Nutritional status in Sri Lanka, determinants and interventions: a desk review

(2006 - 2011)

unicef
Nutritional status in Sri Lanka, determinants and interventions: a desk review

2006 – 2011

Compiled by
Dr. Lalini C Rajapaksa
Dr. Carukshi Arambepola
Dr. Nalika Gunawardena

Research Assistants
Dr. Chamith Rosa
Dr. Shamika Opatha

Maps and cover page created by Dr. Carukshi Arambepola

June 2011
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHB</td>
<td>Annual Health Bulletin</td>
</tr>
<tr>
<td>AL</td>
<td>Advanced Level</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>BF</td>
<td>Breast Feeding</td>
</tr>
<tr>
<td>BFHI</td>
<td>Baby Friendly Hospital Initiative</td>
</tr>
<tr>
<td>BMD</td>
<td>Bone Mineral Density</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>BW</td>
<td>Birth Weight</td>
</tr>
<tr>
<td>CHDR</td>
<td>Child Health and Development Record</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Intervals</td>
</tr>
<tr>
<td>CMC</td>
<td>Colombo Municipal Council</td>
</tr>
<tr>
<td>CSB</td>
<td>Corn Soya Blend</td>
</tr>
<tr>
<td>DCS</td>
<td>Department of Census and Statistics</td>
</tr>
<tr>
<td>DD</td>
<td>Dietary Diversity</td>
</tr>
<tr>
<td>DHS</td>
<td>Demographic and Health Survey</td>
</tr>
<tr>
<td>DPT</td>
<td>Diphtheria, Pertussis and Tetanus</td>
</tr>
<tr>
<td>DS</td>
<td>Divisional Secretary</td>
</tr>
<tr>
<td>DXA</td>
<td>Dual energy X-ray absorptiometry</td>
</tr>
<tr>
<td>ECCD</td>
<td>Early Childhood Care and Development</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
</tr>
<tr>
<td>FHB</td>
<td>Family Health Bureau</td>
</tr>
<tr>
<td>FNAC</td>
<td>Fine Needle Aspiration Cytology</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GND/ GN</td>
<td>Grama Niladhari Divisions</td>
</tr>
<tr>
<td>HDDS</td>
<td>Household Dietary Diversity Score</td>
</tr>
<tr>
<td>HFCAS</td>
<td>Household Food Consumption Adequacy Score</td>
</tr>
<tr>
<td>HH</td>
<td>Household</td>
</tr>
<tr>
<td>HIES</td>
<td>Household Income and Expenditure Survey</td>
</tr>
<tr>
<td>HMIS</td>
<td>Health Management Information System</td>
</tr>
<tr>
<td>HPF</td>
<td>Health Promotion Facilitator</td>
</tr>
<tr>
<td>IASO</td>
<td>International Association for the Study of Obesity</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>IDD</td>
<td>Iodine Deficiency Disorders</td>
</tr>
<tr>
<td>IDDS</td>
<td>Individual Diet Diversity Score</td>
</tr>
<tr>
<td>IMMR</td>
<td>Indoor Morbidity and Mortality Returns</td>
</tr>
<tr>
<td>INP</td>
<td>Integrated Nutrition Package</td>
</tr>
<tr>
<td>IOTF</td>
<td>International Obesity Task Force</td>
</tr>
<tr>
<td>IUGR</td>
<td>Intra Uterine Growth Retardation</td>
</tr>
<tr>
<td>IYCF</td>
<td>Infant and Young Child Feeding</td>
</tr>
<tr>
<td>LBW</td>
<td>Low birth Weight</td>
</tr>
<tr>
<td>LoFe</td>
<td>Low Iron Concentration</td>
</tr>
<tr>
<td>MAM</td>
<td>Moderate Acute Malnutrition</td>
</tr>
<tr>
<td>MC</td>
<td>Municipal Council</td>
</tr>
<tr>
<td>MCH</td>
<td>Maternal and Child Health</td>
</tr>
<tr>
<td>MLEI</td>
<td>Modified Life Events Inventory</td>
</tr>
<tr>
<td>MOH</td>
<td>Medical Officer of Health</td>
</tr>
<tr>
<td>MoH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>MRI</td>
<td>Medical Research Institute</td>
</tr>
<tr>
<td>MUAC</td>
<td>Mid-Upper Arm Circumference</td>
</tr>
<tr>
<td>NCHS</td>
<td>National Centre for Health Statistics</td>
</tr>
<tr>
<td>NERD</td>
<td>National Engineering Research Division</td>
</tr>
<tr>
<td>NFSA</td>
<td>National and Food Security Assessment</td>
</tr>
<tr>
<td>OL</td>
<td>Ordinary Level</td>
</tr>
<tr>
<td>OR</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>PEM</td>
<td>Protein Energy Malnutrition</td>
</tr>
<tr>
<td>PGIA</td>
<td>Postgraduate Institute of Agriculture</td>
</tr>
<tr>
<td>PGIM</td>
<td>Postgraduate Institute of Medicine</td>
</tr>
<tr>
<td>PHM</td>
<td>Public Health Midwife</td>
</tr>
<tr>
<td>PIH</td>
<td>Pregnancy Induced Hypertension</td>
</tr>
<tr>
<td>PPS</td>
<td>Probability Proportional to size</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomized Controlled Trial</td>
</tr>
<tr>
<td>RDA</td>
<td>Recommended Daily Allowance</td>
</tr>
<tr>
<td>SAM</td>
<td>Severe Acute Malnutrition</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SES</td>
<td>Socio-Economic Status</td>
</tr>
<tr>
<td>SGA</td>
<td>Small for Gestational Age</td>
</tr>
<tr>
<td>SLCFS</td>
<td>Sri Lanka Complementary Feeding Study</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>TPA</td>
<td>Thyro Perioxidase Antibody</td>
</tr>
<tr>
<td>TSH</td>
<td>Thyroid Stimulating Hormones</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
</tr>
<tr>
<td>URTI</td>
<td>Upper Respiratory Tract Infection</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
<tr>
<td>VAD</td>
<td>Vitamin A Deficiency</td>
</tr>
<tr>
<td>WFP</td>
<td>World Food Programme</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive summary</td>
<td>xiii</td>
</tr>
<tr>
<td><strong>Chapter 1:</strong> Introduction to the desk review</td>
<td>1</td>
</tr>
<tr>
<td><strong>Chapter 2: The circle of malnutrition</strong></td>
<td>7</td>
</tr>
<tr>
<td><strong>Chapter 3: Low birth weight</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>Chapter 4: Protein energy malnutrition among pre-school children</strong></td>
<td>26</td>
</tr>
<tr>
<td><strong>Chapter 5: Protein energy malnutrition among school children and</strong></td>
<td>52</td>
</tr>
<tr>
<td>adolescents, women and the elderly</td>
<td></td>
</tr>
<tr>
<td><strong>Chapter 6: Anaemia</strong></td>
<td>70</td>
</tr>
<tr>
<td><strong>Chapter 7: Vitamin A and Iodine deficiency disorders</strong></td>
<td>86</td>
</tr>
<tr>
<td><strong>Chapter 8: Food security</strong></td>
<td>101</td>
</tr>
<tr>
<td><strong>Chapter 9: Interventions</strong></td>
<td>120</td>
</tr>
<tr>
<td><strong>Chapter 10: Conclusions and recommendations</strong></td>
<td>138</td>
</tr>
<tr>
<td>References</td>
<td>150</td>
</tr>
<tr>
<td>Bibliography</td>
<td></td>
</tr>
<tr>
<td>Annexes</td>
<td></td>
</tr>
</tbody>
</table>
List of tables

Table 3.1: Prevalence of LBW at national level ................................................................. 10
Table 3.2: Summary of research studies on the prevalence of LBW .................................. 10
Table 3.3: Sectoral differences in the prevalence of LBW .................................................. 11
Table 3.4: Distribution of LBW by monthly household income ......................................... 14
Table 3.5: Distribution of LBW by level of education of the mother .................................. 15
Table 3.6: Trends in birth interval among reproductive aged women .................................. 15
Table 3.7: Characteristics of pregnant mothers and their newborn babies ......................... 17
Table 3.8: Pre pregnancy weight and pregnancy weight gain and birth weight .................. 19
Table 4.1: Comparison of child nutrition data from the DHS 2006-07 and NFSA 2009 ....... 29
Table 4.2: Prevalence and trends in PEM of pre-school children by sector (2000- 2009) .... 30
Table 4.3: Nutritional status of children 4-23 months of age ............................................ 30
Table 4.4: Summary of research studies limited to MOH areas on PEM in pre-school children 34
Table 4.5: Variability of child nutrition indicators within a DS division .............................. 35
Table 4.6: Prevalence and trends in child malnutrition by age group 2000- 2009 ............ 37
Table 4.7: Nutrition indicators of children by birth weight .............................................. 38
Table 4.8: Causes of mortality in children below 5 years of age ........................................ 40
Table 4.9: Comparison of Breast Feeding (BF) indicators among children 0-23 months .... 41
Table 4.10: Summary of determinants of PEM from multivariate analyses ...................... 48
Table 5.1: Prevalence of thinness and stunting among 10-16 year old school children ......... 55
Table 5.2: Prevalence of under nutrition by age group and sex ........................................ 56
Table 5.3: Nutritional status of adolescents ........................................................................ 57
Table 5.4: Nutritional status of women in the reproductive age group ............................... 60
Table 5.5: Sectoral differences in the prevalence of thinness ............................................. 61
Table 5.6: Sectoral-differences in the prevalence of overweight and obesity ....................... 61
Table 5.7: Distribution of nutritional status by BMI and by sector in the Matale district .... 68
Table 6.1: Prevalence of anaemia in children of 6-59 months ............................................ 71
Table 6.2: Prevalence of anaemia among 6-59 month old children by sectors ................... 72
Table 6.3: Prevalence of anaemia in children and adolescents aged 5-19 years ............... 76
Table 6.4: Comparison of anaemia among pregnant women ............................................ 83
Table 7.1: Comparison of the prevalence of VAD among 6-60 month old children (1995/96- 2006) .................................................................................................................... 88
Table 8.1: Per capita calorie intake from main food items in Sri Lanka during
Table 8.2: Trend in the inflation of food prices in Sri Lanka during 1991-2007 .......................................................... 103

Table 8.3: Summary of the distribution of household food security in Sri Lanka ........................ 115
List of figures

**Figure 1.1**: Relationship between child underweight rates (1995-2000) and GDP per capita in a (2002) cross section of low and medium development countries ..................................2

**Figure 1.2**: Relationship between the percent of children under five who were underweight in 1995-2000 and the infant mortality rate in 2002 in a cross-section of low and medium human development countries .................................................................2

**Figure 2.1**: Circle of malnutrition.........................................................................................................................7

**Figure 3.1**: Relationship between LBW and BMI at booking visit .................................................................16

**Figure 3.2**: Polynomial regression showing the relationship between maternal weight at booking visit and birth weight .................................................................................................................................17

**Figure 3.3**: Polynomial regression showing the relationship between maternal height and birth weight........................................................................................................................................................................18

**Figure 3.4**: Polynomial regression showing the relationship between maternal BMI at booking visit and birth weight ........................................................................................................................................................................18

**Figure 3.5**: Family formation patterns of hospitalised women with term pregnancies ........20

**Figure 3.6**: Comparison of LBW, poverty and labour force participation of women by districts .21

**Figure 4.1**: PEM in pre-school children in Sri Lanka 1975-2000.................................................................28

**Figure 4.2**: Growth performance (weight for age) of LBW children compared with those with normal birth weight ........................................................................................................................................................................38

**Figure 4.3**: Feeding status by age among children 0-23 months of age.................................................42

**Figure 5.1**: Mean height by age of school girls (10 -16 years) compared with the WHO/NCHS standard ........................................................................................................................................54

**Figure 5.2**: Mean weight by age of school girls (10 -16 years) compared with the WHO/NCHS standards ..................................................................................................................................................54

**Figure 5.3**: Mean weights and heights in each age group compared with WHO/NCHS reference standards ..................................................................................................................................................56

**Figure 5.4**: Comparison of districts by thinness, short stature and overweight status..................65

**Figure 6.1**: Prevalence of anaemia 6-59 months of age ............................................................................71

**Figure 7.1**: Age and sex adjusted prevalence of goitre by zone.............................................................93

**Figure 7.2**: Goitre prevalence by prevalence of thyroiditis in different zones ....................................97

**Figure 7.3**: Relationship between urine iodine concentration and thyroiditis ................................97

**Figure 7.4**: Urine iodine of those with and without goitre in different zones ........................................98

**Figure 7.5**: Rates of thyroid cancer in Sri Lanka 1985-2005 .................................................................98
Figure 8.1: Average monthly real and nominal mean household income by survey ................ 109

Figure 8.2: Percentage increase in mean and median monthly household income
(2006=07 to 2009-10) ........................................................................................................ 110

Figure 8.3: Food and non-food ratio in Sri Lanka by sector 2009 ...................................... 111

Figure 8.4: Per capita availability of calories per day from various food groups (2005-2009)..... 112

Figure 9.1: Prevalence of LBW by district compared to the baseline survey (N=1761) ............ 123

Figure 9.2: Coverage of vitamin A supplementation during past one year in children above
one year (N=1449) .................................................................................................................. 124


Figure 9.4: Comparison of the progress in weight before and after intervention in children
between intervention and control villages .................................................................................. 136
List of maps

Map 3.1: District distribution of LBW ................................................................. 12
Map 3.2: District distribution of LBW ................................................................. 12
Map 3.3: Distribution of LBW at MOH level ......................................................... 13
Map 4.1: Wasting in children under 5 years ......................................................... 31
Map 4.2: Stunting in children under 5 years ......................................................... 31
Map 4.3: Underweight in children under 5 years ................................................... 32
Map 4.4a: Underweight in Children under 5 years disaggregated by age: Infants........ 32
Map 4.4c: Underweight in Children under 5 years disaggregated by age: 2 – 5 years....... 32
Map 4.5: Underweight in 2-5 year old children at MOH level ................................... 33
Map 4.6: Distribution of stunting in pre-school children in Vellavalei DS division ............. 36
Map 5.1: Short stature among women aged 15 – 49 years ........................................ 63
Map 5.2: Overweight among aged 15 – 49 years ................................................... 63
Map 5.3: District prevalence of thinness among women aged 15 – 49 years .................... 64
Map 5.4: Thinness among pregnant women at booking visit within districts .................. 64
Map 6.1: District distribution of any anaemia in children 6-59 months of age ................. 73
Map 6.2: Distribution of any anaemia in non-pregnant women .................................. 80
Map 7.1: Prevalence of goitres by Provinces in 1989 ............................................... 90
Map 7.2: Prevalence of goitres by Provinces in 2000-01 ........................................... 91
Map 7.3: Median urinary iodine levels by Provinces in 2000-01 ................................. 91
Map 7.4: Prevalence of goitres by Provinces in 2006 ............................................... 92
Map 7.5: Median urinary iodine levels by Provinces in 2006 ....................................... 92
Map 7.6: Goitre prevalence among males in the DS divisions included in the study ......... 94
Map 7.7: Goitre prevalence among females in the DS divisions included in the study ....... 94
Map 7.8: DS divisions with goitre prevalence higher than 15% in Sri Lanka .................. 95
List of annexes

**Annex I:** Information collation for the desk review: January 2006 - April 2011; Nutritional status in Sri Lanka, determinants and interventions

**Annex II:** WHO Global Database on child growth and malnutrition, 1997

**Annex III:** UNICEF conceptual framework for malnutrition

**Annex IV:** Map of Sri Lanka with average annual rainfall and elevation
Acknowledgements

This work was greatly enriched by the contributions of many, in many different ways. We express our deep gratitude to all.

We thank Mr. Reza Hossaini, UNICEF Representative for initiating the project. Dr. Shanthi Gunawardana, Director, Nutrition co-ordination division and Drs. Deepika Atygalle and Indra Tudawe of UNICEF invited us to undertake this exercise and provided technical help when needed. We thank the Hon Member of Parliament Dr. Sudharshani Fernandopulle for encouraging us in this venture.

Many people shared their published and unpublished data with us. Special thanks to Dr. Renuka Jayatissa, Head of the Department of Nutrition, Medical Research Institute for freely sharing with us her many publications and the support given to us in this work. Profs. Chandrani Liyanage, Sunethra Athukorala and members of their research teams and Drs. Chrishantha Abeyesena, Chandrani Piyasena made available their research work and this made our task easier. We express our gratitude to Prof. Ranil Fernando for allowing us to use data from his PhD thesis that is still under preparation.

