: Prevalence of ID and IDA in children by district



3.2.4 CAUSES OF ANAEMIA

As there could be other factors that could lead to anaemia, all anaemic children were subjected to further investigations for the presence of hamoglobinopathies (β Thalassaemia and Hb variant) and for evidence of acute infections as indicated by abnormal CRP values as shown in Figure 3.

This analysis showed that, of all anaemic children, 12.8% had haemoglobinopathies, 4.3% had acute infections and 52.3% were iron deficient. It was not possible to identify the causes of anaemia for the balance of the children because the other causes such as folic acid, vitamin B12 deficiencies were not assessed.

As it was possible that these conditions could co-exist in a given child, further analysis was undertaken. Out of the children with haemoglobinopathies, 84.8% were beta thalassaemic carriers, 12.1% were haemoglobin E carriers, 1.5% were haemoglobin S carriers, 0.8% were combine haemoglobin S/E and 0.8% were haemoglobin D carriers. Of the children who had haemoglobnopathis, 13.2% had evidence of acute infections and 7.7% were iron deficient. Thus it is seen that these causes were not mutually exclusive. It is interesting to note that 8% of Haemoglobinopathy carriers had iron deficiency.

Inter district variation was seen in the percentage of anaemic children who had haemoglobinopathies. The number of anaemic children who were reported as positive for haemoglobinopathies, ranged from zero in Kegalle, Galle and Matara district to 21.7% in Batticaloe district.

In five districts, none of the children studied had acute infections and with the exception of three districts (Jaffna, Kilinochchci and Puttalam), others reported that more than 10% of the anaemic children studied had acute infections.

Among all anaemic children , 52.3% of children were iron deficient. These values also ranged widely from 27.3% in Batticaloa and 28.1% in Mullaitivu to 65.6 % and 64% in Gampaha and Kalutara respectively.

Figure 3: Causes of anaemia by district

3.3 ZINC DEFICIENCY

Serum zinc levels were assessed in 4,477 children as shown in Table 8. After excluding the children with acute infections (CRP≥6.0), 4,463 children were included in the final analysis for zinc deficiency. Criteria used to identify zinc deficiency were as follows:

Zinc Deficiency	Low serum zinc (<65 µg/dL in the morning and <57 µg/dL in the afternoon) with normal CRP (<6.0)

3.3.1 PREVALENCE OF ZINC DEFICIENCY BY SELECTED BACKGROUND CHARACTERISTICS.

As shown in Table 8, among the total sample of children included in the survey, 5.1% of were Zinc deficient. There is a consistent decline in the prevalence seen with increasing age. Male children had higher prevalence compared to females. However, both these observations were not statistically significant.

As with iron deficiency and iron deficiency anaemia, there is no clear pattern seen between the prevalence of Zn deficiency and maternal educational level even though a high prevalence was seen among the children of mothers educated only up to the primary level. However, this observation needs cautious interpretation as the numbers in some of the categories are limited, even though the differences are shown to be statistically significant.

Table 8: Prevalence of zinc deficiency among children by background characteristics

Background characteristic	% of Children with zinc deficiency	CI	Total No of Children investigated	P-Value
Age of the child				
6-11	6.2	[3.6,10.4]	331	0.87
12-23	5.5	[4.0,7.5]	973	
24-35	5.2	[3.8,7.1]	1027	
36-47	4.8	[3.5,6.5]	1034	
48-59	4.7	[3.4,6.3]	1099	
Sex of the child				
Female	5.5	[4.5,6.8]	2157	0.34
Male	4.8	[3.8,5.9]	2307	

Background characteristic	% of Children with zinc deficiency	CI	Total No of Children investigated	P-Value
Mother's education				
No schooling	4.9	[0.7,28.2]	20	0.01
Primary	8.4	[4.8,14.3]	165	
Secondary	3.6	[2.6,5.0]	881	
Passed O' Level	5.1	[4.2,6.2]	2953	
Higher education	4.3	[2.1,8.9]	233	
No information	9.6	[6.2,14.7]	212	
Father's employment				
Managerial	2.0	[0.7,28.2]	54	0.01
Professional	3.5	[4.8,14.3]	121	
Clerical	5.9	[2.6,5.0]	113	
Sales and related	6.1	[4.2,6.2]	758	
Security forces	4.8	[2.1,8.9]	483	
Skilled worker	4.3	[6.2,14.7]	1464	
Unskilled worker	7.2	[0.7,28.2]	343	
Other	5.2	[4.8,14.3]	1127	
No of members in household				
≤ 3	4.9	[3.5,6.6]	1107	0.52
4-6	5.3	[4.5,6.4]	3070	
≥7	3.7	[2.1,6.7]	287	
Sri Lanka	**5.1**	**[4.4,5.9]**	**4463**	

Comparison of prevalence of zinc deficiency among children on fathers of different occupational groups show that the highest prevalence was seen among children of unskilled workers and the lower prevalence among children of fathers employed in occupations categorized as 'managerial, and 'professional'. These differences were found to be statistically significant.