We acknowledge the help given by Dr. KDRR Silva, Dean, Faculty of Livestock, Fisheries and Nutrition, University of Wayamba, Ms. RDLK Malkanthi, Dept. of Nutrition, University of Wayamba, Dr. DGNG Wijesinghe, Dept. of Food Science & Technology, University of Peradeniya and Prof. A Jayakody, Faculty of Agriculture, University of Peradeniya.

We thank Dr. Deepthi Perera, the Director, Family Health Bureau and members of her team, Drs. Chithramalee de Silva, Nilmini Hemachandra, Nirosha Lankasara and Hemantha Perera for making available unpublished routine data from the FHB database.

In the Department of Census and Statistics, Mr. Bandulasena, Director, Information & Communication Technology, Ms. Indu Bandara and Pushpa Gunasekera of the Medical Statistics Unit facilitated our search for data. Their help is gratefully acknowledged.

Dr. Dula de Silva, Programme Officer, Mr. Laksiri Nanayakkara, Ms. Dilka Peiris and Mr. Thushara Keerthiratne of the World Food Programme shared their data and experiences in the field.
Many librarians helped us to obtain data and special mention must be made of the librarians of the Medical Research Institute, World Health Organization, PGIM, PGIA, National Science Foundation and the Family Health Bureau.

We are thankful to Drs. Supun Wijesinghe and Shreenika Weliange for providing us with the most updated digital maps and Dr. Neil Thalagala for assisting in the approximation of MOH areas in the maps.

Comments made at the presentation helped us to improve this document. We thank Drs. SM Mozzame Hossaine, Lalith Chandradasa, RMK Ratnayake, S Mahamithawa and Sarath Amunugama for their constructive feedback.

We thank Mr. Nimal Weerasinghe of UNICEF for logistics support.

In all the places we visited, many people, senior and junior, gave of their time, shared their experience and helped us to obtain relevant data. Although we are unable to mention each individual by name, we are immensely grateful to each and every one of them.
Executive summary

The importance of nutrition for good health of individuals and for the economic growth and development of a country is well recognized. Though Sri Lanka has achieved much improvement in social, health and educational outcomes, nutritional outcomes do not match the achievements in the other sectors.

This review aimed to collate all available documents, reports, research and other information on nutritional status, its determinants and evaluation of interventions with a view to identifying gaps and opportunities to improve nutritional status with particular emphasis on young children and to map available data to the lowest possible geographic unit.

All published and unpublished literature related to nutrition from January 2006 to April 2011 was collected and perused. Surveys were the main source of national and district level information while routinely collected data from information systems of the country and research studies were used to complement this information, wherever available. Attempts were made to illustrate important nutrition related indicators at district level and MOH level using published maps and maps created using ArcGIS 9.3 version software. A preliminary presentation of the desk review was done by the team of reviewers after perusing all relevant literature and comments received were incorporated into the report.

Malnutrition pervades the whole life cycle and the report is based on the nutritional problems at different stages represented in this circle.

Prevalence of LBW has fluctuated between 16.9 - 17.6% from 2003 to 2008. Prevalence of LBW was lowest in the urban sector and highest in the estate sector. District distribution shows that LBW is high in districts where the proportion of population participating in agriculture and women’s participation in the labour force are high. Research suggests that a calorie intake less than 2200 kcal and protein intake of less than 55 g, having 8 or less hours of sleep, standing for >2.5 hours per day either in the second or third trimesters or both and a BMI less than 19.8 kg/m² at the booking visit were found to be predictive of LBW. Analysis of routine data suggested that adequate weight gain during pregnancy can reduce the prevalence of LBW substantially. However, it is noted that only a third of the women gain adequate weight during pregnancy. Therefore, from a programmatic point of view, while educating the population on
the need for an adequate pre-pregnancy BMI, ensuring adequate weight gain during pregnancy should be an immediate priority goal.

The review identified that PEM sets in early in life, even before 6 months of age. Marked disparities exist in the prevalence of PEM among preschool children between the sectors. Prevalence of stunting in the estate sector was three times that of the urban sector and underweight was twice as high while in wasting, the differences in prevalence were not so wide. Studies highlighted the fact that there is marked variation in the prevalence of PEM within districts and even within an MOH area. The key factors identified through multivariate analysis as being associated with all indicators of PEM among children under 5 years were low birth weight and the total number of children in the household. Poor nutritional status of the mother was found associated with wasting and underweight.

Among school age children, prevalence of stunting and thinness were found to be high. Overweight and obesity are emerging in urban populations with the co-existence of high levels of under nutrition. Review indicated that both underweight and overweight/obesity are problems related to PEM among women of reproductive age. Under nutrition was found to be a problem among younger women while overweight and obesity was a problem among the older group. Based on research findings, prevalence of underweight among the elderly population ranged from 13% to 50%. Men were more likely to be underweight compared to women. Over 50% of elderly persons on the estates were malnourished.

Anaemia is a problem in all age groups of the population. Prevalence of anaemia among preschoolers in the country ranged from 25-35%. However, approximately two thirds of them were only mildly anaemic. Though overall prevalence was not different between the three sectors, mild anaemia was commonest in the urban sector while moderate and severe anaemia were highest in the rural sector. Low level of education in the mother, being in lowest wealth quintiles and low individual dietary diversity were significantly associated with anaemia among preschoolers. Data on anaemia among school aged children indicated that prevalence of anaemia ranged from 16.3% among 5-9 year olds, 9.9% - 13.9% among 10-15 years and 54% among 12-16 year olds.

Among reproductive age women, anaemia ranged from 22.2% to 39%. Urban sector reported the highest prevalence of mild anaemia while estate sector reported the highest percentages of moderate and severe anaemia. Prevalence of anaemia was high among older women, those
with higher number of children and among women in the lowest wealth quintiles. Pregnant women recorded a prevalence of anaemia ranging from 16.7% to 34% in different surveys. This prevalence was highest in the urban sector.

A study in 2006 on prevalence of VAD showed that while children did not show any clinical features of VAD such as night blindness and Bitot’s spots, the prevalence of VAD based on biochemical evidence was 29.3%. This suggests that it is still a significant public health problem in the country.

A national prevalence survey in 2005 showed that the overall goitre prevalence in the country had decreased from 18.2% prior to salt iodisation to 3.8%. The median urinary iodine level was found to be 154.4 μg/l and the percentage of households receiving adequately iodised salt had increased to 91%, suggesting that the goal of elimination of iodine deficiency has been achieved in respect of all three indicators at the national level. However, higher prevalence was noted in the Central (10.3%), Western (7.3%) and Uva (7.8%) provinces, these rates being above the desired prevalence of <5%. Although the mean urinary iodine levels were in the desired range, high levels were noted in some geographic areas.

A more recent survey (2009-10) showed the age-sex adjusted national prevalence rate of goitre in persons above the age of 10 years to be 6.8% (95% CI: 6.0-7.6%). The study also identified pockets in which the goitre prevalence was over 10% and 15%. More importantly, a high prevalence of thyroiditis among those detected with goitre was noted, nearly 50% had histological changes and nearly 40% had biochemical changes (thyroperoxidase antibodies) suggestive of thyroiditis. These changes need continuing close observation.

Increasing trends in thyroid cancer are seen in the data from the cancer registry. This may partly reflect increasing detection rates. The changes in histopathology of cancer of the thyroid have been reported from clinical studies and are found to be compatible with the expected pattern of disease in a post iodisation population.

The average energy intake of Sri Lankans has not changed over time. Almost half of the population (50.7%) remains below the minimum level of energy consumption per day. Dietary diversity was low and consumption patterns showed that consumption of certain food items such as fruits, meat/poultry/fish/dry fish and dairy products is low.
A higher proportion of HHs in the estate sector and in the Eastern and Uva provinces reported severe food insecurity. Income of the mother had a positive impact on the calorie allocation for the mother while increasing family size had a negative impact on this. In addition, age and gender based calorie allocation was observed within family.

The main on-going nutrition intervention programmes are the integrated maternal and child health and the food and micronutrient supplementation programmes conducted through the MoH. In addition, there are the food subsidies and poverty alleviation programmes that reach selected population groups. Although the MoH programmes are monitored through the HMIS, their impact on nutrition has not been evaluated. Most of the indicators used in monitoring are process indicators and although there are a few nutrition outcome indicators, these are not linked in evaluation, probably because the very nature of the determinants of malnutrition makes it difficult to do so.

Thriposha, the main nutrition supplementation programme of the MoH is conceptually sound but has many programmatic issues that make it ineffective. The food subsidies and poverty alleviation programmes have not been evaluated adequately in terms of their impact on nutrition outcomes. Nutrition related experiments have mostly focused on correcting anaemia among school children and based on the findings generated, implementation of an iron supplementation programme for school children appears feasible.

Evidence shows that countries which have been successful in reducing malnutrition have had a high level of political commitment. The present commitment of the political leadership, availability of a nutrition policy and a national strategic plan of action are factors that need to be optimised in attempts to improve nutrition in the country.

The importance of strengthening and mainstreaming nutrition interventions through the MoH, while working in collaboration with other sectors at national and sub-national levels to improve food security and food diversity at household level are stressed. In this effort, the importance of strengthening the nutrition functions within the Directorate of Maternal and Child Health is emphasized.

The review identified that malnutrition particularly PEM and anaemia pervades the life circle. It also identified a window of opportunity to break the circle, by focusing on the period from
beginning of pregnancy to the end of the 2\(^{nd}\) year of life. The review therefore focuses mainly on strategies to address the issue of low birth weight and PEM in the first two years of life.

Strong monitoring and evaluation systems that feed into the programme planning cycle are prerequisites for success of interventions. The review suggests that some methods may strengthen routine data collection for effective monitoring and supervision at field level and also feed into a national nutrition outcome database.

The importance of developing methodologies to evaluate interventions and building them into the programme itself in the planning stages is stressed. It is also necessary to evaluate interventions before scaling up since experience shows that conceptually correct interventions that are shown to be effective in the experimental situation often do not produce the expected nutrition outcomes in the field. Success of programmes depends on the identification and remediation of problems seen.

The review highlighted several gaps in knowledge. In the socio demographic groups that have a high prevalence of malnutrition, a larger percentage has escaped malnutrition. It would be appropriate to study the ways in which this has been achieved and identify lessons that can be replicated.

Little is known about the socio cultural beliefs and behaviours during pregnancy that may influence birth weight.

The data available are mostly from cross sectional surveys and have limitations for causal analysis. Feasibility of acquiring longitudinal data on growth of infants and young children at least during the first 2 years of life needs to be explored.

Timeliness of further analysis of large datasets and also the use of analytical strategies that would focus on points for action would be useful. The iron supplementation programs show high coverage that is not reflected in the level of anaemia seen in the population. The reasons for this are not obvious and this is an area that needs exploration.

The estate population has special ethno-social beliefs and practices that influence nutrition. Given these differences, it is important to study separately the determinants of malnutrition in the sector and tailor programmes to address specific underlying needs.
Chapter 1

Introduction to the desk review

1.1 Introduction

“The real wealth of a nation is its people. And the purpose of development is to create an enabling environment for people to enjoy long, healthy and creative lives”.


So began the first Human Development Report in 1990 (UNDP, 1990). The importance of nutrition as a foundation for good health cannot be underestimated. Nutrition influences the ability to grow physically and emotionally, the capacity to learn and develop intellectually, and is the basis of productivity.

Malnutrition slows economic growth and perpetuates poverty. This is a result of losses in productivity from poor physical health, poor cognitive development, low educational attainment and increased health care costs. Productivity losses of an individual are estimated as 10% of one’s life time earnings and the losses to GDP as 2-3%. On the other hand, the returns on investments in nutrition are high and are rated among the highest in potential development investments (World Bank, 2006).

Sri Lanka has long been recognised as a model country, which has achieved extraordinary success in attaining high levels of male and female literacy, school enrolments and health outcomes despite low levels of per capita income. However, this statement does not stand true in relation to nutrition outcomes. Figure 1.1 shows the relationship between GDP rates per capita and child underweight rates in countries with low and medium human development. This shows that the prevalence of child underweight in Sri Lanka is much higher than that expected for the country’s per capita GDP. In fact, many countries with lower GDP have lower rates of underweight.
Figure 1.1: Relationship between child underweight rates (1995-2000) and GDP per capita (2002) in a cross-section of low and medium development countries

The nutritional status of Sri Lankan children does not match its achievements in child survival and this is illustrated in figure 1.2. Countries with similar levels of infant mortality have 20% of the underweight seen in Sri Lanka.

Figure 1.2: Relationship between the percent of children under five who were underweight in 1995-2000 and the infant mortality rate in 2002 in a cross-section of low and medium human development countries

Source: World Bank, 2005
Achievements in combating malnutrition over the last few decades have been modest in Sri Lanka with nutrition remaining as an unresolved health issue as well as a challenge. It is considered an important public health problem, if not the most important, because of the sheer magnitude, susceptibility and interaction with infections, the effects it has on cognitive development, probable contribution of some indicators to non-communicable diseases in later life, the inter-generational effects and the influence on adult productivity, both directly through health status and indirectly through educational attainment. The country is undergoing a demographic, epidemiological, social and nutrition transition and is on the threshold of a double burden of both under nutrition and overweight.

1.2 The terms of reference

The terms of reference for the assignment were:

- to collate all available documents, reports, research and other information on nutritional status, its determinants and evaluation of interventions for the period from January 2006 to April 2011;
- to review data with a view to identifying gaps and options to improve nutritional status with particular emphasis on young children;
- to map available data to the lowest possible geographic unit.

This review does not include nutrition during emergencies since such situations need special approaches and services.

1.3 Methodology

1.3.1 Methods used in the literature review

Literature related to nutritional status, determinants and interventions in Sri Lanka was collected for the period from January 2006 to April 2011. Two full time pre-intern medical officers obtained this information over a period of three months by visiting all relevant institutions and meeting at least one key resource person (Annex I). All published data available in these institutions for the required period were perused. In the absence of data within the study period, the search was advanced to literature available during 3-4 years prior to 2006. Most of the data were obtained by perusing published reports, records, abstract books of
conference proceedings and scientific journals while some data were directly accessed through their official websites. In addition, unpublished data were obtained through personal communication with the resource persons met. Finally, an internet search was conducted through Pub Med and Google Scholar using specific search terms such as ‘nutrition’, ‘low birth weight’, ‘iron deficiency anaemia’, food security’, etc., so as to ensure access of all relevant data.

Two types of health and non-health related data on nutrition were collected. Health-related data were on prevalence of malnutrition (protein-energy malnutrition, over-nutrition and micro-nutrient deficiencies) and their determinants, etc. Non-health related nutritional data were on food availability, food security, evaluation of nutritional programmes, etc.

Surveys were the main source of information while routinely collected data and research studies were used to complement this information, wherever available. National level information was mostly available from surveys conducted at regular intervals such as Sri Lanka Demographic and Health Surveys (DHS 1993, DHS 2000, DHS 2006-07), Household Income and Expenditure Survey (HIES 2006-07), Sri Lanka Complementary Feeding Study (SLCFS 2008) and Nutrition and Food Security Assessment in Sri Lanka (NFSA 2009). Some surveys were limited to a few selected districts.

The Family Health Bureau (FHB) was the only source for routinely collected nutritional data of the country based on H509 quarterly returns received from all Medical Officers of Health (MOH) areas. Annual Report of the FHB provides published data up to year 2009 (Family Health Bureau, 2011). In some instances, unpublished data of the FHB were used by the reviewers for calculating nutrition related indicators not available in the annual report.

Published research studies were mostly confined to one district or smaller administrative area.

Main places from where information was obtained for the review were: FHB, Ministry of Health (MoH), Department of Census and Statistics (DCS), Nutrition Coordination Unit, Nutrition Unit of the Medical Research Unit (MRI), Postgraduate Institute of Medicine (PGIM), Postgraduate Institute of Agriculture (PGIA), Universities, Ministry of Agriculture and Livestock Development and non-governmental organizations such as World Vision Lanka, World Food Programme (WFP) and World Health Organization (WHO).
1.3.2 Details of sampling used in the national surveys

Given below are the sampling details of the most frequently reviewed surveys, all of which had used 2001 census data as the sampling frame.

- **DHS 2006-07** (Department of Census & Statistics, 2009a) – The report was based on data from 19,862 housing units representing Sri Lanka excluding districts in Northern province (Jaffna, Kilinochchi, Mannar, Vavuniya and Mullaitivu) and provided accurate and representative nutritional data at national, sector (urban, rural and estate) and district levels. A stratified two-stage cluster sampling method was used to identify 2,500 out of 100,000 enumeration areas defined in the 2001 census and then a cluster of 10 households per enumeration area using a random systematic method. All ever married women aged 15-49 years living in these households were selected as participants. Anthropometry was carried out among children less than 5 years of age living in the selected households.

- **NFSA 2009** (Jayatissa & Hossain, 2010) – The report was based on data from 6,071 households representing 9 districts selected randomly from each province (Anuradhapura, Badulla, Colombo, Hambantota, Jaffna, Kurunegala, Nuwara Eliya, Ratnapura and Trincomalee) and Colombo Municipal Council (CMC) area. A multi-stage cluster sampling method was used to identify 30 clusters of Grama-Niladhari Divisions (GND) per district using Probability Proportionate to Size (PPS) technique and then 21 households per GND using a random systematic method. Irrespective of whether there was a child under five, all households were selected for the survey.

- **SLCFS 2008** (Ministry of Health, 2008) – Although of a small sample size, selection of the sample was based on a robust sampling method. The sample for the quantitative study was 1,878 households in 22 districts (excluding Mannar, Mullaitivu and Kilinochchi) selected from 57 clusters of Public Health Midwife (PHM) areas based on PPS technique and then 33 households per PHM area using a random systematic sampling method. Households having at least one child of 4-23 months of age were included.

- **HIES 2006-07** (Department of Census & Statistics, 2008) – The report was based on data from 22,000 housing units representing Sri Lanka excluding Northern province and Trincomalee district in the Eastern province. A two-stage stratified random sampling method was used to identify 2,200 clusters of census blocks and then 10 housing units per census block.
1.3.3 Mapping nutritional vulnerability

An attempt was made to spatially reference some of the important nutrition related indicators. Wherever published maps were not available, maps were created using ArcGIS Version 9.2 software. Maps were drawn to illustrate the distribution of nutrition information at district level and, whenever data were available, maps were created for the MOH level based on routine data from the FHB. District maps that were used were based on digital boundaries provided by the Survey General’s Department and MOH maps developed by the WHO country office. All maps were drawn to 1:50,000 scale.

In the FHB database, latest data are available for the year 2009 for 313 recently re-defined MOH areas. A difficulty was encountered in digitizing this data on maps due to the unavailability of digital maps geo-referenced according to the re-definition of MOH boundaries. Currently available digital maps are drawn according to previously defined boundaries of 279 MOH areas. Therefore, whenever an MOH area in the map was not identical with any of the MOH areas given in the FHB database, data were approximated to the map area that encompassed most of that MOH area within its geographical boundaries. Such approximations were made with the assistance of the FHB.

1.4 Preliminary presentation of the desk review

A preliminary presentation of the desk review was made on the 20\textsuperscript{th} of April 2011 by the team of reviewers after perusing all relevant literature. The purpose of the presentation was to obtain a feedback from the audience that mostly consisted of the researchers and programme officers who were responsible for the literature reviewed. A request was made by the review team to provide data not included, if any.
Chapter 2

The circle of malnutrition

Malnutrition pervades the whole life cycle and is illustrated in figure 2.1. Chapters 2 - 7 focus on the nutritional problems in different stages represented in this life cycle.

Figure 2.1: Circle of malnutrition

Elderly (60 – 74 years)

BMI
- Underweight 12.8%
- Overweight 8.8%
- Obese 2.8%

(De Silva, 2010)

Newborn

LBW
- 16.6% (DHS 2006-7)
- 18.1% (NFSA 2009)

1-5 years

Anaemia 25.2%
(NFSA 2009)

End of 2 years

- Stunting 22.0%
- Wasting 14.7%
- Underweight 21.1%

(DHS 2006-07)

End of 5 years

- Stunting 17.3%
- Wasting 14.7%
- Underweight 21.1%

(DHS 2006-07)

5-10 year olds

- Thinness 47%

More among boys than girls
(Jayatissa & Ranbanda 2006)

Lactating women

Anaemia 22.2%
(NFSA 2009)

Pregnant women

MUAC =< 23 cm
- Under nutrition 18.4%
- Anaemia 16.7%

(NFSA 2009)

Non pregnant women with a child under 5 years of age

- Anaemia 22.2%

(NFSA 2009)

End of 2 years

- Stunting 22.0%
- Wasting 14.7%
- Underweight 21.1%

(DHS 2006-07)

5-10 year olds

- Thinness 47%

More among boys than girls
(Jayatissa & Ranbanda 2006)

Ever married women

15-49 years

- Underweight 16.2%
- Overweight 24.0%
- Obese 7.2%

Height<145 cm 10.6%

(DHS 2006-07)
Chapter 3

Low birth weight

“In right now is the time his bones are being formed, his blood is being made and his senses are being developed. To him, we cannot answer “Tomorrow”. His name is “Today”.”

- Gabriela Mistral (1948)

Intra-uterine growth of the foetus is considered critical since there is evidence to suggest that much of the child’s future growth pattern is ‘set’ during this period of life. There is a large body of research to demonstrate that the foundation for adult health is laid down in-utero and in early childhood. For example, diseases such as coronary heart disease, hypertension and diabetes originate through responses to under nutrition during foetal life and infancy and these responses permanently change the structure, physiology and metabolism of the body (Barker et al, 1989 and 1995).

3.1 Sources of data

3.1.1 Surveys

National and district level data on Low Birth Weight (LBW) are available from three sources:

• DHS 2006-07
• SLCFS 2008
• NFSA 2009

The prevalence of LBW reported in the DHS 2006-07 was based on 6,864 surviving children who were born in the 5 years preceding the survey and on weighted data that take the differential sampling fractions into account. The interviewers were able to locate the Child Health Development Record (CHDR) in 935 of children identified. In the estate sector, the CHDR was available only in 72% in contrast to 94% and 95% in the urban and rural sectors. In the Nuwara Eliya district, data were available only from 79% of the identified children.

In the SLCFS 2008, birth weight data were available from 1,878 children 4-23 months of age and thus represented values applicable for the two years preceding the survey.
Prevalence of LBW reported in the NFSA 2009 was based on 2,634 surviving children born 5 years prior to survey. Sampling weights have been used in computation of the prevalence.

3.1.2 Routine data

- Indoor Morbidity and Mortality Returns (IMMR) - This data is published in the Annual Health Bulletin (AHB) up to year 2007 (Ministry of Health, 2007a)
- Maternal and Child Health (MCH) Returns from MOH areas (H509) available with FHB

The prevalence values of LBW given by the two sources of routine data differ from each other. The IMMR includes all live births occurring in an institution and does not necessarily relate to births of a given district. Furthermore, this data include the weight of all live births (including babies who may die prior to discharge from hospital) in each institution. The reporting for any given year is incomplete and the degree of under reporting varies from year to year. The proportion of LBW reported for a given year may also be influenced by the type and nature of institutions that do not report in a given year. However, this information is not affected by the increased survival of LBW infants seen in recent times.

The MCH return is based on data recorded in the CHDR collected by the PHM for all births registered by her, and should reflect the district situation more accurately, if coverage is complete. However, these data are affected by survival of LBW babies.

3.1.3 Research studies

A few studies that have explored different aspects of LBW are included.

3.2 Prevalence of LBW

The medium term plan on Family Health 2007-2011 has as one of its objectives a reduction of LBW to below 12% by year 2011 (Family Health Bureau, 2007). Table 3.1 shows that the prevalence of LBW has changed little during the period 2003-2008. The prevalence of 12.5% and 13.9% reported by the FHB is suggestive of under reporting in the field data. The figures reported in the DHS 2006-07 and SLCFS 2008 were very similar and compatible with the data.
from AHB. The higher value seen in the NFSA 2009 is most likely to be a function of the districts that were randomly selected in to the sample at the first stage of sampling.

Table 3.1: Prevalence of LBW at national level

<table>
<thead>
<tr>
<th>Source</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2003</td>
</tr>
<tr>
<td>AHB</td>
<td>16.9%</td>
</tr>
<tr>
<td>FHB</td>
<td></td>
</tr>
<tr>
<td>DHS 2006-07</td>
<td></td>
</tr>
<tr>
<td>SLCFS 2008</td>
<td></td>
</tr>
<tr>
<td>NFSA 2009</td>
<td></td>
</tr>
</tbody>
</table>

* Medical Statistics Unit, Department of Census & Statistics, 2008 (unpublished data)

Three hospital-based studies on LBW report varying prevalence of LBW and are summarised in table 3.2

Table 3.2: Summary of research studies on the prevalence of LBW

<table>
<thead>
<tr>
<th>Author and year</th>
<th>Time and place</th>
<th>Sample size</th>
<th>% LBW</th>
<th>Mean birth weight</th>
<th>District values from AHB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herath, 2004</td>
<td>Teaching Hospital Kandy Sep - August, 2001</td>
<td>424 births</td>
<td>23.8%</td>
<td>2742.9 g</td>
<td>Kandy 22.3 % (2003)</td>
</tr>
<tr>
<td>Ibralebbe, 1995</td>
<td>Base Hospital Avissawella, 1995</td>
<td>548 births</td>
<td>15.3%</td>
<td>2859.6 g</td>
<td>Colombo 16.1% (2003)</td>
</tr>
</tbody>
</table>

Classification of LBW

Birth weight is the commonly used indicator for comparison of population characteristics because of the relative simplicity, accuracy and reproducibility of the measurements as well as the difficulty in ascertaining gestational age accurately. However, a birth weight less than 2500 g may be due to the baby being born preterm (a baby born before completing 37 weeks or 259 days of gestation), Intra-Uterine Growth Retardation (IUGR) of a term baby or may be a
combination of the two. In planning interventions, it is therefore important to know the extent of preterm and IUGR since the interventions for prevention of these are different.

Although recent national level data on this are not available, it is likely that the majority of LBW may be due to IUGR. A study by Soysa & Jayasuriya (1975) based on deliveries in the University Unit at the De Soysa Hospital for Women reported that 80% of LBW was due to IUGR. A later study in 1992 also reported a rate of 76% (De Silva et al, 1992). A prospective study carried out in Gampaha district between May 2001 and April 2002, during which a total of 885 pregnant mothers were recruited at \( \leq 16 \) weeks of gestation and followed up until partus reported a LBW rate of 12.2%. In this cohort of women, 12% delivered preterm babies while 16.8% had a weight below the \( 10^{\text{th}} \) percentile for gestational age and 9.2% a weight below the \( 5^{\text{th}} \) percentile (Abeyesena, personal communication, 2011).

### 3.3 Geographical distribution of LBW

#### 3.3.1 Sectoral variation of LBW

Sectoral differences were observed in the prevalence of LBW and in the mean birth weight (Table 3.3).

<table>
<thead>
<tr>
<th>Source</th>
<th>Prevalence of LBW %</th>
<th>Mean birth weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>DHS 2006-07</td>
<td>12.8</td>
<td>16.4</td>
</tr>
<tr>
<td>SLCFS 2008</td>
<td>12</td>
<td>16.7</td>
</tr>
<tr>
<td>NFSA 2009</td>
<td>15.7</td>
<td>16.8</td>
</tr>
</tbody>
</table>

*It must be noted that the sample size in the estate sector was small in the SLCFS 2008.*

#### 3.3.2 District variation of LBW

The comparison of district prevalence of LBW between the DHS and NFSA shows that the latter has consistently reported higher values for the districts common to both. However, in the absence of reported sampling errors for the variable at district level in either of the surveys, it is difficult to determine if the increase is a true deterioration of nutritional status.
Maps shown below are drawn by the prevalence of LBW in each district/MOH area categorised into three levels (low = ≤ 15.0%, moderately high = 15.1-20.0%, very high = > 20.0%) based on MCH goals of the FHB for year 2015.

Maps 3.1 and 3.2 compare the district distribution of LBW, as reported in the DHS 2006-07 and based on unpublished IMMR data from the Medical Statistics Unit compiled for year 2008. Compared to DHS data (map 3.1), map 3.2 shows that the percentages are higher for districts that have large teaching hospitals and provincial hospitals which are referral centres for pregnancies with complications.

Map 3.1: District distribution of LBW  
Map 3.2: District distribution of LBW

*Source of data:* DHS, 2006-07  
*Source of data:* Medical Statistics Unit, Dept. of Census & Statistics, 2008  
(IMMR, unpublished data)
Map 3.3 shows the wide variation of LBW within districts at MOH level using FHB data for 2009. Interpretation of data in the Central province shown in the map is difficult due to reasons mentioned in section 1.3.3.

Map 3.3: Distribution of LBW at MOH level

Source of data: Family Health Bureau, 2009
(MCH quarterly return – H509, unpublished data)

Refer section 3.1.1 for limitations in interpreting the map.

3.4 Determinants of LBW

3.4.1 Maternal socio-demographic characteristics

• Age of mother

DHS 2006-07 data show that the percentage LBW decreases with increasing age of the mother at birth, the highest percentage (25.8%) being in those less than 20 years of age. However, it should be noted that in the year 2006, only 5.4% of the births (i.e. 20,153 births) were to mothers below 20 years of age. The highest proportion of LBW was reported among those in birth order one, the risk increasing in birth orders 4 and above.
• *Household income*

It is important to note that families in the richest wealth quintile had a LBW rate of 11% (DHS 2006-07) while households with monthly income exceeding Rs. 32,000 had a LBW rate of 11.3% (NFSA 2009). This highlights the fact that factors other than poverty play a role in the generation of LBW.

Households reporting an income below Rs. 14,000 per month accounts for 41.7% of the LBW (Table 3.4). It is estimated that if the income of those receiving below Rs. 14,000 were to improve so that they have a monthly household income of Rs. 14,000-19,999, the overall prevalence of LBW would decrease from the current 18% to 14.8% [Calculation by the reviewers using data reported in the NFSA].

**Table 3.4: Distribution of LBW by monthly household income**

<table>
<thead>
<tr>
<th>Monthly household income (Rupees)</th>
<th>Prevalence of LBW %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;9 000</td>
<td>21.1</td>
</tr>
<tr>
<td>9 000-13 999</td>
<td>20.6</td>
</tr>
<tr>
<td>14 000-19 999</td>
<td>16.6</td>
</tr>
<tr>
<td>20 000-31 999</td>
<td>14.6</td>
</tr>
<tr>
<td>&gt;= 32 000</td>
<td>11.3</td>
</tr>
</tbody>
</table>

*Source: NFSA, 2009*

• *Maternal education*

Maternal education is inversely related to LBW, mothers with higher educational attainment having lower prevalence of LBW (table 3.5). In improving educational attainment, a high-risk approach of reducing the prevalence in the lower educational categories to that of the secondary education level will result in a LBW prevalence of 16.1%. However, by improving education so that the population in each category moves to the category above, the overall prevalence of LBW can be reduced to 14.5%. Therefore, the educational approach should be focused not only towards ensuring school enrolment but an overall improvement so that there is a population shift towards achieving higher educational levels [Calculation by the reviewers using data reported in the DHS 2006-07].
Table 3.5: Distribution of LBW by level of education of the mother

<table>
<thead>
<tr>
<th>Level of schooling</th>
<th>Prevalence of LBW %</th>
</tr>
</thead>
<tbody>
<tr>
<td>No education</td>
<td>30.3</td>
</tr>
<tr>
<td>Primary</td>
<td>20.6</td>
</tr>
<tr>
<td>Secondary</td>
<td>17.5</td>
</tr>
<tr>
<td>Passed GCE Ordinary Level (OL)</td>
<td>14.7</td>
</tr>
<tr>
<td>Higher</td>
<td>13.2</td>
</tr>
</tbody>
</table>

*Source: DHS, 2006-07*

- **Birth interval**

It is well documented that birth interval has a J shaped relationship with birth weight (Conde-Agudelo et al, 2006) However, published DHS 2006-07 data have not presented the effects of the length of birth interval. In this context, it is important to examine the trends of this variable over time (table 3.6). Although the percentage of women with a birth interval less than 2 years has decreased over time, so has the percentage of women with a birth interval of 24-35 months, during which the risk of LBW is lowest. There is also a marked increase in long birth intervals over 48 months, during which the risk of LBW is high. These changes are likely to influence the prevalence of LBW. This data suggests that attention to spacing births may be an important point for intervention.