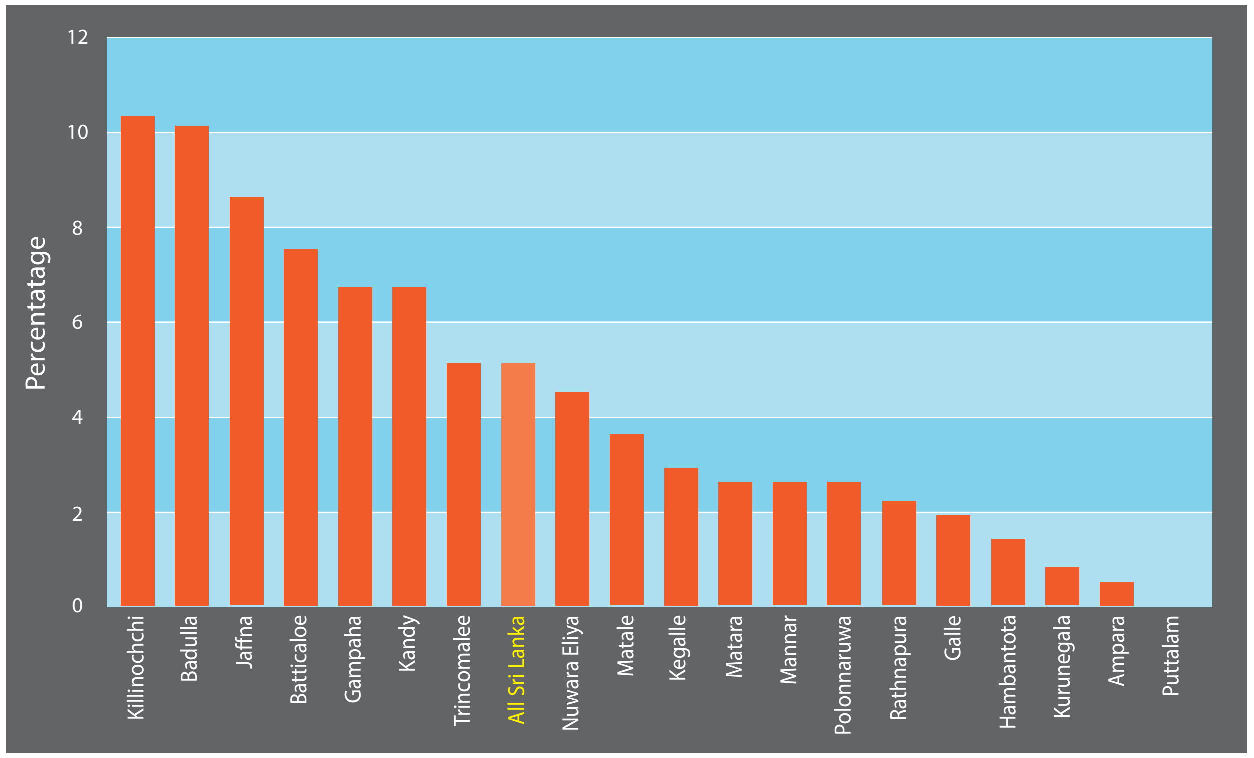
There is no consistent pattern in the prevalence of Zn deficiency seen with increase in the monthly household income. However, there is significant decline in the prevalence seen as wealth quintiles increase with the exception of the highest quintile which shows a marginal increase (Table 9).

Table 9: Prevalence of zinc deficiency among children, by Economic indicators

Background characteristic	% of Children with zinc deficiency	CI	Total No of Children investigated	P-Value
Monthly household income				
<9000	6.4	[4.5,9.1]	389	
9000-13999	6.4	[4.7,8.6]	751	
14000-19999	4.9	[3.6,6.6]	977	0.28
20000-31,999	4.1	[3.1,5.5]	1735	
> 32,000	6.1	[3.9,9.6]	503	
No information	4.5	[1.5,12.7]	109	
Wealth index quintile				
Lowest	7.2	[4.8,7.7]	493	0.01
Second	6.2	[4.9,9.1]	824	
Middle	5.2	[2.5,5.7]	885	
Fourth	3.5	[2.1,4.9]	1078	
Highest	4.9	[4.1,8.4]	1184	
Sri Lanka	**5.1**		**4463**	

Inter district variations in the prevalence of zinc deficiency is shown in Figure 4. High values of approximately 15% were reported from Vavuniya and Mullaitivu with low values of approximately 2% reported from Colombo, Mannar , Matara, Hambantota and Ratnapura. Districts of Kurunegala, Ampara were less than one with zero prevalence reported from Puttalam.

Figure 4: Prevalence of zinc deficiency among children, by district



3.3.2 ZINC STATUS OF CHILDREN BY NUTRITIONAL STATUS

Table 10: Prevalence of zinc deficiency among children, by indicators on nutritional status

	No. of children	% with zinc deficiency	CI	P-Value
Nutritional status*				
Wasting	896	6.3	[4.6,8.5]	0.13
Stunting	563	4.9	[3.3,7.2]	0.80
Underweight	1063	5.9	[4.4,7.8]	0.26
Overweight	103	2.7	[0.8,9.0]	0.29
Normal	2,952	5.0	[4.2,6.0]	0.67
Anaemia				
Yes	636	6.7	[4.7,9.6]	0.09
No	3,746	4.8	[4.1,5.7]	
Iron deficiency				
Yes	1,240	5.2	[3.8,7.0]	0.72
No	2,364	5.5	[4.6,6.7]	

* There were some children who belonged to more than one nutritional status category, hence the total number of children exceeds those investigated for zinc deficiency

Table 10 presents data on the prevalence of Zn deficiency is relation to the nutritional status of the children. Prevalence was seen to be lowest in the overweight group. It was also seen that the prevalence in the stunted group was lower than those in the wasted and underweight groups. Nutritionally normal children reported a prevalence nearly that of stunted children. A higher prevalence was seen among the children who were anaemic and the prevalence was marginally higher among those children who were not iron deficient.

3.4 CALCIUM DEFICIENCY

Assessment of calcium status was made in 3127 children and 3071 children were included in the analysis. Results were not adjusted for serum albumin levels. A child whose calcium levels was less than 8.4 mg/dl was considered as calcium deficient.

Table 11: Prevalence of calcium deficiency among children, by background characteristics

Background characteristic	% of Children with Calcium deficiency	CI	Total No of Children investigated	P-Value
Age				
6-11	38.0	[30.0,46.6]	201	0.01
12-23	44.1	[39.5,48.9]	656	
24-35	51.1	[46.6,55.5]	714	
36-47	52.0	[47.4,56.5]	720	
48-59	45.9	[41.6,50.3]	780	
Sex				
Female	47.3	[44.2,50.4]	1,471	0.78
Male	47.9	[44.9,51.0]	1,600	
Mother's education				
No schooling	32.0	[12.0,62.0]	20	0.01
Primary	49.2	[39.1,59.3]	106	
Secondary	55.9	[51.1,60.5]	594	
Passed O' Level	45.7	[43.0,48.5]	2,055	
Higher education	46.8	[36.9,57.0]	146	
No information	42.7	[34.3,51.6]	151	
Father's employment				
Managerial	35.8	[19.0,57.1]	42	0.69
Professional	47.9	[35.4,60.7]	96	
Clerical	43.2	[29.7,57.7]	87	
Sales and related	50.1	[44.4,55.8]	478	
Security forces	45.1	[38.9,51.4]	355	
Skilled worker	46.1	[42.0,50.2]	943	
Unskilled worker	50.2	[42.7,57.7]	235	
Other	49.4	[45.5,53.2]	835	
No. of members in household				
≤ 3	47.0	[42.7,51.4]	767	P value
4-6	48.3	[45.7,51.0]	2,114	
>7	42.4	[34.3,50.9]	190	
Sri Lanka	**47.6**	**[45.4,49.8]**	**3,071**	

As shown in Table 11, among the total sample of children included in the survey , 47.6% of were calcium deficient. The lowest prevalence was seen in the 6 – 11 month age group. The differences seen in the different age groups were statistically significant even though there is no clear pattern. There is no difference in the prevalence between male and female children.