Table 3.6: Trends in birth interval among reproductive aged women

<table>
<thead>
<tr>
<th>DHS</th>
<th>Birth intervals (months)</th>
<th>&lt; 23</th>
<th>24-35</th>
<th>36-47</th>
<th>48 +</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-07</td>
<td></td>
<td>10.1</td>
<td>16.1</td>
<td>17.9</td>
<td>56.0</td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td>17.6</td>
<td>21.5</td>
<td>17.5</td>
<td>43.4</td>
</tr>
<tr>
<td>1993</td>
<td></td>
<td>21.4</td>
<td>26.5</td>
<td>17.2</td>
<td>34.8</td>
</tr>
</tbody>
</table>

*Source: DHS, 2006-07*

3.4.2 **Maternal anthropometric characteristics**

Maternal height, pre-pregnancy weight, Body Mass Index (BMI) and weight gain during pregnancy have all been shown to be predictors of LBW.

In the DHS 2006-07, the BMI has been calculated for all non-pregnant married women aged 15-49 years including those who have completed childbearing. Therefore, the prevalence of low BMI reported in this survey is probably not a satisfactory proxy measure for pre-pregnant
weight of women. On the other hand, the NFSA data were for non-pregnant women of the same age category and with a child under 5 years of age, and therefore more likely to be a younger group of women, some of whom may not have completed their child bearing. Maternal BMI at the first booking visit available through routine data from the FHB is a better proxy measure for pre-pregnant BMI of women. Figure 3.1 shows the relationship between prevalence of LBW and the proportion of mothers having a BMI below 18.5 at the booking visit by district. It is interesting to note that the weight of mothers in Nuwara Eliya at the booking visit was not greatly different from that in many districts which have lower prevalence of LBW, suggesting that LBW may be due to low weight gain during pregnancy.

**Figure 3.1: Relationship between LBW and BMI at booking visit**

![Figure 3.1: Relationship between LBW and BMI at booking visit](image)

**Source of data:** Family Health Bureau, 2008

Jananthan et al (2009) reported a study carried out in Jaffna where secondary analysis of anthropometric data was carried out in a sample of 563 normotensive, non-morbid adult pregnant mothers who had the first visit = 13 weeks and had term singleton births (37 completed weeks). They were selected from among 2,056 singleton deliveries occurring over a period of 3 years to women registered for care by the MOH office Jaffna. The characteristics of pregnant mothers and their new born babies are given in table 3.7.
Table 3.7: Characteristics of pregnant mothers and their newborn babies

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>28.2</td>
<td>5.5</td>
</tr>
<tr>
<td>Parity</td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Weight at first visit (kg)</td>
<td>53.3</td>
<td>10.6</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>155.1</td>
<td>6.2</td>
</tr>
<tr>
<td>Pre pregnancy BMI (kg/m²)</td>
<td>22.2</td>
<td>4.3</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>3040.0</td>
<td>441.9</td>
</tr>
</tbody>
</table>

Source: Jananthan et al, 2009

Jananthan et al (2009) used a polynomial regression model to examine critical values of weight, height and BMI to ascertain a birth weight of 2500 g. The weight at first visit corresponding to a birth weight of 2500 g was 50.3 kg. However, this cut off had a low sensitivity of 54%. If the cut off was taken as < 58.1 kg, then the sensitivity would increase to 80% (figure 3.2).

Figure 3.2: Polynomial regression showing the relationship between maternal weight at booking visit and birth weight

Source: Jananthan et al, 2009

Maternal height analysis shows that the height corresponding to a BW of 2500 g was 154 cm. The sensitivity at this level was only 45% while if the cut off is increased to 162 cm, the sensitivity would increase to over 80% (figure 3.3). The BMI corresponding to a birth weight of
2500 g was 21.1 kg/m². Sensitivity at this level was 60% while a BMI cut-off value of 23.7% would increase the sensitivity to 80% (figure 3.4). Pregnancy weight gain has not been examined by Jananthan et al.

Figure 3.3: Polynomial regression showing the relationship between maternal height and birth weight

Source: Jananthan et al, 2009

Figure 3.4: Polynomial regression showing the relationship between maternal BMI at booking visit and birth weight

Source: Jananthan et al, 2009
It is important to note that in this select healthy group whose mean weight, height and BMI were 53.3%, 155 cm and 22.2 kg/m² respectively, the LBW rate was as low as 8.7%.

Table 3.8 is based on unpublished data from the FHB collected during the nutrition week in 2010.

**Table 3.8: Pre pregnancy weight and pregnancy weight gain and birth weight**

<table>
<thead>
<tr>
<th>Category</th>
<th>No.</th>
<th>Mean birth weight</th>
<th>Number % less than 2.5 kg</th>
<th>Mean weight gain kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI &lt; 18.5 kg/m² &amp; adequate weight gain</td>
<td>948</td>
<td>2.96</td>
<td>117</td>
<td>12.3</td>
</tr>
<tr>
<td>BMI &lt; 18.5 kg/m² &amp; inadequate weight gain</td>
<td>2038</td>
<td>2.78</td>
<td>490</td>
<td>24.0</td>
</tr>
<tr>
<td>BMI &gt;= 18.5 kg/m² &amp; adequate weight gain</td>
<td>2532</td>
<td>3.09</td>
<td>225</td>
<td>8.9</td>
</tr>
<tr>
<td>BMI &gt;= 18.5 kg/m² &amp; inadequate weight gain</td>
<td>5042</td>
<td>2.95</td>
<td>682</td>
<td>13.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10560</strong></td>
<td><strong>2.95</strong></td>
<td><strong>1514</strong></td>
<td><strong>14.3</strong></td>
</tr>
</tbody>
</table>

*Source of data*: Family Health Bureau, 2010

Adequate weight gain in those with BMI < 18.5 kg/m² at first visit = > 12.5 kg based on recommended weight gain 12.5 - 18 kg.

Adequate weight gain in those with BMI >= 18.5 kg/m² at first visit = >11.5 kg based on recommended weight gain 11.5 - 16 kg.

The data show that even if the BMI at first visit is low, if the recommended weight gain is achieved during pregnancy, the LBW rates can be reduced. It is seen that a pre-pregnancy BMI of over 18.5 kg/m² and adequate weight gain during pregnancy would halve the current LBW rate (table 3.8).

Pre-pregnancy BMI ideally should be addressed through improved nutrition of adolescents and young females. But since most of childbearing still occurs within marriage in Sri Lanka, the time between marriage and first pregnancy may provide a vital opportunity to improve their nutrition. However, as shown in figure 3.5, this interval is very short.
3.4.3 Food intake during pregnancy

Perera and Wijesinghe (2007) following up a cohort of 140 women registered for antenatal care in the Kandy General Hospital examined the effects of maternal energy and protein intake on birth weight. Women selected for the study were healthy women with a pre-pregnancy weight > 45.5 kg, height > 145 cm and a gestational duration more than 37 weeks. Dietary data were collected using a food frequency questionnaire and two dietary recalls done in the third trimester. The study showed that weight gain during pregnancy was highly correlated with a maternal energy intake of over 2200 kcal/day (r=0.67, p=0.000) and a protein intake of over 55 g/day (r=0.6, p=0.000). Importantly, it was shown that 50% of the maternal weight gain was accounted for by the calorie intake in contrast to only 10% by the protein intake. These values have implications for supplementation programmes.

In the same study, birth weight of the infants showed a significant correlation (r=0.447, p=0.000) with pregnancy weight gain. However, height did not show a significant relationship (r=0.028, p=0.745). The lack of a relationship with height in this study may be because only women with a height > 145 cm were selected into the sample. The study however, did not attempt to quantify work during pregnancy which is an important factor that would influence the relationship examined.

3.4.4 Poverty and labour force participation of women

Figure 3.6 examines the relationship between the district prevalence of LBW, proportion of population below the poverty line, proportion of women participating in the labour force and the percentage of the population in agriculture.
<table>
<thead>
<tr>
<th>District</th>
<th>LBW averaged for 3 years 2006-2008</th>
<th>% Population below poverty line 2007</th>
<th>% Labour force participation rate for women 2009</th>
<th>% Population engaged in agriculture 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombo</td>
<td>16.9</td>
<td>5.4</td>
<td>29.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Gampaha</td>
<td>14.3</td>
<td>8.7</td>
<td>27</td>
<td>7.5</td>
</tr>
<tr>
<td>Kalutara</td>
<td>15.8</td>
<td>13</td>
<td>30.1</td>
<td>19.8</td>
</tr>
<tr>
<td>Kandy</td>
<td>20.4</td>
<td>17</td>
<td>28</td>
<td>24.8</td>
</tr>
<tr>
<td>Matale</td>
<td>19.0</td>
<td>18.9</td>
<td>34.7</td>
<td>42.5</td>
</tr>
<tr>
<td>Nuwara Eliya</td>
<td>32.0</td>
<td>33.8</td>
<td>45.3</td>
<td>69.4</td>
</tr>
<tr>
<td>Galle</td>
<td>12.5</td>
<td>13.7</td>
<td>32.9</td>
<td>28.6</td>
</tr>
<tr>
<td>Matara</td>
<td>18.3</td>
<td>14.7</td>
<td>33.1</td>
<td>41.8</td>
</tr>
<tr>
<td>Hambantota</td>
<td>13.7</td>
<td>12.7</td>
<td>36.5</td>
<td>44.4</td>
</tr>
<tr>
<td>Jaffna</td>
<td>15.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kilinochchi</td>
<td>11.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mannar</td>
<td>14.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vavuniya</td>
<td>16.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mullaitivu</td>
<td>18.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batticaloa</td>
<td>18.6</td>
<td>10.7</td>
<td>20.6</td>
<td>27.2</td>
</tr>
<tr>
<td>Ampara</td>
<td>14.0</td>
<td>10.9</td>
<td>18.8</td>
<td>36.2</td>
</tr>
<tr>
<td>Trincomalee</td>
<td>14.6</td>
<td></td>
<td>27.6</td>
<td>38</td>
</tr>
<tr>
<td>Kurunegala</td>
<td>16.5</td>
<td>15.4</td>
<td>34.2</td>
<td>35.3</td>
</tr>
<tr>
<td>Puttlam</td>
<td>13.2</td>
<td>13.1</td>
<td>29</td>
<td>32.3</td>
</tr>
<tr>
<td>Anuradhapura</td>
<td>17.2</td>
<td>14.9</td>
<td>44.8</td>
<td>59.3</td>
</tr>
<tr>
<td>Polonnaruwa</td>
<td>17.2</td>
<td>12.7</td>
<td>33.9</td>
<td>47.9</td>
</tr>
<tr>
<td>Badulla</td>
<td>23.6</td>
<td>23.7</td>
<td>46.6</td>
<td>63</td>
</tr>
<tr>
<td>Monaragala</td>
<td>20.5</td>
<td>33.2</td>
<td>43.5</td>
<td>62.4</td>
</tr>
<tr>
<td>Ratnapura</td>
<td>18.0</td>
<td>26.6</td>
<td>39.9</td>
<td>47.1</td>
</tr>
<tr>
<td>Kegalle</td>
<td>19.2</td>
<td>21.1</td>
<td>34.9</td>
<td>29.5</td>
</tr>
</tbody>
</table>

Sources: ¹ Annual Health Bulletin, 2006 and 2007; Medical Statistics Unit, Department of Census & Statistics, 2008; ² Institute of Policy Studies, 2010; ³ Department of Census & Statistics, 2009b
When districts with a prevalence of LBW more than 18% are considered, it is seen that they are predominantly districts where more than 40% of the population are engaged in agriculture and labour force participation of women is over 30%. Hambantota is an exception in that, though it is a predominantly agricultural district with high participation rates of women in the labour force, the percentage LBW was low. It is further noted that in Hambantota district, the percentage below poverty line was low (12.7%). In Anuradhapura and Polonnaruwa, the two other districts which are mainly agricultural and have high participation rates for women, the percentage below the poverty line was below 15%.

### 3.4.5 Work during pregnancy

Aggregate data shown in figure 3.6 demonstrate that the type of work during pregnancy may be a predictor of birth weight. There is paucity of studies examining the relationship between work and birth weight.

Abeyesena et al examined the effects of psychological stress and physical activity on LBW, IUGR and pre term births (Abeyesena et al, 2009, 2010a, 2010b). They collected trimester specific information on the two exposures of interest as well as on confounders. Physical activities were assessed by inquiring about the duration of specific postures adopted per day during each trimester both at home and at work, while psychosocial stress was examined using the Modified Life Events Inventory (MLEI) and the General Health Questionnaire 30.

The risk factors for LBW in the uni-variate analysis were increase in maternal age, maternal height <= 153 cm, pre-pregnancy weight <= 40 kg, BMI < 19.8 kg/m², past history of LBW, sleeping less than 8 hours/ day, standing for 2.5 hours/day or more in the second or third trimesters or both, sitting for less than 3.5 hours/day during the second trimester and an MLEI score of 3 or more during the pregnancy. In the multivariate analysis, standing for 2.5 hours or more per day, sleeping equal to or less than 8 hours per day and BMI below 19.8 kg/m² were the only variables found to increase the risk of delivering a LBW baby (Abeyesena et al, 2010a).
The same study found that maternal age less than 25 years, mothers with primary level of education, past history of LBW, low weight gain during pregnancy, exposure to physical and chemical hazards during first trimester and shift work during the first trimester, standing for 2.5 hours/day or more during the second trimester and sleeping less than 8 hours/day during 1st and 3rd trimesters to be associated with preterm births. In the multivariate model, standing for 2.5 hours/day or more during any trimester and maternal age less than 25 years were shown to increase the risk of a pre-term birth (Abeyesena et al, 2010b).

Examining the relationship between Small for Gestational Age (SGA), the same authors reported that shift work and exposure to physical and chemical hazards during 2nd and 3rd trimesters, sleeping for less than or equal to 8 hours during 2nd or 3rd or both trimesters, walking for less than or equal to 2.5 hours per day, alcohol consumption during the 3rd trimester and a poor weekly gestational weight gain were significantly associated with SGA < 10th and < 5th percentiles. In the multivariate model, only poor weekly weight gain remained a predictor for SGA (Abeyesena et al, 2009).

All three papers by the above authors stress the importance of sleep and moderate exercise during pregnancy to reduce the risk of a LBW baby.

### 3.4.6 Previous history of LBW

Senanayake (personal communication, 2011) studied the reproductive performance of women who previously delivered a LBW baby at term using a matched case-control study design. Women with a documented previous term low birth-weight baby (<2.5 kg at a period of gestation > 37 completed weeks) were categorized as cases (N=100). Women with no such history matched for age (+/- 5 years), height (+/- 5 cm), BMI at booking (+/- 2.5 kg/m²), parity and medical disorders were selected as controls (N=100). The study demonstrated that there was a significant risk of delivering another low birth-weight baby in a future pregnancy (27% versus 4%; p<0.001). The risks of other adverse outcomes such as preterm labour in subsequent pregnancies were also increased.

### 3.4.7 Medical conditions

- **Psycho-social stress**

The study by Abeyesena et al (2010a) quoted above did not demonstrate psychosocial stress to be a risk factor for LBW, although Abeyesena (1995) had shown an increased risk of LBW [Odds
Ratio (OR) = 2.94; 95% CI: 1.38-6.3] in those who experienced => 2 adverse life events in an earlier study. This earlier study used a case control methodology in contrast to the cohort design used in the later study. The earlier study controlled for maternal age and per capita monthly income in the design stage of the study but in analysis, logistic regression or a similar procedure had not been applied. This may have resulted in incomplete control of confounders, hence the difference in the findings of the two studies.

• **Hypertensive disease**

Hypertensive disease of pregnancy is the second commonest cause of maternal mortality currently in Sri Lanka. Perera (2008) following up a cohort of 1020 pregnant women attending antenatal clinics in the Gampaha district before completion of 10th week of gestation until 6 weeks post partum reported the incidence of Pregnancy Induced Hypertension (PIH) to be 5.68 per 1000 pregnancies. In this cohort, the prevalence of LBW was 27%. The aetiological fraction i.e. the proportion of all cases of LBW that could be attributed to the exposure to PIH when all other factors affecting LBW are also taken into consideration was 14%. The study also showed that the presence of urinary micro-albumin at 20 weeks of gestation was a sensitive test (sensitivity of 94.8% and specificity of 72.8%) to identify women who may develop PIH later in pregnancy.