Similarly, there is no clear pattern seen between the prevalence of calcium deficiency and maternal educational level even though a high prevalence was seen among the children of mothers educated only up to the secondary level. However, this observation needs cautious interpretation as the there is a wide variation in the numbers of mothers belonging to different educational levels, even though the differences are shown to be statistically significant.

Comparison of prevalence of calcium deficiency among children of fathers of different occupational groups show that the highest prevalence was seen among children of unskilled workers and sales workers and the lowest prevalence among children of fathers employed in occupations categorized as 'managerial'. However, the decline in the prevalence of calcium deficiency does not show a clear pattern in relation to the number of household members.

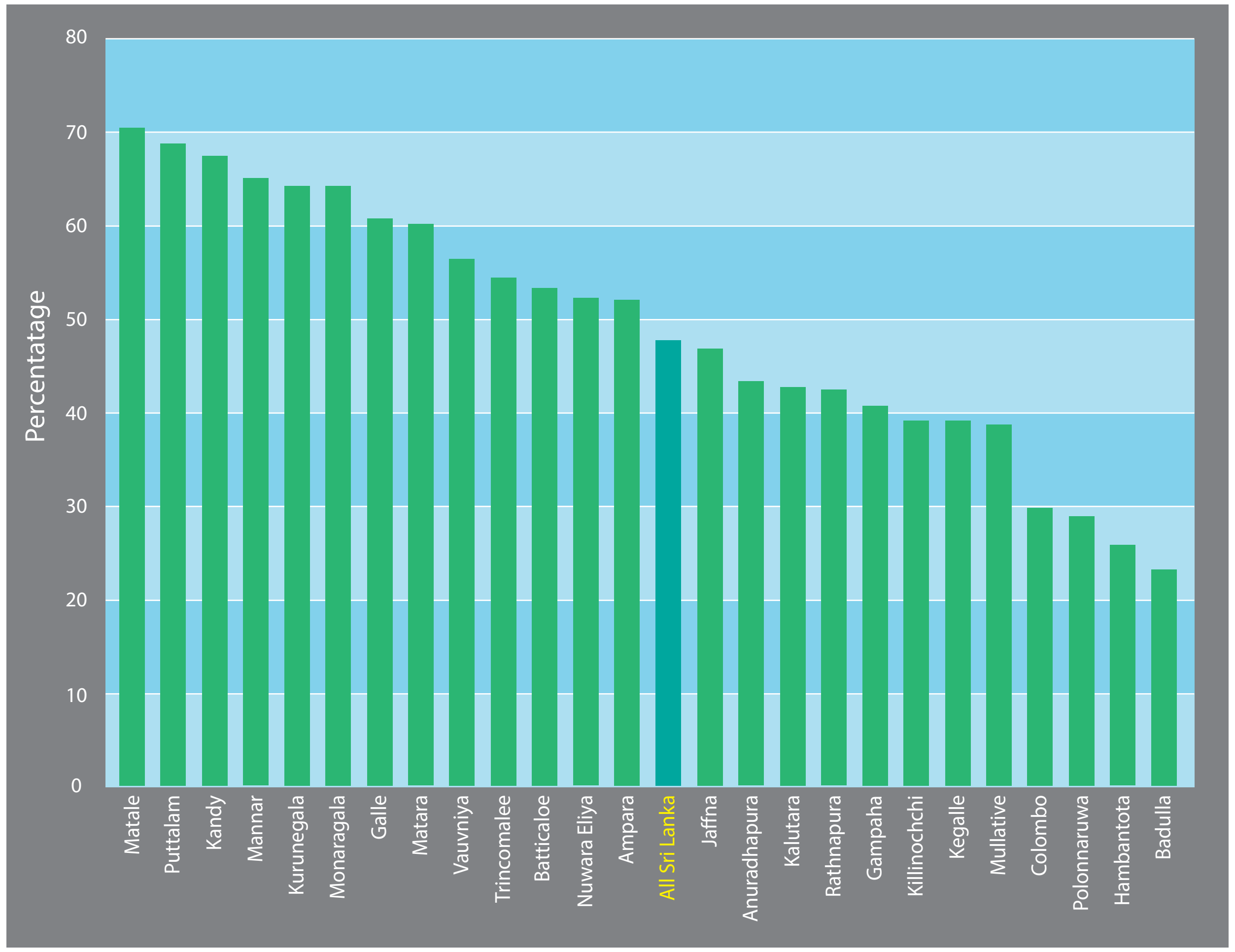
There was no consistent pattern in the prevalence of calcium deficiency seen with increase in the monthly household income. The middle and the highest wealth quintiles showed lower prevalence rates, even though there is no clear trend. However, the differences were statistically significant (Table 12).

Table 12: Prevalence of calcium deficiency among children, by economic indicators

	% of Children with Calcium deficiency	CI	Total No of Children investigated	P-Value
Monthly household income				
<9000	48.8	[42.8,54.8]	297	0.69
9000-13999	49.1	[44.1,54.0]	518	
14000-19999	48.9	[44.3,53.6]	651	
20000-31,999	47.0	[43.3,50.6]	1,203	
> 32,000	46.5	[39.4,53.7]	325	
No information	38.0	[26.6,51.0]	78	
Wealth index quintile				
Lowest	50.7	[46.6,54.8]	617	0.01
Second	51.0	[46.2,55.8]	624	
Middle	44.2	[39.4,49.1]	635	
Fourth	50.5	[45.4,55.6]	615	
Highest	41.4	[36.2,46.9]	580	
Sri Lanka	**47.6**	**[45.4,49.8]**	**3,071**	

Prevalence of calcium deficiency showed a wide variation between districts, ranging from 23.1 % in Badulla to 70.3% in Matale district. Four districts showed a prevalence less than 30% with 5 districts showing a prevalence between 30% and 49%. And 5 districts, more than 60%. Distribution of prevalence rates by district is given in Figure 5.

Figure 5: Prevalence of calcium deficiency among children, by district



Data on prevalence of calcium deficiency by nutritional status of the children are given in table 13.Lowest prevalence was seen in the overweight category with the prevalence among stunted and underweight groups being approximately 50%.

Table 13: Prevalence of calcium deficiency among children by nutritional status

Nutritional status	No. of children	% calcium deficient
Wasting	610	46.9 [42.2,51.7]
Stunting	391	51.0 [45.2,56.8]
Underweight	712	50.3 [45.9,54.6]
Overweight	74	42.4 [29.6,56.4]
Normal	2,035	47.7 [45.0,50.5]

3.5 OTHER FACTORS INFLUENCING ANAEMIA, IRON DEFICIENCY AND ZINC DEFICIENCY

3.5.1 CHILDHOOD ILLNESS

Association if any, between the occurrence of respiratory illness and diarrhoea within the 2 weeks preceding the interview and prevalence of anaemia, iron deficiency and zinc deficiency was studied. As shown in Table 14, those who had anaemia were higher among those who reported symptoms of respiratory illness, even though the differences were not statistically significant. However, a significantly high prevalence of anaemia was seen among those who reported symptoms of diarrhea.

The differences seen between the occurrence of symptoms of respiratory illness and of diarrhea were not significantly associated with iron deficiency nor with zinc deficiency

Table 14: Percentage of children who reported symptoms of respiratory illness and diarrhea by prevalence of anaemia, iron deficiency and zinc deficiency

	Total no. children	% reported symptoms of Respiratory illness		% reported symptoms of Diarrhoea	
		Yes	No	Yes	No
Anaemia					
Yes	43	46.0 [28.6, 64.4]	54.0 [35.6, 71.4]	22.4 [10.1, 42.5]	77.6 [57.5, 89.9]
No	181	30.1 [23.0, 38.2]	68.3 [60.0, 75.6]	8.1 [4.3, 14.5]	91.8 [85.4, 95.6]
P value		0.31		0.03	
Iron Deficiency					
Yes	64	24.8 [14.7, 38.7]	75.2 [61.3, 85.3]	14.8 [6.8, 29.0]	85.2 [71.0, 93.2]
No	131	35.2 [26.2, 45.4]	62.6 [52.3, 71.8]	8.5 [3.8, 17.9]	91.3 [82.0, 96.0]
P value		0.34		0.34	
Zinc deficiency					
Yes	15	22.6 [7.2, 52.4]	77.4 [47.6, 92.8]	24.5 [8.2, 54.2]	75.5 [45.8, 91.8]
No	180	32.5 [24.9, 41.2]	65.9 [57.1, 73.7]	9.4 [5.0, 17.1]	90.5 [82.8, 94.9]
P value		0.74		0.13	

3.5.1 DIETARY INTAKE

Assessment of association if any, between the prevalence of anaemia, iron deficiency and Zn deficiency and intake of food items was studied. For this purpose comparison between the percentage of children with and without each of the above deficiency states was made in relation to their intake of food items belonging to different food groups, on the day preceding the interview. Further, the mean number of days of consumption of food items belonging to different food groups, during the seven days preceding the interview, was studied in relation to the prevalence of anaemia, iron deficiency and zinc deficiency.

Table 15: Percentage of children given food items belonging to different food groups, on the day preceding the interview by prevalence of anaemia, iron deficiency and zinc deficiency

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes	No	Yes	No	Yes	No
Grains/Roots/Tubers						
Yes	15.0 [13.9, 16.0]	85.0 [84.0, 86.1]	33.4 [31.9, 35.0]	66.6 [65.0, 68.1]	5.1 [4.4, 5.9]	94.9 [94.1, 95.6]
No	27.3 [17.3, 40.2]	72.7 [59.8, 82.7]	46.6 [32.4, 61.4]	53.4 [38.6, 67.6]	9.2 [2.2, 31.4]	90.8 [68.6, 97.8]
P value	0.01		0.07		0.39	
Legumes/Nuts						
Yes	15.4 [14.0, 16.9]	84.6 [83.1, 86.0]	33.5 [31.5, 35.6]	66.5 [64.4, 68.5]	4.7 [3.8, 5.9]	95.3 [94.1, 96.2]
No	14.7 [13.2, 16.2]	85.3 [83.8, 86.8]	33.6 [31.4, 35.9]	66.4 [64.1, 68.6]	5.6 [4.5, 6.9]	94.4 [93.1, 95.5]
P value	0.47		0.94		0.27	

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes	No	Yes	No	Yes	No
Vitamin A rich fruits and vegetables						
Yes	15.2 [14.0, 16.4]	84.8 [83.6, 86.0]	33.9 [32.2, 35.7]	66.1 [64.3, 67.8]	5.1 [4.3, 6.0]	94.9 [94.0, 95.7]
No	14.8 [12.8, 17.1]	85.2 [82.9, 87.2]	32.2 [29.1, 35.4]	67.8 [64.6, 70.9]	5.2 [3.7, 7.2]	94.8 [92.8, 96.3]
P value	0.77		0.35		0.95	
Other fruits and vegetables						
Yes	15.0 [13.8, 16.2]	85.0 [83.8, 86.2]	33.3 [31.5, 35.2]	66.7 [64.8, 68.5]	5.1 [4.2, 6.1]	94.9 [93.9, 95.8]
No	15.4 [13.6, 17.4]	84.6 [82.6, 86.4]	34.1 [31.4, 37.0]	65.9 [63.0, 68.6]	5.2 [4.0, 6.8]	94.8 [93.2, 96.0]
P value	0.67		0.64		0.85	
Diary products (milk, yogurt, cheese)						
Yes	14.3 [13.2, 15.5]	85.7 [84.5, 86.8]	33.2 [31.4, 35.0]	66.8 [65.0, 68.6]	5.0 [4.2, 5.9]	95.0 [94.1, 95.8]
No	17.8 [15.7, 20.0]	82.2 [80.0, 84.3]	34.8 [31.8, 38.0]	65.2 [62.0, 68.2]	5.7 [4.3, 7.5]	94.3 [92.5, 95.7]
P value	0.01		0.35		0.43	
Eggs						
Yes	15.7 [14.0, 17.6]	84.3 [82.4, 86.0]	33.0 [30.4, 35.7]	67.0 [64.3, 69.6]	5.2 [4.1, 6.6]	94.8 [93.4, 95.9]
No	14.8 [13.5, 16.1]	85.2 [83.9, 86.5]	33.8 [32.0, 35.7]	66.2 [64.3, 68.0]	5.1 [4.2, 6.1]	94.9 [93.9, 95.8]
P value	0.38		0.61		0.82	
Meat/Fish/Poultry/ organ meats						
Yes	14.5 [13.3, 15.7]	85.5 [84.3, 86.7]	33.2 [31.5, 35.0]	66.8 [65.0, 68.5]	5.1 [4.3, 6.1]	94.9 [93.9, 95.7]
No	17.1 [15.1, 19.3]	82.9 [80.7, 84.9]	34.7 [31.7,37.8]	65.3 [62.2, 68.3]	5.2 [4.0, 6.9]	94.8 [93.1, 96.0]
P value	0.03		0.40		0.85	