**3.4.8 Other factors known to influence LBW**

There are no recent studies on the relationship between urinary tract infections and lower genital tract infections and gender based violence/intimate partner violence. Studying the relative importance of wood smoke as a factor that may influence LBW is important since a large proportion of households in the country use solid fuel (79.6% national, 36.3% urban, 97.4% estates) and women are the most exposed to this risk.
Summary

• Prevalence of LBW has changed little from 2003-2008 fluctuating between 16.9% -17.6%.

<table>
<thead>
<tr>
<th>Year</th>
<th>% LBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>16.5</td>
</tr>
<tr>
<td>2004</td>
<td>17</td>
</tr>
<tr>
<td>2005</td>
<td>17.5</td>
</tr>
<tr>
<td>2006</td>
<td>17</td>
</tr>
<tr>
<td>2007</td>
<td>17.5</td>
</tr>
<tr>
<td>2008</td>
<td>18</td>
</tr>
</tbody>
</table>

• LBW prevalence is lowest in the urban sector and is 1.3 times this value in the rural sector and 2.4 times in the estate sector. District distribution shows that LBW is high in districts where the proportion of population participating in agriculture and women’s participation in the labour force is high.

• Research suggests that a minimum calorie intake of 2200 kcal and 55 g of protein to be essential to reduce LBW. The calorie intake will have to be adjusted taking type of work into account.

• Having ≤ 8 hours of sleep, standing for 2.5 hours or more per day in the second or third trimesters or both and a BMI 19.8 kg/m² were found to be predictive of LBW.

• Analysis of routine data suggests that adequate weight gain during pregnancy [i.e. 12.5-18.0 kg in those with a BMI <18.5 at booking and 11.5-16 kg in those whose BMI was ≥ 18.5 kg] can reduce the prevalence of LBW substantially.

• Scientific literature has identified indoor air pollution to be a risk factor for LBW. Although local data on this is not available, given the high percentage of households that use fire wood for cooking and the poor structure of housing, efforts to develop smoke free hearths is worthwhile.
Chapter 4
Protein energy malnutrition among pre-school children

“We are guilty of many errors and many faults, but our worst crime is abandoning the children, neglecting the foundation of life.”
- Gabriela Mistral (1948)

4.1 Sources of data

4.1.1 Surveys

National and district level data on Protein Energy Malnutrition (PEM) are available from a series of surveys conducted periodically up to 2009.

- DHS 2006-07
- NFSA 2009
- SLCFS 2008

The DHS 2006-07 and NFSA 2009 are comparable in terms of the age group studied, classifications and cut-offs used to identify malnutrition and the reference population used. It should however be noted that the latter survey identified its sample by randomly selecting one district per province in comparison to a more representative sample at national and sectoral levels in the DHS. Comparison of the district estimates between the two surveys is not possible since the confidence intervals of the district estimates are not available with the published data from either study.

The WHO nutrition database provides data converted to the WHO growth standards for the 1987 and the 2000 DHS surveys. However, comparisons with the DHS 2006-07 and the NFSA 2009 surveys are not possible from the limited information available.

4.1.2 Routine data

Routine data on weight for age is available from FHB based on its growth monitoring programme. The data are reported as percentage of children who fall below the 3rd percentile
weight for age in a given area out of those attending the growth monitoring programme. The possibility that the same child enters the statistics each month is high. Furthermore, the proportion not attending the growth monitoring programme is not known and it is likely that children who do not do well come to the clinic more often than the others to obtain their food supplements. The contrary may also be true in that mothers who are marginalised and likely to have malnourished children do not access services as often as the others.

The advantages of FHB data is that it is timely (available at the FHB on a quarterly basis up to 2009) and can be analysed by MOH areas. Repetitive information from the same child can be avoided by examining the data for a randomly selected month. However, it should be noted that mapping of this data might not be 100% accurate (refer section 1.3.3). This highlights the importance of the Ministry of Health conforming to administrative boundaries that are nationally gazetted, mapped and made available in the digital form from the Surveyor General’s Department when demarcating MOH areas. This has the added advantage of being able to share data collected and collated by other agencies, especially in planning and evaluation of multi-sectoral interventions aimed at improving nutrition.

4.1.3 Research studies

Research evidence on PEM of pre-school children is from studies in selected MOH areas. Among them, two studies were reviewed in detail:

- Baseline survey of the national nutrition surveillance system of Sri Lanka 2006
  This cross-sectional study was conducted in 5,164 households by the Nutrition Coordination Division of the MoH in 30 Divisional Secretary (DS) divisions (24 vulnerable DS divisions in 14 districts and 6 from unclear areas) in 5% of all households that had at least one child under 5 years (Nutrition Coordination Division, 2006). The study was done during the first phase of its nutrition surveillance programme and the selection of areas for surveillance was based on expert opinion, prevalence of underweight and trends in malnutrition identified using FHB data and the vulnerability mapping done by WFP/DCS.

- The series of studies commissioned by World Vision Sri Lanka on health and nutritional status of children under 5 years of age 2007
  The study identified selected DS divisions and in each, GN areas where their intervention programmes were planned. All households with a child under 5 years of age in the selected GN
areas were included in the survey. Thus, the prevalence computed for each GN area is for the total population under five years of age.

### 4.2 Prevalence of PEM

Figure 4.1 examines trends in child PEM that have been computed by the MRI correcting for age and standards used.

This shows that there has been a gradual reduction in the rates of child malnutrition from 1975 to 2000. The prevalence of underweight children has fallen from 38% in 1993 to 29% in 2000 (data from the two DHS surveys 1993 and 2000 were for the same age group and used the same reference population). The proportion of stunted children has declined even more (from 25% to 14%). It is seen that the underweight and stunting rates have declined at annual rates of 1.3 and 1.6 percentage points, respectively, over the period 1993-2000.

**Figure 4.1: PEM in pre-school children in Sri Lanka 1975-2000**

![Graph showing the prevalence of PEM in pre-school children in Sri Lanka from 1975 to 2000.](image)

*Source:* Medical Research Institute, 2002 cited in Jayatissa et al, 2006
Table 4.1 gives the current prevalence of malnutrition and compares the data from the DHS 2006-07 and NFSA 2009. The two surveys are comparable in terms of the age group studied and the reference populations used. However, they differ by their selection of districts for the survey in that, the 2009 study randomly selected one district per province. For example, 3 districts that reported a very high prevalence of malnutrition in the DHS 2006-07 (Badulla, Nuwara Eliya and Trincomalee) and Jaffna which was not included in the DHS 2006-07 were included in the NFSA 2009. Considering the wide variation in the nutrition indicators between districts within each province, it should be noted that an upward bias in the computed national values cannot be excluded.

**Table 4.1: Comparison of child nutrition data from the DHS 2006-07 and NFSA 2009**

<table>
<thead>
<tr>
<th>Year of survey</th>
<th>No.</th>
<th>Weight for age</th>
<th>Height for age</th>
<th>Weight for height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt; -3SD</td>
<td>&lt; -2SD</td>
<td>&lt; -3SD</td>
</tr>
<tr>
<td>All</td>
<td>2006-07</td>
<td>6648</td>
<td>3.7</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td>2009</td>
<td>2589</td>
<td>3.9</td>
<td>21.6</td>
</tr>
<tr>
<td>Male</td>
<td>2006-07</td>
<td>3436</td>
<td>3.8</td>
<td>21.8</td>
</tr>
<tr>
<td></td>
<td>2009</td>
<td>1261</td>
<td>3.6</td>
<td>21.6</td>
</tr>
<tr>
<td>Female</td>
<td>2006-07</td>
<td>3212</td>
<td>3.5</td>
<td>20.4</td>
</tr>
<tr>
<td></td>
<td>2009</td>
<td>1328</td>
<td>4.2</td>
<td>21.6</td>
</tr>
</tbody>
</table>

*Source: DHS, 2006-07; NFSA, 2009*

SLCFS 2008 reports data on malnutrition for the age group 4-23 months of age. The overall prevalence of stunting, wasting and underweight was 15.7%, 12.6% and 16.3%, respectively. This study highlights the fact that malnutrition sets in very early in life.

### 4.3 Geographical distribution of PEM

#### 4.3.1 Sectoral and provincial variation of PEM

Sectoral differences in malnutrition have been well documented (table 4.2). All three surveys show that the rural and estate sectors have higher rates of malnutrition compared to the urban sector, the estate sector being markedly worse off than the other two. This is an inequity that has persisted over time.
It is further noted that although there have been major improvements in educational attainment and access to improved sanitation and safe water, access to health services - an important determinant of nutrition - still remains difficult for those living on estates due to distance, difficult terrain and limitations of transport.

Table 4.2: Prevalence and trends in PEM of pre-school children by sector (2000-2009)

<table>
<thead>
<tr>
<th>Sector</th>
<th>% Stunted</th>
<th>% Wasted</th>
<th>% Underweight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DHS 2000</td>
<td>DHS 06/07</td>
<td>NFSA 2009</td>
</tr>
<tr>
<td>Colombo Metro</td>
<td>9.1</td>
<td>13.8</td>
<td>10.1</td>
</tr>
<tr>
<td>Other urban</td>
<td>12.1</td>
<td>6.3</td>
<td>15.0</td>
</tr>
<tr>
<td>Rural</td>
<td>18.1</td>
<td>16.2</td>
<td>17.4</td>
</tr>
<tr>
<td>Estate</td>
<td>43.4</td>
<td>40.2</td>
<td>46.7</td>
</tr>
</tbody>
</table>

Figures for DHS 2000 are from the WHO Global data base on child growth and malnutrition corrected for the new WHO standard; The data from the SLCFS (2008) are not included in the table above as the number of children from the estate sector was small and the age group studied was limited to 4-23 months of age.

The SLCFS 2008 reports data for all the provinces. It is seen that stunting is highest in the Uva and Central provinces and lowest in the Southern province. The highest prevalence of underweight children was also from the Central and Uva provinces (table 4.3).

Table 4.3: Nutritional status of children 4-23 months of age

<table>
<thead>
<tr>
<th>Province</th>
<th>Underweight N=1784</th>
<th>Stunted N=1790</th>
<th>Wasted N=1797</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western</td>
<td>12.4</td>
<td>11.9</td>
<td>13.2</td>
</tr>
<tr>
<td>Southern</td>
<td>16.5</td>
<td>15.8</td>
<td>11.4</td>
</tr>
<tr>
<td>Uva</td>
<td>19.3</td>
<td>24.8</td>
<td>10.6</td>
</tr>
<tr>
<td>North Western</td>
<td>15.1</td>
<td>10.3</td>
<td>9.9</td>
</tr>
<tr>
<td>Central</td>
<td>21.1</td>
<td>20.9</td>
<td>13.4</td>
</tr>
<tr>
<td>Sabaragamuwa</td>
<td>17.3</td>
<td>14.6</td>
<td>10.9</td>
</tr>
<tr>
<td>North Central</td>
<td>13.6</td>
<td>13.6</td>
<td>14.8</td>
</tr>
<tr>
<td>Eastern</td>
<td>18.4</td>
<td>18.8</td>
<td>14.9</td>
</tr>
<tr>
<td>Northern</td>
<td>19.4</td>
<td>19.4</td>
<td>15.3</td>
</tr>
<tr>
<td>All Provinces</td>
<td>16.3</td>
<td>15.6</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Source: SLCFS, 2008
4.3.2 District variation of PEM

As stated previously, a comparison of the district estimates between DHS 2006-07 and NFSA 2009 is not possible since the confidence intervals of the district estimates are not available in the published data for either study.

Maps shown below are drawn for three indicators of PEM (wasting, stunting and underweight) in each district/MOH area. The prevalence of wasting based on weight-for-height, stunting based on height-for-age and underweight based on weight-for-age is categorised into three levels according to the classification used by the WHO global database on child growth and malnutrition (World Health Organization, 1997) (Annex II). Prevalence of wasting and underweight has been further divided within the 'high' prevalence category because of high values in all districts.

Maps 4.1-4.3 show the district differences of wasting, stunting and underweight among children under five, based on DHS 2006-07 data. It is seen that districts in the Eastern and Uva provinces showed relatively high prevalence rates for all three indicators.

**Map 4.1: Wasting in children under 5 years**

![Map of wasting in children under 5 years](image1)

*Source of data: DHS, 2006-07*

**Map 4.2: Stunting in children under 5 years**

![Map of stunting in children under 5 years](image2)

*Source of data: DHS, 2006-07*
Map 4.3: Underweight in children under 5 years

![Map showing underweight in children under 5 years]

Source of data: DHS, 2006-07

The high prevalence of underweight seen among under five children is further disaggregated by age groups using FHB data for year 2009 (Maps 4.4 a-c). The maps show that underweight increases markedly after infancy and the problem becomes more with increasing age.

Map 4.4 a - c: Underweight in children under 5 years disaggregated by age

![Maps showing underweight in children under 5 years for different age groups]

Source of data: Family Health Bureau, 2011
4.3.3  Variation of PEM within districts

Map 4.5 shows the variation of underweight within districts of Sri Lanka. A high proportion of MOH areas shows a prevalence of underweight exceeding 25%.

**Map 4.5: Underweight in 2-5 year old children at MOH level**

Refer section 3.1.1 for limitations in interpreting the map.

**Source of data:** Family Health Bureau, 2009 (MCH Quarterly returns – H509, unpublished data)

During the period under review, there were a few studies on nutritional status of children that were limited to MOH areas. They are summarised in the table 4.4. The results highlight the fact that there is a high degree of variability in nutritional status within a geographic area.
Table 4.4: Summary of research studies limited to areas within districts on PEM in pre-school children

<table>
<thead>
<tr>
<th>Author and year</th>
<th>Geographic area</th>
<th>Age group</th>
<th>No.</th>
<th>% Stunted</th>
<th>% Wasted</th>
<th>% Underweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chandrasekara et al (2005)</td>
<td>Kurunegala Municipal area</td>
<td>3 - &lt;6 years</td>
<td>305</td>
<td>2.6 (18.6)</td>
<td>27.7 (13.3)</td>
<td>18.7%</td>
</tr>
<tr>
<td>Kodagoda (2009)</td>
<td>Ehetuwewa DS division</td>
<td>6-59 months</td>
<td>630</td>
<td>21.6 (18.6)</td>
<td>19.8 (13.3)</td>
<td>29.4</td>
</tr>
<tr>
<td>Peiris &amp; Wijesinghe (2005)</td>
<td>Weeraketiya DS division</td>
<td>&lt;5 years</td>
<td>1219</td>
<td>11.8 (18.8)</td>
<td>42.7 (20.9)</td>
<td>41.2</td>
</tr>
<tr>
<td>Chandrasekara (2003)</td>
<td>Ambalangoda Fishing families</td>
<td>1-5 years</td>
<td>189</td>
<td>11.3 (16)</td>
<td>23 (14.3)</td>
<td>31</td>
</tr>
<tr>
<td>Lathaharan (2009)</td>
<td>Nuwara Eliya MOH area</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; year of life</td>
<td>367</td>
<td>33.5 (40%)</td>
<td>Not studied</td>
<td></td>
</tr>
</tbody>
</table>

*Value within parenthesis is for the district from DHS 2006-07 for children aged less than 5 years

Studies 1 and 2 were from the same district, the first in an urban area and the second in a rural area. This probably accounts for the differences seen in the prevalence. The fishing community in Ambalangoda (Study 4) is a group where stunting was low but where acute malnutrition and wasting were higher than in the rest of the district. Study 5 that looked at stunting alone was confined to the MOH area Nuwara Eliya, and would represent the urban sector of the district. Although the sample included the estate sector, the prevalence of stunting was less than expected considering the district prevalence and the fact that the second year of life has the highest prevalence of stunting.

Cohort data on nutritional status are scarce while the commonly available data are from cross-sectional studies. A study done in the MOH area Kurunegala enrolled a cohort of 200 infants 4 months of age and followed them up to 6 months of age. Less than half the original sample (N=95) was seen at 6 months. Anthropometry was carried out at the 4<sup>th</sup> month and at the 6<sup>th</sup> month and information on feeding practices collected. The analysis is presented as a cross-section at the two points of time thus losing the advantage of a cohort study. At four months, 17.5% of infants were stunted, 11% wasted and 12% underweight. As is the usual pattern, stunting and underweight have increased and the prevalence of wasting has shown a reduction at 6 months.
4.3.4 Variation of PEM within DS divisions

The baseline survey of the Nutrition Coordination Division of the MoH in 2006 covered 5,164 households in all 3 sectors. The data on nutritional status of children under 5 years of age are presented for 27 DS divisions. Between the studied DS divisions, the prevalence of stunting varied from 45.9% to 9.4%, wasting from 34.3% to 10.0% and underweight from 40.8% to 13.4%. The percentage anaemic varied from 58.1% to 19.9%.

As shown in table 4.5, the series of surveys commissioned by the World Vision in Hambantota, Ampara and Anuradhapura districts highlight the very high variability of the nutrition indicators between GN divisions within a given DS division, i.e. malnutrition is seen to cluster within a DS division. This further highlights the need for collecting data on malnutrition for the smallest geographic area feasible for better targeting of interventions. Given the health infrastructure in the country, it is a feasible option to map some indicators of malnutrition at the MOH level by PHM area.

Table 4.5: Variability of child nutrition indicators within DS divisions

<table>
<thead>
<tr>
<th>DS Division</th>
<th>No. GND sampled</th>
<th>No. children measured</th>
<th>Range of the indicator ( % prevalence)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Height for age</td>
</tr>
<tr>
<td>1 Weeraketiya</td>
<td>26</td>
<td>1219</td>
<td>3 – 24</td>
</tr>
<tr>
<td>2 Lunugamwehera</td>
<td>25</td>
<td>1425</td>
<td>3 - 32.1</td>
</tr>
<tr>
<td>3 Pottuvil</td>
<td>20</td>
<td>1465</td>
<td>8.8 - 35.3</td>
</tr>
<tr>
<td>4 Vellavalei</td>
<td>20</td>
<td>1594</td>
<td>9.6 – 45.2</td>
</tr>
<tr>
<td>5 Paddipalai</td>
<td>23</td>
<td>2079</td>
<td>16.7 – 45.7</td>
</tr>
<tr>
<td>6 Kabithigollewa</td>
<td>9</td>
<td>452</td>
<td>18.2 – 39.7</td>
</tr>
</tbody>
</table>


Map 4.6 further illustrates this large variability observed in one of the DS divisions surveyed.
Overweight

Prevalence studies that highlight the problem of overweight in this age group are scarce. One such study done in pre-schools in Bambalapitiya and Wellawatta area was perused (Yathunanthan, 2009). A sample of 250 pre-school children aged 2-5 years was drawn from 9 pre-schools including two “international schools”. The study found that over-nutrition existed together with under nutrition. Fifteen percent of the children were stunted while 16% were wasted. Thirteen percent were overweight and importantly, 6% of them were also stunted.

4.4 Determinants of PEM

4.4.1 Child characteristics

- Age

The age distribution of childhood malnutrition is an important dimension of the problem from an intervention point of view. Table 4.6 shows that malnutrition starts early in life, even before 6 months of age and the maximum damage occurs in the first two years of life. The sharpest increase in malnutrition is noted in the second half of the first year and is seen to continue on to the second year of life. Studies from many parts of the world have consistently shown that this is the peak age for growth faltering and that it is very difficult to reverse the stunting after a
child has reached two years of age (WHO, 2005). Thus, the period from birth to two years of age becomes a ‘critical window of opportunity’ for promotion of growth. The need to focus on this period is stressed.

- **Birth weight**

LBW is an important predictor of malnutrition. It is shown that a child born with a weight below 2500 g is more than twice at risk of being malnourished (table 4.7).

<table>
<thead>
<tr>
<th>Birth weight</th>
<th>Stunting %</th>
<th>Wasting %</th>
<th>Underweight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2500 g</td>
<td>32.3</td>
<td>20.5</td>
<td>39.7</td>
</tr>
<tr>
<td>&gt;= 2500 g</td>
<td>15.6</td>
<td>9.9</td>
<td>17.1</td>
</tr>
<tr>
<td>Odds ratio</td>
<td>2.1</td>
<td>2.1</td>
<td>2.3</td>
</tr>
</tbody>
</table>

*Source*: NFSA, 2009

Figure 4.2 further illustrates that in LBW children, the decline in growth performance is greater and that their weight for age remains throughout the five years below that of the children born with normal birth weights.

**Figure 4.2: Growth performance (weight for age) of LBW children compared with those with normal birth weight**

*Source*: World Bank, 2007 (Based on DHS 2000)
Table 4.7 and figure 4.2 clearly identify a “window of opportunity” (pre-conception to two years) for the prevention of malnutrition in children under five years of age.

- **Gender**

Gender disadvantage in malnutrition among girls is not seen in Sri Lanka. The DHS 2006-07, SLCFS 2008 and the NFSA 2009 all showed that male children had only slightly higher values than girls for all three nutrition indicators.

### 4.4.2 Maternal characteristics

Maternal education has an inverse relationship with all three indicators of malnutrition. The strongest influence was seen for stunting, where children of mothers who have not had any schooling were at 4.2 times increased risk of stunting compared to children whose mothers have had schooling beyond the GCE Ordinary Level (OL) (DHS 2006-07).

Maternal BMI is also seen to be inversely related to malnutrition. Women whose current BMI was $< 18.5 \text{ kg/m}^2$ were 1.5 times more likely to have a thin child compared to women with a normal BMI. Maternal thinness is probably a proxy indicator of household food availability (DHS 2006-07).

### 4.4.3 Monthly household income and wealth index

As could be expected, the poorest wealth quintile and those with a lower income have a higher prevalence of malnutrition. It is noteworthy that around 10% of those in the highest wealth quintile as well as those with a monthly family income over Rs. 32,000 have children who have chronic malnutrition. However, this relationship is not observed for weight-for-height and weight-for-age (DHS 2006-07 and NFSA 2009).

### 4.4.4 Childhood diarrhoea and respiratory diseases

Diarrhoea, respiratory infections and asthma are common morbidities that specially impact on the nutritional status in children under 5 years of age. Although morbidity based on admissions to government health care institutions are available for pre-school children in the AHB, these morbidity patterns need to be interpreted with caution. The data represent episodes of illness and not persons and thus are influenced by the incidence and severity of disease as well as admission and management practices. Information on diarrhoea, respiratory illness and fever in
the two weeks preceding the survey is available from the DHS 2006-07 and the NFSA 2009. Table 4.8 shows the relative importance of common causes of mortality in children less than five years of age. It should be noted that the figures reported could be influenced by the timing of surveys in relation to seasonality of the illnesses.

Table 4.8: Causes of mortality in children below 5 years of age

<table>
<thead>
<tr>
<th>Causes of under 5 mortality</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhoea</td>
<td>3</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>10</td>
</tr>
<tr>
<td>Prematurity</td>
<td>24</td>
</tr>
<tr>
<td>Birth asphyxia</td>
<td>9</td>
</tr>
<tr>
<td>Neonatal sepsis</td>
<td>2</td>
</tr>
<tr>
<td>Congenital abnormalities</td>
<td>19</td>
</tr>
<tr>
<td>Other diseases</td>
<td>18</td>
</tr>
<tr>
<td>Injuries</td>
<td>15</td>
</tr>
</tbody>
</table>


The hospital data show that the death rates and case-fatality rates due to intestinal infections have decreased over time. A corresponding decrease in hospital admission rates for these infections is not observed (Ministry of Health, 2007a). The DHS 2000, 2006-07 and the NFSA 2009 reported prevalence of diarrhoea in the two weeks preceding the survey to be 6.7%, 3.3%, and 7.0%, respectively. In both the DHS 2006-07 and NFSA, the highest prevalence of diarrhoea was seen among 6-11 month age group. It is important to note that the NFSA reported a prevalence of diarrhoea as high as 8.5% among infants less than 6 months of age. The survey further reported very low rates of exclusive breast feeding such as 74% at 4 months, 45% at 5 months and only 10% at 6 months.

Age disaggregated data on respiratory morbidity are not available from the AHB. However, in children under one year, diseases of the respiratory system is the third commonest cause of hospitalisation (the first two being peri-natal conditions and the group with no definite diagnosis) and is ranked second in children 1-4 years (the commonest being ill defined conditions). The DHS 2006-07 and NFSA 2009 inquired about the signs and symptoms of acute respiratory infections and reported its 2 week period prevalence as 4.3% and 17%, respectively. The DHS 2006-07 further showed that 17.4% of children reported fever, a common symptom of infection during the two weeks prior to the survey. In comparison, the SLCFS 2008 reported
fever in nearly 50% of children in the two weeks preceding the study. Cough and cold were the commonest symptoms reported (47%). The estate population reported more illness than the other sectors.

SLCFS 2008 gives details of quantities of food and drink offered during illness. During the most recent episode of illness, nearly 60% of children were offered less than usual amounts of drink and nearly 71% less than usual amounts of food. It is seen that feeding during diarrhoea is somewhat better than for other illnesses, but here again nearly 39% were offered less than usual amounts of food and nearly 17% were given less than the usual quantity of breast milk and other fluids. The importance of paying attention to maintaining adequate nutrition during illness needs special attention.

4.4.5 Breast feeding practices

Availability of adequate quantities of appropriate food is a key determinant of a child’s nutritional status. Given the age distribution of malnutrition, it is important to pay attention to breast feeding and complementary feeding practices. Indicators related to breast feeding and young child feeding available from the DHS 2000 and 2006-07 have been analysed by Senarath et al (2010 and 2011) and compared in table 4.9.

Table 4.9: Comparison of Breast Feeding (BF) indicators among children 0-23 months

<table>
<thead>
<tr>
<th>Breast feeding indicators</th>
<th>DHS 2000</th>
<th>DHS 2006-07</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate %</td>
<td>95% CI</td>
</tr>
<tr>
<td>Early initiation of BF (0-23)</td>
<td>56.3</td>
<td>51.6-60.9</td>
</tr>
<tr>
<td>Children ever BF (0-23)</td>
<td>99.7</td>
<td>98.0-100</td>
</tr>
<tr>
<td>Exclusive BF rate(0-5 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predominant BF rate (0-5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full BF rate (0-5)</td>
<td>60.6</td>
<td>54.1-66.8</td>
</tr>
<tr>
<td>Current BF rate (0-23)</td>
<td>85.0</td>
<td>882.3-87.2</td>
</tr>
<tr>
<td>Continued Bf rate (1 yr)</td>
<td>85.7</td>
<td>79.4-0.3</td>
</tr>
<tr>
<td>Continued Bf rate (2 yr)</td>
<td>65.7</td>
<td>57.3-73.2</td>
</tr>
<tr>
<td>Median duration of any BF (&lt; 36 month)</td>
<td>22.2</td>
<td></td>
</tr>
<tr>
<td>Median duration of exclusive BF (&lt; 36 months)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Senarath et al, 2010; Senarath et al, 2011
As shown in table 4.9, current breast feeding practices have improved from the status described in the DHS 2000. The 2007 data show that the majority initiated breast feeding within the first hour after birth, exclusive breast feeding rate in children under 6 months of age was high and that almost all children under two years of age were currently being breast fed.

The rate of breast feeding has remained high during the first and second years of life. Figure 4.3 summarises the feeding status of children 0-23 months of age (Senarath et al, 2011).

**Figure 4.3: Feeding status by age among children 0-23 months of age** (N=2,735)

![Graph showing feeding status by age among children](image)

*Source:* Senarath et al, 2011

The analysis of factors influencing breast feeding indicated that breast feeding is strongly influenced by place of residence and the health care system, especially the work of the PHM. Delayed initiation was more likely in children delivered by Caesarian section and in those with a LBW and less likely among female infants, mothers from the estate sector and in richer wealth quintiles.

Non-exclusive breast feeding seemed to associate with babies in urban areas and estate sector. Absence of postnatal visits by PHM was an important determinant of non-exclusive breast feeding. A child was at risk of being “currently not breast-fed”, if born in a private hospital, was delivered by caesarian section or living in urban or estate areas. A woman living on the estates and not receiving postnatal home visits were more likely to discontinue breast feeding by one year (Senarath et al, 2011).
4.4.6 Complementary feeding practices

Detailed information on complementary feeding practices is available from the SLCFS 2008 as well as the NFSA 2009.

The SLCFS 2008 was planned to gather information on complementary feeding and used both qualitative and quantitative methodologies. The study triangulated information from key informant interviews, focus group discussions, observation of child mother pairs, as well as from a cross-sectional survey. The survey examined seven aspects in respect of complementary feeding: age of introduction of food, quantity, frequency, density, diversity, hygiene and responsive feeding. They found a delay in the initiation of complementary feeding due to the cultural practice of a “first feeding ceremony”, this being more for boys than girls. Prior to the first feeding ceremony, the child is not deprived of food but is given thin gruels of a liquid consistency. These practices are seen to violate two of the global recommendations on complementary feeding.

According to the SLCFS (2008), 50-60% of young infants do not meet the criterion of minimum meal frequency. In children 6-9 months of age, 62% met this criterion but with increasing age, this proportion declined to 45% in children 12-18 months and to 42% in those 18-24 months. The NFSA 2009 identified that only 53% of breast-fed children and 26% of non-breast fed children adequately met the minimum meal frequency criterion. This would be further compounded if the energy density of the food consumed is low, which is a common problem with cereal based diets (De Silva et al, 1994).

Both studies highlighted the fact that dietary diversity was low. Irrespective of the type of household, consumption of animal protein was low. Fish and eggs were consumed by 25% and 18%, respectively. Consumption of vitamin A rich foods and vegetables, lentils and dairy products was low especially in food insecure households (SLCFS 2008). Mean Individual Diet Diversity Score (IDDS) was 4.8 increasing with higher maternal education, income and wealth quintiles. The percentage of children yet to achieve the target of IDDS was 63.7% (NFSA 2009).

Good hygienic practices during preparation of food are important to prevent infections that may occur with the introduction of complementary feeding. The SLCFS 2008 found that only a fifth of the mothers were washing their hands with soap after cleaning the child while nearly third of mothers did not wash their hands with soap before preparing food or before feeding their child. The study also showed that mothers were not very sensitive to hunger cues.
The study done in pre-schools in Bambalapitiya and Wellawatta areas used a logistic regression analysis to examine the factors associated with stunting co-existing with overweight. Giving other milk foods during the breast feeding period, higher levels of consumption of food from outside, longer duration of TV watching and consumption of cola drinks were significantly associated with the outcome. LBW and smaller family size were found to be protective (Yathunanthan, 2009).

4.6 Multivariate analysis of the determinants of PEM

Some studies and surveys have used multivariate techniques to examine the determinants of malnutrition among pre-school children.

- World Bank, 2005
- Jayatissa et al, 2006
- World Bank, 2007
- Aturupane et al, 2008
- SLCFS 2008
- NFSA 2009

The first of the above analyses used two sets of nationally representative data i.e. HIES data from three rounds in 1990-91, 1995-96 and 2002, and DHS data in 1993 and 2000 (World Bank, 2005). The analysis revealed that girls had a significantly lower likelihood than boys of being underweight. However, this nutritional advantage was seen to diminish with age and disappear by 21 months of age. Beyond this age, girls had a higher likelihood of being underweight than boys. They also found that higher birth order children were significantly more likely to be underweight even after controlling for age. Maternal schooling was associated inversely but not their fathers’ education. Predicted monthly consumption expenditure per capita was used as a proxy for the household’s living standards and this was predictive of underweight. The model predicted a 1% increase in consumption expenditure to be associated with a 0.16% decline in the risk of being underweight. Absence of infrastructure facilities such as a flush-toilet, pipe-borne water and electricity in the house was predictive of child malnutrition.

Three analyses used the UNICEF conceptual frame work (Annex III) to examine malnutrition in children 6-60 months of age. The first of these reported by Jayatissa et al (2006) analysed the data from the DHS 2000 and the UNICEF Survey on Child Welfare and Health 2003. The independent variables were classified as immediate, underlying and basic. Logistic regression
models were created with each of the nutrition indicators as the dependent variable. LBW was the most significant predictor of height-for-age, weight-for-height and weight-for-age. Falling below the birth weight band during the first two years of life and the total number of children in the household were also predictors of all these three indicators. House type probably a proxy indicator of household wealth, and living in the estate sector were the other variables independently associated with stunting.

Of the immediate level predictor variables, occurrence of respiratory tract infections in the two weeks preceding the survey was associated with wasting. Maternal nutritional status and the quality of antenatal care were predictors of wasting as well as underweight. Possession of a vehicle and use of solid fuel for cooking were associated with the child being underweight, these probably being proxy indicators of wealth.