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes	No	Yes	No	Yes	No
Fortified food						
Yes	14.8 [13.7, 16.0]	85.2 [84.0, 86.3]	33.2 [31.6, 34.9]	66.8 [65.1, 68.4]	5.1 [4.3, 6.0]	94.9 [94.0, 95.7]
No	16.7 [14.1, 19.6]	83.3 [80.4, 85.9]	35.4 [31.4, 39.5]	64.6 [60.5, 68.6]	5.2 [3.6, 7.6]	94.8 [92.4, 96.4]
P value	0.21		0.33		0.89	
Overall	15.1 [14.1, 16.2]	84.9 [83.8, 85.9]	33.6 [32.0, 35.1]	66.4 [64.9, 68.0]	5.1 [4.4, 5.9]	94.9 [94.1, 95.6]

As shown in Table 15, intake of items belonging to 8 different food groups were studied. It is seen that a significantly higher percentage of those who did not consume three of the food groups, grains/roots/ tubers, dairy products and meat/fish/poultry /organ meats, were anaemic. The differences seen in the intake of other food items were not significantly associated with the prevalence of the deficiency states studied.

Association if any, between the mean number of days of consumption of food items belonging to 8 different food groups within 7 days preceding the interview, by prevalence of anaemia, iron deficiency and zinc deficiency was studied (Table 16). Reduced consumption of grains, roots and tubers was seen to be significantly related to presence of anaemia. Frequency of consumption of eggs seem to show a less consistent pattern, indicating a relationship between lower consumption of eggs being associated with anaemia. However, a reverse pattern is seen in relation to the intake of vitamin A rich foods and dairy products on the occurrence of anaemia and iron deficiency.

Table 16: Mean number of days of consumption of food items belonging to different food groups, during seven days preceding the interview, by prevalence of Anaemia, iron deficiency and zinc deficiency

Food group	Mean no. of days	Anaemia		Iron deficiency		Zinc deficiency	
		Yes	No	Yes	No	Yes	No
Grain/roots and tubers	1-2	28.1 [15.7, 45.0]	71.9 [55.0, 84.3]	33.5 [19.8, 50.9]	66.5 [49.1, 80.2]	9.1 [3.8, 20.0]	90.9 [80.0, 96.2]
	3-5	13.9 [12.6, 15.4]	86.1 [84.6, 87.4]	32.1 [30.1, 34.2]	67.9 [65.8, 69.9]	5.2 [4.3, 6.3]	94.8 [93.7, 95.7]
	>5	15.8 [14.3, 17.4]	84.2 [82.6, 85.7]	34.8 [62.8, 67.4]	65.2 [62.8, 67.4]	4.7 [3.7, 6.0]	95.3 [94.0, 96.3]
P value		0.02		0.21		0.39	
Legumes/ nuts	0	21.6 [14.4, 31.1]	78.4 [68.9, 85.6]	43.6 [32.1, 55.9]	56.4 [44.1, 67.9]	7.0 [2.7, 16.8]	93.0 [83.2, 97.3]
	1-2	15.3 [13.2, 17.7]	84.7 [82.3, 86.8]	31 [28.0, 34.2]	69 [65.8, 72.0]	5.2 [3.8, 7.1]	94.8 [92.9, 96.2]
	3-5	15.5 [13.2, 18.1]	84.5 [81.9, 86.8]	34.4 [31.1, 38.0]	65.6 [62.0, 68.9]	3.9 [2.6, 5.8]	96.1 [94.2, 97.4]
	>5	11.1 [5.4, 21.4]	88.9 [78.6, 94.6]	45.6 [33.1, 58.6]	54.4 [41.4, 66.9]	3.9 [1.4, 10.5]	96.1 [89.5, 98.6]
P value		0.33		0.02		0.48	
Vitamin A rich foods	0	5.8 [1.6, 19.3]	94.2 [80.7, 98.4]	18.7 [4.7, 51.9]	81.3 [48.1, 95.3]	4.0 [1.0, 14.6]	96.0 [85.4, 99.0]
	1-2	15.5 [13.7, 17.5]	84.5 [82.5, 86.3]	34.5 [31.8, 37.3]	65.5 [62.7, 68.2]	4.5 [3.4, 6.0]	95.5 [94.0, 96.6]
	3-5	34.9 [20.6, 52.5]	65.1 [47.5, 79.4]	42.6 [24.6, 62.8]	57.4 [37.2, 75.4]	1.7 [0.2, 11.4]	98.3 [88.6, 99.8]
	>5	0.0	100.0	0.0	100.0	0.0	100.0
P value		0.00		0.45		0.71	
Other fruits and vegetables	0	15.4 [14.1, 16.9]	84.6 [83.1, 85.9]	33.9 [31.9, 36.0]	66.1 [64.0, 68.1]	5.3 [4.3, 6.4]	94.7 [93.6, 95.7]
	1-2	13.9 [10.9, 17.6]	86.1 [82.4, 89.1]	30.9 [26.3, 35.9]	69.1 [64.1, 73.7]	3.5 [2.1, 6.0]	96.5 [94.0, 97.9]
	3-5	13.2 [8.7, 19.5]	86.8 [80.5, 91.3]	29.9 [22.0, 39.1]	70.1 [60.9, 78.0]	5.7 [2.2, 14.4]	94.3 [85.6, 97.8]
	>5	6.7 [2.6, 15.9]	93.3 [84.1, 97.4]	34.5 [22.1, 49.4]	65.5 [50.6, 77.9]	8.4 [2.7, 23.2]	91.6 [76.8, 97.3]
P value		0.22		0.58		0.49	
Dairy products (milk, yoghurt, cheese)	0	21.9 [18.9, 25.1]	78.1 [74.9, 81.1]	39.0 [35.0, 43.2]	61.0 [56.8, 65.0]	5.9 [4.1, 8.6]	94.1 [91.4, 95.9]
	1-2	19.8 [13.8, 27.7]	80.2 [72.3, 86.2]	37.3 [28.1, 47.5]	62.7 [52.5, 71.9]	1.8 [0.7, 4.7]	98.2 [95.3, 99.3]
	3-5	12.9 [8.6, 18.8]	87.1 [81.2, 91.4]	28.3 [21.9, 35.8]	71.7 [64.2, 78.1]	3.2 [1.3, 7.8]	96.8 [92.2, 98.7]
	>5	12.6 [11.0, 14.4]	87.4 [85.6, 89.0]	31.5 [29.0, 34.2]	68.5 [65.8, 71.0]	4.6 [3.5, 6.1]	95.4 [93.9, 96.5]
P value		0.00		0.01		0.16	
Eggs	0	12.2 [7.3, 19.9]	87.8 [80.1, 92.7]	28.8 [19.1, 41.1]	71.2 [58.9, 80.9]	3.4 [1.5, 7.5]	96.6 [92.5, 98.5]
	1-2	12.8 [10.3, 15.8]	87.2 [84.2, 89.7]	32.3 [28.0, 36.9]	67.7 [63.1, 72.0]	6.7 [4.6, 9.6]	93.3 [90.4, 95.4]
	3-5	18.1 [15.5, 20.9]	81.9 [79.1, 84.5]	33 [29.4, 36.8]	67 [63.2, 70.6]	4.9 [3.5, 6.9]	95.1 [93.1, 96.5]
	>5	17.5 [12.2, 24.4]	82.5 [75.6, 87.8]	38.3 [30.4, 46.7]	61.7 [53.3, 69.6]	2.5 [0.9, 6.8]	97.5 [93.2, 99.1]
P value		0.04		0.54		0.13	

Food group	Mean no. of days	Anaemia		Iron deficiency		Zinc deficiency	
		Yes	No	Yes	No	Yes	No
Meat, Fish, Poultry, organ meats	0	13.6 [6.7, 25.8]	86.4 [74.2, 93.3]	43.4 [28.8, 59.2]	56.6 [40.8, 71.2]	4.4 [1.5, 12.2]	95.6 [87.8, 98.5]
	1-2	14.4 [12.9, 16.0]	85.6 [84.0, 87.1]	31.5 [29.3, 33.8]	68.5 [66.2, 70.7]	4.6 [3.5, 5.8]	95.4 [94.2, 96.5]
	3-5	17.2 [12.8, 22.8]	82.8 [77.2, 87.2]	31.0 [24.4, 38.4]	69.0 [61.6, 75.6]	6.0 [3.0, 11.7]	94.0 [88.3, 97.0]
	>5	0	100	0	100	0	100
P value		0.67		0.33		0.83	
Fortified food	0	13.8 [12.1, 15.6]	86.2 [84.4, 87.9]	32.1 [29.5, 34.8]	67.9 [65.2, 70.5]	4.2 [3.2, 5.6]	95.8 [94.4, 96.8]
	1-2	15 [12.8, 17.5]	85 [82.5, 87.2]	34.8 [31.4, 38.4]	65.2 [61.6, 68.6]	5.3 [3.8, 7.3]	94.7 [92.7, 96.2]
	3-5	15.9 [13.8, 18.2]	84.1 [81.8, 86.2]	34.4 [31.3, 37.7]	65.6 [62.3, 68.7]	7.0 [5.3, 9.2]	93.0 [90.8, 94.7]
	>5	15.5 [12.6, 19.0]	84.5 [81.0, 87.4]	31.6 [27.2, 36.3]	68.4 [63.7, 72.8]	3.4 [2.0, 5.8]	96.6 [94.2, 98.0]
P value		0.48		0.46		0.02	

3.5.2 FEEDING PRACTICES

The feeding practices, 'ever breast fed', 'time of initiation of breast feeding' and 'currently breast fed' were studied among the children aged between 6 – 23 months (Table 17). The prevalence of anaemia was seen to be higher among the children 'ever breast fed' and the 'currently breast fed' groups. None of the breast feeding practices were significantly associated with iron or zinc deficiency.

Table 17: Infant and young child feeding practices of children, by prevalence of Anaemia, iron deficiency and zinc deficiency

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes %	No %	Yes %	No %	Yes %	No%
Ever breastfed						
Yes	28.0 [25.6, 30.6]	72.0 [69.4, 74.4]	47.7 44.6, 50.8]	52.3 [49.2, 55.4]	5.8 [4.3, 7.7]	94.2 92.3, 95.7]
No	10.9 [7.2, 16.3]	89.1 [83.7, 92.8]	36.5	63.5 [52.8, 73.0]	5.5 [2.5, 11.9]	94.5 [88.1, 97.5]
P value	0.00		0.04		0.91	
Time of initiation						
Within 1 hour of birth	27.4 [25.0, 29.9]	72.6 [70.1, 75.0]	47.3 [44.1, 50.4]	52.7 [49.6, 55.9]	5.8 [4.4, 7.6]	94.2 [92.4, 95.6]
Within 1 day of birth	19.1 [12.0, 29.0]	80.9 [71.0, 88.0]	42.0 [31.0, 53.9]	58.0 [46.1, 69.0]	5.1 [1.5, 16.1]	94.9 [83.9, 98.5]
P value	0.10		0.58		0.95	
Currently breastfed						
Yes	28.0 [25.6, 30.6]	72.0 [69.4, 74.4]	47.7 [44.6, 50.8]	52.3 [49.2, 55.4]	5.8 [4.3, 7.7]	94.2 [92.3, 95.7]
No	10.9 [7.2, 16.3]	89.1 [83.7, 92.8]	36.5 [27.0, 47.2]	63.5 [52.8, 73.0]	5.5 [2.5, 11.9]	94.5 [88.1, 97.5]
P value	0.00		0.16		0.83	

3.5.3 CONSUMPTION OF SUPPLEMENTS AND MEDICATIONS

Influence if any, of the consumption of selected supplements and medications on the presence of anaemia, iron deficiency and zinc deficiency were studied. Findings are presented in Table 18. The studied practices were: taken vitamin A mega dose, multiple micronutrients, multivitamin syrup, deworming tablets and receipt of thriposha. Children who received Vitamin A mega dose was seen to reduce with the increasing age of the child. This percentage was seen to influence the presence of anaemia and iron deficiency in that those who did not receive vitamin A mega dose in the higher age groups reported a significantly higher prevalence of anaemia.