Another analysis using the UNICEF’s conceptual model as the basis was presented in the publication ‘Malnutrition in Sri Lanka: scale, scope, causes and potential response’ (World Bank, 2007). This used data from the DHS 2000 and probit regression models were estimated to explain the probability of a child becoming malnourished, using each of the three indicators of malnutrition as the dependent variable. Household wealth was used as a proxy for food security. It was recognised that wealth could also operate through care practices, health and environmental conditions. The analysis therefore controlled for these factors so that household wealth that does not operate through these pathways could be examined as a proxy for food security. Wealth coefficient remained unchanged in the model, suggesting wealth has little influence through care practices, health and environmental conditions. This is probably because the care practices available in the data set have little variability. Furthermore, in this analysis too, LBW was strongly associated with both stunting and underweight. The relationship was not affected by controlling for factors such as caring practices. Mother’s nutritional status and being born to a wealthier household were both significantly associated with the two outcome variables.

Most analyses have found maternal education to have an inverse relationship with malnutrition. In the analysis by World Bank in 2007, maternal education was found to be protective only with high levels of education, i.e., completion of secondary schooling. However, when living conditions and wealth were controlled for, the effect of maternal education was no longer significant (World Bank, 2007).
Although earlier analyses (World Bank, 2005; Jayatissa et al, 2006) have found associations with improved sanitation and water supply to be predictors of underweight, the analysis in 2007 did not reveal a relationship with these variables. Once wealth status, living conditions and health care were controlled for, care practices were not found to be important in the analysis. Household characteristics such as number in the household was also not found to be significant while sector of residence was significant in the stunting model but not in the underweight model. Key findings of these three analyses are consistent with each other.

The SLCFS 2008 presents a multivariate analysis which examines the causes of malnutrition in children 4-23 months of age. This survey had the advantage of including many variables on food availability and young child feeding practices that were not available for the earlier analyses based on the DHS 2000. The model for underweight found that after adjusting for the age of the child and the number of children less than 15 years old in the household, LBW, being a boy child, not consuming vitamin A rich food and vegetables, and being from a food insecure household were strongly associated with underweight. There was a marginal association between a child not consuming fleshy foods and being underweight. In the presence of above factors, variables such as parent’s education, area of residence, socio-economic scores were no longer important explanatory factors.

In the SLCFS 2008, stunting was strongly associated with low birth weight, as well as being a boy after adjusting for age and number of children below 15 years of age in the household. The practice of not eating from his or her individual plate was strongly associated with stunting. Increasing Socio-Economic Status (SES) scores were found to be strongly protective.

The model for wasting identified LBW, being a boy child, an episode of fever during the two weeks preceding the survey and living in a severely food insecure household as strong determinants after adjusting for SES scores. Poor feeding practice during illness that was noted probably explains the significance of fever in this model.

The data from the NFSA 2009 was used to examine the basic causes, underlying causes and immediate causes of malnutrition as well as biological and maternal nutritional status. They also found that LBW was associated with stunting. The model further identified that children 6-5 months living in the districts of Badulla, Nuwara Eliya, Trincomalee, Ratnapura and Colombo had an increased risk of stunting compared to those living in the Colombo Municipality area. The risk of living in the estate sector did not show a statistically significant increased risk. This is
probably because of the presence of the districts of Nuwara Eliya, Badulla and Ratnapura which have high estate populations in the model. Households with 7 or more members and 3 or more children were at increased risk of having a stunted child. Compared to children 6-11 months of age, older children were more likely to be stunted.

Wasting was low in families that had fewer than 2 children below 5 years of age, and those in the richest wealth quintile. Being female and increasing maternal BMI reduced the risk of wasting. Receiving food aid was protective for wasting. Increasing age of the child, and a low birth weight were associated with higher risk of being wasted.

Increased risk of underweight was identified in those with LBW, increasing age of the child and in families with 7 or more members. Being in the richest wealth quintile and receiving food aid were protective. Increasing maternal BMI reduced the risk of underweight.

Although several food-related variables were available in the dataset, none of these variables were found to be significant in any of the models. It may be that in the presence of older age groups, these variables are not as important as in the younger age group. It is also not stated if the model referred to is the most parsimonious model.

Table 4.10 summarises the variables found to be common and important determinants in the multivariate analyses given above.
Table 4.10: Summary of determinants of PEM from multivariate analyses

<table>
<thead>
<tr>
<th>Stunting</th>
<th>Wasting</th>
<th>Underweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>House type</td>
<td>Quality of antenatal care</td>
<td>Quality of antenatal care</td>
</tr>
<tr>
<td>*Total no. of children in the household</td>
<td>Mother’s nutritional status (BMI)</td>
<td>Mother’s nutritional status (BMI)</td>
</tr>
<tr>
<td>LBW</td>
<td>*Total no. of children in the household</td>
<td>*Total no. of children in the household</td>
</tr>
<tr>
<td>Being a boy</td>
<td>Being a boy</td>
<td>Being a boy</td>
</tr>
<tr>
<td></td>
<td>Fever in the two weeks preceding the survey</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Living in a severe food insecure household</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not consuming fleshy food</td>
<td>Not consuming vitamin A rich food and vegetables</td>
</tr>
<tr>
<td></td>
<td>Use of solid fuel for cooking</td>
<td></td>
</tr>
<tr>
<td>Living on estates</td>
<td></td>
<td>Possession of a vehicle</td>
</tr>
</tbody>
</table>

*In the SLCFS (2008), the variable is defined as the number of children less than 15 years in the household.

A more recent analysis by Aturupane et al (2008) examined the determinants of child height and weight using a different approach. They argued that socioeconomic variables and policy interventions may affect child nutrition differently at different points of the conditional nutrition distribution and that using quantile regression would enable the exploration of such variation. They used as the dependent variable z-scores of height and weight and the independent variables included were child level characteristics, household variables and infrastructure characteristics (Aturupana et al, 2008).

The quantile regression results suggest important differences from the models discussed earlier. It is seen that the coefficients of the sex variable are larger, significant and negative at the lower end of the weight distribution while insignificant at the higher quantiles (0.75 and 0.95). This is suggestive of possible intra-household gender discrimination in the allocation of food at the bottom of the weight distribution but not at the top. Another interesting finding is the significance of birth order in the middle of the distribution but not at the very top or the very bottom of the distribution. This may be similar to the J shaped relationship that infant mortality has with birth order although the explanation as to why it is so is unclear. Another notable
result of this analysis is the income influencing the weight only at the 0.9 quantile and above. This suggests that policy initiatives which seek to improve household income are unlikely to improve weights of children at the lower end of the distribution. A similar finding is that the beneficial effects of mother’s education on weight accrue disproportionately to children at the upper end of the weight distribution. The results with height are broadly similar. In general, this analysis shows that most of the explanatory variables used in the analysis tend to have significant and larger effects on child height and weight at the higher quantiles than at the lower quantiles. This has important implications for policy in that general interventions such as improving parental income, infrastructure and education do not appear to work at the lower end of the weight and height distribution. Directly targeted nutritional interventions that have not been addressed adequately in any of the analysis may have more influence at the lower end of the anthropometric distributions.

However, it must be noted that there is paucity of information on factors such as child stimulation, time spent with children by parents, quality of such time, happiness, love and security in the home environment, etc. These are aspects that are difficult to measure objectively in survey settings, nevertheless crucial in promoting growth and development of children. As such, attempts to examine these in future are important.

4.5 Determinants of PEM in the estate sector

The estate population is the most disadvantaged in terms of health and nutrition indicators. The socioeconomic and cultural norms and practices in this population are different from those of the rest of the country. Compared to the other sectors, connectivity to government infrastructure is poor probably due to isolation and marginalisation. In this situation, it is important to analyse the determinants of poverty and malnutrition specific to this setting despite such analysis being scarce.

The socioeconomic conditions of this sector have shown much improvement over the last few decades; especially in the areas of education, water, sanitation, living conditions and in use of modern methods of family planning. Youth unemployment has decreased, yet the poverty indicators show deterioration (Department of Census and Statistics, 2008). The poverty head count ratio is 32% in comparison to 6.7% in urban and 15.5% in rural sectors.
Working on many days as possible is a priority expressed by many women. In addition to working on the tea estates, they also work on vegetable cultivations in nearby villages. Alcohol consumption is high among both men and women. Poor money management at household level is seen often and women though wage earners have little power over spending decisions, even food marketing being done by the men. Furthermore, the estate sector is shown to have the lowest proportion of recipients of welfare schemes (De Silva A, 2009).

De Silva A (2009) attempted to answer the question why malnutrition is common in this setting and to find out the local level strategies that communities were employing to improve nutrition status. She found that knowledge on dietary requirements was poor, supplements were often shared and food related behaviour and practices were strongly influenced by the elders (mothers and mothers-in-law). Exclusive breast feeding is rare, mothers often resuming work during the period of maternity leave. Advertising by milk food companies often influences mothers to the extent that some believe formula milk is better for the baby. They do not take the breast feeding breaks that are given due to long distances they have to travel from work area.

Since the women work even during weekends, preparation of food is often neglected if work is available. Foods given to children lack variety and consist of biscuits and rice gruel given sometimes as early as 3 months despite advice by the PHM. Although a variety of green leaves is available, these are not included in the diets of their children. Animal protein consumption is low and is often confined to pay day. Fruits are rarely given to children although giving sweets is common. Feeding is limited during illness (De Silva A, 2009). The distances that have to be travelled, difficulties in communication due to the language barrier and attitudes of health staff limit their access to health care. Although the situation is improving, there is much more to be done.
Summary

- The nutritional status of Sri Lankan children does not match the country’s achievements in child survival and per capita GDP.
- Marked disparities exist in the prevalence of PEM between the sectors. Prevalence of stunting in the estate sector is 3 times that of the urban sector and underweight is twice as high while in wasting, the difference in prevalence is not so wide.
- The review highlights the variability of prevalence of PEM even within an MOH area and the need to map data to the lowest geographical area possible. Improvements in routine data collection will enable this to be achieved.
- The risk of malnutrition is doubled in LBW babies and their weight for age remains below that of children with normal birth weight throughout the first five years of life.
- The largest deviation in weight for age from the mean occurs during the first 2 years.
- The need to focus on the period from birth to two years for the promotion of growth so as to minimize growth faltering during this period is stressed.
- Table 4.9 gives a summary of the determinants of PEM.
- Although breast feeding practices have improved during the period between the two DHS surveys 2000 and 2007, continued inputs are necessary to protect and improve on achievements. The data show that breast feeding is strongly influenced by the health care system especially the work of the PHM.
- Complementary feeding is an area that needs an intense campaign. The timing of commencement of complementary feeding, consistency, quantity and frequency of food given, responsive feeding practices as well as feeding during infections are areas to be addressed.
- The feasibility of establishing a food and nutrition “advisory/consultation capability” at MOH/district level should be considered so as to supplement existing services.
- Identifying households that are food insecure and providing adequate safety nets are important.
- The socio-ethnographic and cultural norms and practices in the estate population are different from those of the rest of the country. Therefore, it is important to analyse the determinants of poverty and malnutrition specific to this setting and plan programmes accordingly.
Chapter 5

Protein energy malnutrition
among school children and adolescents, women and the elderly

In this chapter, PEM in the following stages of the life circle is presented.

5.1 School children and adolescents
5.2 Reproductive age women
5.3 Elderly population

5.1 School children and adolescents

Good health and nutrition is a valuable asset during any stage of life but during the school years, it is particularly important to ensure that children benefit maximally from the education process. In a country like Sri Lanka which invests heavily on a free education system, this is doubly important so that the investment in education is maximised. This is also the period during which children and young adults form personal preferences about food, dietary patterns and habits that may persist throughout life. School children have been successfully used as messengers to promote good health and nutrition practices among families and communities. Addressing nutrition issues in school thus forms a good entry point for prevention of diet related illness in later life.

5.1.1 Sources of data

- Surveys

National level information on the nutritional status of schooling population is scarcer than that on children under five. The review identified three reports of surveys carried out by the Nutrition Division of the MRI (Jayatissa et al, 1997; Jayatissa et al, 2002; Jayatissa, 2002). Although these were done before the period under review, they were included due to paucity of information in this age group.
• **Routine data**

Although FHB collates information that is routinely collected by the MOH during school medical inspections where anthropometry is also carried out, the quality of this data is poor and hence was not reviewed.

• **Research studies**

A series of small studies often limited to small geographic areas is available on different aspects of PEM among school children.

### 5.1.2 Prevalence and geographical distribution of PEM

#### 5-9 year old age group

Jayatissa et al (2002) carried out a survey on a large sample (N = 7,200) of primary school children 5-9 years of age. Samples of 800 children were selected from each province. A multistage, probability-proportional-to-size technique was used to select the classes. The whole class underwent anthropometric investigations while 20 children randomly selected from each class underwent a clinical examination to identify vitamin A deficiency and another 9 children were randomly selected for Haemoglobin (Hb) examination.

The prevalence of stunting was 17.3%, which was significantly higher among boys (19.5%) than girls (15.1%). Stunting was seen to increase up to 7 years. Prevalence of underweight was 33.6% in boys and 26% in girls. The highest was 40.2% at 6 years of age. The overall prevalence of overweight was 1% according to the age and sex specific BMI reference proposed by the International Obesity Task Force (IOTF), the prevalence of overweight was 1.7% and obesity 0.6%. Stunting, wasting and anaemia were markedly higher in rural children compared to those living in urban areas.

#### 10-16 year old age group

Jayatissa et al (1997) carried out a survey on overweight, thinness and stunting among adolescent school children. The study was limited to nine Type 2 and 3 schools within an educational zone of the Colombo district and to girls aged 10-16 years. The large schools with Advanced Level (AL) Science classes (Type I) and the small schools with only primary classes (Type 4) were excluded.
Figures 5.1 and 5.2 show that, as age advances, the mean heights and weights of the study population fall away from the mean of the standard population, the fall off starting to maximise around 13 years of age. In this population of girls, the mean age at menarche was reported as 12.2 years (Standard Deviation (SD) = 1.2) and thus suggesting that the secondary growth spurt that occurs around menarche has not been satisfactory.

**Figure 5.1: Mean height by age of school girls (10-16 years) compared with the WHO/NCHS standard**

![Mean height by age of school girls](image1)

*Source:* Jayatissa et al, 1997

**Figure 5.2: Mean weight by age of school girls (10-16 years) compared with the WHO/NCHS standard**

![Mean weight by age of school girls](image2)

*Source:* Jayatissa et al, 1997
The survey indicated a high prevalence of thinness and stunting in this population and a low prevalence of obesity (table 5.1).

<table>
<thead>
<tr>
<th>Age in years</th>
<th>No.</th>
<th>Mean BMI (SD)</th>
<th>Thinness % BMI for age &lt;5th percentile</th>
<th>Overweight % BMI for age &gt;85th percentile</th>
<th>Stunting &lt; -2SD %</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>19</td>
<td>15.4 (2.2)</td>
<td>31.6</td>
<td>5.3</td>
<td>0.0</td>
</tr>
<tr>
<td>11</td>
<td>91</td>
<td>15.7 (2.5)</td>
<td>40.7</td>
<td>3.3</td>
<td>11.0</td>
</tr>
<tr>
<td>12</td>
<td>151</td>
<td>16.5 (2.8)</td>
<td>31.8</td>
<td>4.6</td>
<td>19.2</td>
</tr>
<tr>
<td>13</td>
<td>161</td>
<td>17.0 (2.5)</td>
<td>19.9</td>
<td>1.9</td>
<td>24.8</td>
</tr>
<tr>
<td>14</td>
<td>182</td>
<td>18.7 (3.0)</td>
<td>9.3</td>
<td>5.5</td>
<td>14.3</td>
</tr>
<tr>
<td>15</td>
<td>87</td>
<td>18.4 (6.2)</td>
<td>16.1</td>
<td>4.6</td>
<td>20.7</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
<td>19.5 (2.6)</td>
<td>0.0</td>
<td>0.0</td>
<td>60.0</td>
</tr>
<tr>
<td>All ages</td>
<td>696</td>
<td>17.3 (2.)</td>
<td>22.1</td>
<td>4.0</td>
<td>18.1</td>
</tr>
</tbody>
</table>

Source: Jayatissa et al, 1997

- **5-15 year old age group**

In a survey by MRI (Jayatissa, 2002), 10 districts were selected and 800 children in grades 1, 4 and 7 in each district were selected through a stratified multi stage, probability-proportional-to-size technique. Prevalence of under nutrition, vitamin A and iodine deficiencies, and anaemia was estimated. The figure 5.3 compares the mean weights and heights with the WHO/NCHS reference standards.
Figure 5.3: Mean weights and heights in each age group compared with WHO/NCHS reference standards

Source: Jayatissa, 2002

Table 5.2 gives the prevalence of under nutrition by age group and sex.