Consumption of multiple micronutrient supplements by children was seen to be associated with a significantly lower prevalence of iron deficiency and zinc deficiency. Similarly, receipt of deworming tablets was also seen to positively influence occurrence of iron deficiency and zinc deficiency.

Table 18: Percentage of children with anaemia, iron deficiency and zinc deficiency, in relation to availability of supplements and medications

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes	No	Yes	No	Yes	No
Vitamin A mega dose supplementation						
12 months	34.0	66.0	46.7	34.0	66.0	46.7
	[28.9, 39.4]	[60.6, 71.1]	[40.5, 53.0]	[28.9, 39.4]	[60.6, 71.1]	[40.5, 53.0]
18 months	24.7	75.3	46.9	24.7	75.3	46.9
	[22.2, 27.4]	[72.6, 77.8]	[43.5, 50.4]	[22.2, 27.4]	[72.6, 77.8]	[43.5, 50.4]
24 months	13.3	86.7	33.4	13.3	86.7	33.4
	[11.4, 15.5]	[84.5, 88.6]	[30.4, 36.6]	[11.4, 15.5]	[84.5, 88.6]	[30.4, 36.6]
36 months	10	90	28.7	10	90	28.7
	[8.3, 11.9]	[88.1, 91.7]	[25.7, 31.9]	[8.3, 11.9]	[88.1, 91.7]	[25.7, 31.9]
48 months	6.9	93.1	21.8	6.9	93.1	21.8
	[5.5, 8.7]	[91.3, 94.5]	[19.2, 24.7]	[5.5, 8.7]	[91.3, 94.5]	[19.2, 24.7]
P value	0.00		0.00		0.68	
MMN received						
Yes	15.8	84.2	29.5	15.8	84.2	29.5
	[14.0, 17.8]	[82.2, 86.0]	[26.8, 32.4]	[14.0, 17.8]	[82.2, 86.0]	[26.8, 32.4]
No	15	85	34.2	15.0	85.0	34.2
	[13.9, 16.2]	[83.8, 86.1]	[32.5, 35.9]	[13.9, 16.2]	[83.8, 86.1]	[32.5, 35.9]
P value	0.48		0.01		0.00	
Any multi vitamin syrup						
Yes	15.4	84.6	31.2	15.4	84.6	31.2
	[12.6, 18.7]	[81.3, 87.4]	[26.8, 35.9]	[12.6, 18.7]	[81.3, 87.4]	[26.8, 35.9]
No	15.1	84.9	33.8	15.1	84.9	33.8
	[14.0, 16.2]	[83.8, 86.0]	[32.2, 35.5]	[14.0, 16.2]	[83.8, 86.0]	[32.2, 35.5]
P value	0.82		0.28		0.56	
Deworming received						
Yes	12.7	87.3	32.0	12.7	87.3	32.0
	[11.6, 13.8]	[86.2, 88.4]	[30.3, 33.8]	[11.6, 13.8]	[86.2, 88.4]	[30.3, 33.8]
No	21.9	78.1	38.1	21.9	78.1	38.1
	[19.7, 24.3]	[75.7, 80.3]	[35.0, 41.2]	[19.7, 24.3]	[75.7, 80.3]	[35.0, 41.2]
P value	0.00		0.00		0.78	

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes	No	Yes	No	Yes	No
Received Thriposha						
Yes	14.7	85.3	33.2	14.7	85.3	33.2
	[13.6,15.9]	[84.1,86.4]	[31.6,35.0]	[13.6,15.9]	[84.1,86.4]	[31.6,35.0]
No	16.3	83.7	34.5	16.3	83.7	34.5
	[14.1,18.8]	[81.2,85.9]	[31.2,37.9]	[14.1,18.8]	[81.2,85.9]	[31.2,37.9]
P value	0.22		0.51		0.22	

3.5.4 WATER AND SANITATION

The households studied had several methods of obtaining drinking water. Type of drinking water consumed by the households was studied in relation to the occurrence of anaemia, iron deficiency and zing deficiency among the children.

Table 19: Distribution households by main source of drinking water by prevalence of Anaemia, iron deficiency and zinc deficiency

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes	No	Yes	No	Yes	No
Piped into dwelling	15.4	84.6	36.0	64.0	4.8	95.2
	[13.0, 18.1]	[81.9, 87.0]	[32.3, 39.9]	[60.1, 67.7]	[3.3, 6.8]	[93.2, 96.7]
Piped into yard or plot	15.5	84.5	40.1	59.9	6.6	93.4
	[12.3, 19.3]	[80.7, 87.7]	[34.8, 45.7]	[54.3, 65.2]	[4.1, 10.6]	[89.4, 95.9]
Public tap	13.5	86.5	33.5	66.5	8.9	91.1
	[10.1, 17.7]	[82.3, 89.9]	[28.0, 39.6]	[60.4, 72.0]	[5.6, 13.9]	[86.1, 94.4]
Tube well	16.5	83.5	27.9	72.1	9	91
	[13.0, 20.8]	[79.2, 87.0]	[23.0, 33.4]	[66.6, 77.0]	[5.7, 13.9]	[86.1, 94.3]
Protected well	14	86	34.5	65.5	4.9	95.1
	[11.9, 16.5]	[83.5, 88.1]	[31.2, 37.9]	[62.1, 68.8]	[3.4, 6.9]	[93.1, 96.6]
Protected spring	12.8	87.2	37.2	62.8	4.2	95.8
	[8.5, 18.9]	[81.1, 91.5]	[29.1, 46.1]	[53.9, 70.9]	[1.6, 10.6]	[89.4, 98.4]
Rain water collection	0	100	0	100	0	100
Bottled water	17.8	82.2	34.2	65.8	17.9	82.1
	[7.7, 35.9]	[64.1, 92.3]	[18.1, 55.0]	[45.0, 81.9]	[5.3, 45.9]	[54.1, 94.7]

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes	No	Yes	No	Yes	No
Unimproved sources	15.5 [13.8, 17.3]	84.5 [82.7, 86.2]	29.8 [27.4, 32.3]	70.2 [67.7, 72.6]	3.7 [2.8, 4.8]	96.3 [95.2, 97.2]
Overall	15.1 [14.1, 16.2]	84.9 [83.8, 85.9]	33.6 [32.1, 35.1]	66.4 [64.9, 67.9]	4.8 [3.3, 6.8]	95.2 [93.2, 96.7]
P-Value	0.68		0.01		0.01	

As shown in table 18, there was no statistically significant differences between the sources of drinking water consumed by the children related to anemia. However, it is seen that the differences seen in the source of drinking water, high prevalence of iron deficiency and the high prevalence of zinc deficiency seen among those who used bottled water, were significant. However, it is necessary to pay attention to the number of households that used the different sources of drinking water, when drawing conclusions.

Influence of means of disposal of excreta on the occurrence of anaemia, iron deficiency and zinc deficiency did not show any significant difference between the method of disposal of excreta and occurrence of anaemia, iron or zinc deficiency (Table 20).

Table 20: Distribution(%) households by sanitary means of excreta by prevalence of anaemia, iron deficiency and zinc deficiency

	Anaemia		Iron Deficiency		Zinc deficiency	
	Yes %	No %	Yes%	No %	Yes %	No%
Flushed	15.0 [14.0, 16.1]	85.0 [83.9, 86.0]	33.8 [32.2, 35.4]	66.2 [64.6, 67.8]	5.0 [4.2, 5.8]	95.0 [94.2, 95.8]
Pit	13.8 [10.1, 18.5]	86.2 [81.5, 89.9]	27.8 [21.3, 35.2]	72.2 [64.8, 78.7]	8.4 [4.8, 14.1]	91.6 [85.9, 95.2]
Temporary	19.3 [15.4, 23.9]	80.7 [76.1, 84.6]	33.1 [27.2, 39.5]	66.9 [60.5, 72.8]	7.1 [4.3, 11.5]	92.9 [88.5, 95.7]
Overall	15.1 [14.1, 16.2]	84.9 [83.8, 85.9]	33.6 [32.1, 35.1]	66.4 [64.9, 67.9]	5.1 [4.4, 6.0]	94.9 [94.0, 95.6]
P-Value	0.10		0.26		0.07	

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

1. Of the total sample of children, 15.1% were anaemic and of all anaemic children, 32.7% had haemoglobinopathies (β Thalassaemia and Hb variants), 4.3% had evidence of acute infections and 52.3% were iron deficient. It was also shown that these conditions were not mutually exclusive.

2. Highest prevalence of ID and IDA was present during the second year of life and between 6-11 months respectively. IDA and ID was significantly higher among male children. No clear pattern was seen related to maternal educational status, father's occupation and indicators of economic status.

3. Overweight children showed the highest prevalence of ID.

4. include the conclusions on IYCF and IDA or ID.

5. There was a wide inter district variation in the prevalence of ID and IDA. Prevalence of ID was highest in Matale and lowest in Mullaitivu. IDA was highest in Kilinochchci and lowest in Batticaloa.

6. For the total sample of children, the prevalence of zinc deficiency was 5.1%.The prevalence was not associated with maternal educational status, father's occupation nor with indicators of economic status.

7. Inter district variations in the prevalence of Zinc deficiency showed a wide variation with approximately 15% prevalence in some districts and less than 1% in others.

8. Prevalence of zinc deficiency was lowest in the overweight group. Among the other nutritional status categories, the stunted group had the lowest prevalence.

9. The children who reported have had diarrhea within the preceding two weeks reported a higher prevalence of anaemia.

10. Overall prevalence of calcium deficiency was high in this age group, with lowest prevalence rates among children in the 6 – 11 month age group. Low levels of prevalence were seen among the children belonging to the households in the highest wealth quintile.

11 Those who did not consume items belonging to the food groups, grains/roots/tubers, dairy products and meat/fish/organ meats on the day preceding the interview, showed a higher prevalence of anaemia.

12 None of the breast feeding practices were significantly associated with ID or IDA. However, those belonging to the categories 'ever breast fed' and 'currently breast fed', had a higher prevalence of anaemia.

13 Children who did not receive vitamin A mega dose at the higher age groups showed a higher prevalence of anaemia. Those who did not have micronutrient supplements and deworming facilities also showed a higher prevalence of anaemia.

14 Type of supply of drinking water nor the availability of sanitary means of excreta disposal had an influence any of the deficiency states.

4.2 RECOMMENDATIONS

1 The findings of this study indicate that factors other than iron deficiency are causes of anaemia in this age group, specially haemoglobinopathies. In view of the on going preventive programmes focusing mainly on iron supplementation, it is necessary to review these programmes, which need to be supported by in depth research on the causes of anaemia. In the presence of thalassemia you can also suggest the importance of food fortification and its relative advantage to address IDA/ID instead of a supplementation approach.

2 Once such reviews are made, the programmes may need to be modified / revised/ replaced and appropriate guidelines developed for their implementation. Such actions may need development of appropriate screening facilities practicable at the field level, for other factors contributing to anaemia.

Association of IYCF practices ie., breastfeeding and complementary feeding on IDA/ID.

3 In this study, the assessment of association between food intake and anaemia has been studied using broad categories, both in terms of food groups as well as the pattern of food intake. More in depth studies are necessary to identify practices related to food intake that are beneficial.

4 In general, the zinc levels in this population group could be considered as satisfactory indicating that current dietary practices have satisfactory as far as zinc status in this population group is concerned and need to be maintained with improvements as may be required..

5 Inter district variations in iron deficiency, and other contributory factors to anaemia such as prevalence of haemoglobinopathies have to be taken into consideration in developing appropriate interventions at the districts level.

6 The study identified the need to focus on the intake of calcium rich foods in the diets of children in this age group.

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Annexture 1

DISTRIBUTION OF DISTRICTS BY PREVALENCE OF IRON DEFICIENCY (ID)

Prevalence %	Districts
<20	Mullaitivu
20-24.9	Batticaloa, Kegalle
25-29.9	Kalutara, Mannar,Vavuniya,Trincomalee, Kurunegala
30-24.9	Kandy, Nuwara Eliya,Jaffna,Kilinochchi, Ampara,Polonnaruwa, Badulla, Ratnapura
35-39.9	Colombo, Gampaha, Galle, Hmabantota,Anurafhapura
>=40	Matale, Matara, Puttalam

DISTRIBUTION OF DISTRICTS BY PREVALENCE OF IRON DEFICIENCY ANAEMIA (IDA)

Prevalence %	Districts
<5	Batticaloa,Nuwara Eliya,Matale, Kegalle, Mullaitivu
5-9.9	Colombo,Kalutara, Kandy,Matale,Galle,Hambanatota, Jaffna,Mannar, Vavuniya,Ampara, Trincomalee,Kurunegala, Anuradhapura,Badulla Ratnapura,Moneragala
>=10	Gampaha, Kilinochchci,Puttalam, Polonnaruwa