Table 5.2: Prevalence of under nutrition by age group and sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>5 - 9 years</th>
<th>10 - 14.9 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Stunting</td>
</tr>
<tr>
<td>Male</td>
<td>2754</td>
<td>19.6</td>
</tr>
<tr>
<td>Female</td>
<td>2792</td>
<td>14.5</td>
</tr>
<tr>
<td>Total</td>
<td>5546</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Source: Jayatissa, 2002
A summary of the findings of 10 small-scale research studies is given in table 5.3.

Table 5.3 Nutritional status of adolescents

<table>
<thead>
<tr>
<th>District Author, year</th>
<th>Age years</th>
<th>No.</th>
<th>Stunting %</th>
<th>Thinness %</th>
<th>Under weight %</th>
<th>Over weight %</th>
<th>Obese %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Colombo (a) Kumudini et al, 2008</td>
<td>10-12</td>
<td>662 (F) 729 (M)</td>
<td>6.6</td>
<td>4.0</td>
<td>20.9</td>
<td>9.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2 Colombo (a) * Wickramasinghe et al, 2004</td>
<td>8-12</td>
<td>588 (M) 636 (F)</td>
<td>5.1 (M) 5.2 (F)</td>
<td>24.7 (M) 23.1 (F)</td>
<td>7.0 (M) 6.8 (F)</td>
<td>10.4 (M) 7.8 (F)</td>
<td>4.3 (M) 3.1 (F)</td>
</tr>
<tr>
<td>3 Negombo town (a) Gunathilake, 2007</td>
<td>10-12</td>
<td>153 (M&amp;F)</td>
<td>2.6 M) 7.8 (F)</td>
<td>36.4 (F) 14.5 (M)</td>
<td>9.2 (M) 3.9 (F)</td>
<td></td>
<td>2.6 (M)</td>
</tr>
<tr>
<td>4 Haliella MOH area (b) ** Nirangala, 2009</td>
<td>13-16</td>
<td>524 (F)</td>
<td>39.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Kalutara MOH area (a) ** De Silva, 2006</td>
<td>15-16</td>
<td>283 (M) 356 (F)</td>
<td>35.4 43.8 M 28.7 F</td>
<td></td>
<td>6.7 4.3 (M) 8.7 (F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Gampaha Municipal council (a) * Sudasinghe, 2005</td>
<td>13-14</td>
<td>698 (F)</td>
<td>25.6</td>
<td></td>
<td>7.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Ambalangoda Urban Council Samaraweera, 2004</td>
<td>11-12</td>
<td>420 (M&amp;F)</td>
<td></td>
<td></td>
<td>7.7</td>
<td>10.2</td>
<td>4.8</td>
</tr>
<tr>
<td>8 University students Weeratunge &amp; Adikari, 2007</td>
<td>155 (M) 145 (F)</td>
<td></td>
<td>16</td>
<td>14.6</td>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

(a) School children (b) Estate population
*Obesity and overweight defined, as recommended by IOTF (IOTF/IASO/WHO, 2002)
** Cut-off values recommended by the WHO

In the study by Kumudini et al (2008), two groups of schools were studied, larger schools designated as national schools within the Ministry of Education and smaller non-national schools. The study showed that obesity was marginally higher in the national schools (male 3.0%, female 6.3%) compared to 2.0% in males and 2.% in females in the non-national schools.

Wickramasinghe et al (2004) reported that 66% of obese children and 43.5% of overweight children were from high income categories (> Rs. 20,000). The results demonstrate that the nutrition transition is evident at least in the urban areas.
Kumarapeli and Athauda (2004) compared the dietary patterns and anthropometry among school girls from two defined urban and rural areas. The urban area selected was the Colombo Municipal Council (CMC) area while the rural area was Meeligama Pradeshiya Sabha area. Nearly 30% of rural girls compared to 24% of urban girls were underweight. Obesity was higher among the urban population being 25% compared to nearly 18% among the rural girls.

The studies summarised above show that while under nutrition still persists, problems of over nutrition are becoming important especially in the urban settings.

- **15 - 19 year old age group**

A cross-sectional study was conducted among 15-19 year old out-of-school girls selected using a two-stage random sampling method from an urban district (Colombo, N=307) and a rural district (Kalutara, N= 306). Weight, height, waist circumference and skin-fold-thickness were measured (de Lanerolle et al, 2010). Of them, 33.2% were underweight, and 6% were overweight. The study concluded that underweight continues to be a major public health problem among out-of-school girls in both urban and rural settings.

### 5.1.3 Determinants of PEM

Dissanayake & Chandrasekara (2007) examined the ethnic differences in nutritional status among adolescent girls. However, the sample sizes were very small in this study, being 40 each from Sinhala, Tamil and Muslim ethnicities. They identified that weight, waist and hip circumference, waist to hip ratio and waist to height ratio were significantly different among different ethnicities. The Muslim girls were heavier, had larger waist and hip circumference and waist to hip ratios. The mean BMI was lowest among the Sinhala girls and highest among the Muslim girls.

Kumarapeli and Athauda (2004) described dietary practices and recreational activities among adolescents and they showed that consumption of junk food, soft sugary drinks, low levels of physical activity and regular TV watching were common while knowledge on nutrition was found to be inadequate.

De Lanerolle et al (2009a) identified that prevalence of underweight was high (24.6%) with no difference between ethnic groups. Prevalence of overweight was 6.1% with significant (p<0.05) differences among Moor (15.2%), Sinhala (4.3%) and Tamil (3.1%) populations. Among those
underweight, 4.1% perceived themselves as being overweight and 21.9% as normal weight. In those overweight, 5.6% perceived themselves as being underweight and 11.1% as normal weight. The study showed that the incorrect perception affects both ends of the spectrum of nutritional status.

5.2 Women in the reproductive age group

Nutrition of reproductive age women influences child malnutrition.

5.2.1 Sources of data

• Surveys

The DHS 2006-07 and NFSA 2009 provide national level data on nutrition among reproductive age women.

• Routine data

The FHB collates information on BMI of pregnant mothers that is routinely collected at MOH level by the PHM during women’s first antenatal clinic visit to the MOH office. Since a high proportion of pregnant women visit these field clinics within 8 weeks of their pregnancy, this data can be considered as a good proxy measure of the PEM status of reproductive age women in the country. Using the data compiled for years 2007-2009 by FHB, the proportion of thin women was calculated by the reviewers for the country and for each district.

• Research studies

A few research studies are available on PEM of reproductive age women.

5.2.2 Prevalence of PEM

Thinness, overweight and obesity of women in the reproductive age group are summarised in table 5.4. The mean BMI of women in the DHS 2006-07 was 23.1 kg/m². In addition, in the DHS 2006-07, mean height of the women was 152 cm and of them, 10.6% were of a height < 145 cm, indicating short stature.
### Table 5.4: Nutritional status of women in the reproductive age group

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample size</th>
<th>% Thinness BMI &lt;18.5 kg/m²</th>
<th>% Overweight BMI 25-29.9 kg/m²</th>
<th>% Obesity BMI &gt;30 kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS 2006-07</td>
<td>Ever married (N=13,749)</td>
<td>Overall: 16.2%</td>
<td>9.9%</td>
<td>7.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mild (17-18.5 BMI): 7.2%</td>
<td>Milder (18.5-19.9 BMI): 8.9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate or severe &lt;17 BMI:</td>
<td>6.4%</td>
<td></td>
</tr>
<tr>
<td>FHB 2007</td>
<td>Women at first antenatal clinic</td>
<td>26.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FHB 2008</td>
<td>clinic visit</td>
<td>26.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FHB 2009</td>
<td></td>
<td>25.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NFSA 2009</td>
<td>2146 non-pregnant</td>
<td>18.2%</td>
<td>22.5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>228 pregnant</td>
<td>18.4%*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Thinness was assessed considering MUAC ≤ 23cm

Only three research studies had assessed the nutrition status of women. A household survey (N=80 households) was conducted in 20 DS divisions across 10 districts (Anuradhapura, Polonnaruwa, Kurunegala, Kegalle, Ratnapura, Badulla, Moneragala, Hambantota, Galle and Matara) (Malkanthi et al, 2007). Households selected were primarily involved with paddy farming having at least one child less than 5yrs of age. Of the 192 females living in these households, 24% was found to be underweight.

Effects of the global financial crisis on the food security of poor urban households were assessed through a case study in Colombo (Atukorala et al, 2010). A total of 32 PHM areas of two randomly selected ‘districts’ of the CMC area was selected for the study. A total of 600 households (N=300 households from slums and N=300 households from middle income) were visited and as part of this study, weight and height measurements of mothers of children 0 – 6 years old were assessed. The BMI data of these women aged 15-49 years indicated that 13.3% (N = 44) in the middle income areas and 16.1% (n = 56) in slum areas were thin (BMI < 18.5 kg/m²) within the CMC area.

In the baseline survey of the national nutrition surveillance system of Sri Lanka (Nutrition Coordination Division, 2006), anthropometry measurements of mothers of children under 5 years were performed. Mean BMI of women aged 15-49 was 21.6 kg/m². Thinness was
prevalent in 22.1% of these women in contrast to overweight in 16.8% and obesity in 2.7%. Among pregnant women, 23.6% were undernourished.

5.2.3 Geographical distribution of PEM

• Sectoral variation of PEM

Short stature

Based on DHS data, the estate sector can be identified as an area needing attention to prevent short stature. The proportion of short stature in estates (17.1%) was twice the proportion seen in the urban sector (8.6%).

Thinness

Table 5.5 summarises the sectoral differences in relation to thinness. In both surveys, estate sector was seen to have the highest proportion of thinness among reproductive age women. In addition, the NFSA 2009 has shown in their multivariate analysis that living in estate sector (OR=4.9) is an independent risk factor for thinness.

Table 5.5: Sectoral differences in the prevalence of thinness

<table>
<thead>
<tr>
<th>Source</th>
<th>% Urban</th>
<th>% Rural</th>
<th>% Estate</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS 2006-07</td>
<td>9.7%</td>
<td>16.3%</td>
<td>33.3%</td>
<td>16.2%</td>
</tr>
<tr>
<td>NFSA 2009</td>
<td>11.3%</td>
<td>18.7%</td>
<td>42.6%</td>
<td>18.2%</td>
</tr>
</tbody>
</table>

Overweight and obesity

As for overweight and obesity, both surveys have confirmed that proportions were highest in urban sectors and lowest in estate. Table 5.6 demonstrates these sectoral differences among women.

Table 5.6: Sectoral differences in the prevalence of overweight and obesity

<table>
<thead>
<tr>
<th>Source</th>
<th>% Overweight Urban</th>
<th>% Overweight Rural</th>
<th>% Overweight Estate</th>
<th>% Overweight Total</th>
<th>% Obesity Urban</th>
<th>% Obesity Rural</th>
<th>% Obesity Estate</th>
<th>% Obesity Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS 2006-07</td>
<td>33.1%</td>
<td>23.4%</td>
<td>9.2%</td>
<td>24.0%</td>
<td>14.2%</td>
<td>6.5%</td>
<td>1.5%</td>
<td>7.2%</td>
</tr>
<tr>
<td>NFSA 2009</td>
<td>28.3%</td>
<td>21.6%</td>
<td>7.4%</td>
<td>22.5%</td>
<td>15.0%</td>
<td>4.2%</td>
<td>0.0%</td>
<td>6.7%</td>
</tr>
</tbody>
</table>

61
• **District variation of PEM**

Maps shown below (maps 5.1-5.4) are drawn based on DHS 2006-07 data of women aged 15-49 years and show the prevalence of short stature, and thinness and overweight based on BMI.

**Short stature**

The districts that recorded higher proportion of short stature than the national level in DHS 2006-07 were Nuwara Eliya, Galle, Ratnapura, Trincomalee, Kandy and Badulla (map 5.1).

**Overweight**

Both DHS 2006-07 and NFSA 2009 commonly identified Colombo as having a higher proportion of overweight than the national average (map 5.2). Data from Gampaha, Puttalam, Kandy and Batticaloa were also higher than the national average of overweight according to DHS 2006-07 but none of these districts were included in the NFSA 2009.

**Obesity**

Colombo and Trincomalee were identified as districts with high prevalence of obesity by both DHS 2006-07 and NFSA 2009. Batticaloa, Puttalam and Gampaha were the other districts that recorded a higher prevalence compared to the national average in DHS but these districts were not covered in NFSA 2009.

In the assessment of correlates in the NFSA 2009, living in CMC or Colombo district was associated significantly with overweight/obesity among women. In the multivariate analysis of NFSA 2009, it was found that living in Ratnapura (OR=0.46), Jaffna (OR=0.5), Colombo (OR=0.53), Hambantota (OR=0.57) and Badulla (OR= 0.56) as opposed to CMC were associated with lower risk of overweight/obesity.
Map 5.1: Short stature among women aged 15-49 years

Map 5.2: Overweight among women aged 15-49 years

Source of data: DHS, 2006-07

Thinness

The DHS 2006-07 has identified Moneragala, Matale, Ratnapura, Nuwara Eliya, Trincomalee, Hambantota, Polonnaruwa, Kurunegala, Badulla, Galle, Kegalle and Matara as the districts with a high proportion of thinness in 2006-07 (map 5.3). According to FHB data for years 2007-2009, the districts that showed a prevalence of thinness higher than national average were Ampara, Kilinochchi, Ratnapura, Moneragala, Kegalle, Polonnaruwa, Hambantota, Matara, Mullaitivu and Matale. Of the districts included in the NFSA 2009, Ratnapura, Badulla, Nuwara Eliya, Jaffna and Hambantota showed proportions of thinness above the national average. The NFSA 2009 also assessed correlates of thinness of non-pregnant women. Living in districts of Ratnapura, Badulla and Nuwara Eliya were significantly associated with thinness.

In summary, Ratnapura and Hambantota were identified as districts with high proportions of thinness by all three sources. In addition to that, DHS 2006-07 and FHB data identified Moneragala, Kegalle, Polonnaruwa, Matara and Matale as districts with high proportions of
thinness (These districts were not covered by the NFSA 2009). It should be further noted that of the districts that were identified by FHB as having high proportion of thinness, Kilinochchi and Mullaitivu were not included in the DHS 2006-07.

Map 5.4 has been drawn using 2009 data from the FHB and shows the prevalence of thinness among pregnant women at the booking visit disaggregated by MOH area. It shows the wide variation of thinness among women within districts. Interpretation of data in the Central province shown in the map is difficult due to reasons mentioned in section 1.3.3.

**Map 5.3: District prevalence of thinness**

Map 5.4: Thinness among pregnant women

![Map 5.3: District prevalence of thinness](image1)

**Source of data:** DHS, 2006-07

![Map 5.4: Thinness among pregnant women](image2)

**Source of data:** Family Health Bureau, 2009

(MCH Quarterly returns –H509, unpublished data)

*Multiple PEM related issues*
Both short stature and thinness were high in the districts of Nuwara Eliya, Galle, Trincomalee and Badulla as per DHS 2006-07.

Figure 5.4 shows the district distribution of short stature, thinness and overweight among reproductive age women based on the DHS 2006-07 and highlights the co-existence of both thinness and overweight in several geographical areas. It should be noted that in Trincomalee, all anthropometric indicators are high. Nuwara Eliya and Ratnapura districts have higher prevalence of both short stature and thinness.

**Figure 5.4: Comparison of districts by thinness, short stature and overweight status**

<table>
<thead>
<tr>
<th>District</th>
<th>% Short stature &lt; 145 cm height</th>
<th>% Thinness BMI &lt; 18.5 kg/m²</th>
<th>% Overweight BMI ≥ 25.0 kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombo</td>
<td>8.2</td>
<td>9.6</td>
<td>47.4</td>
</tr>
<tr>
<td>Gampaha</td>
<td>7.7</td>
<td>10.9</td>
<td>40.7</td>
</tr>
<tr>
<td>Kalutara</td>
<td>10.4</td>
<td>16.8</td>
<td>30.1</td>
</tr>
<tr>
<td>Kandy</td>
<td>11.6</td>
<td>14.4</td>
<td>33.6</td>
</tr>
<tr>
<td>Matale</td>
<td>9.7</td>
<td>22.9</td>
<td>21.5</td>
</tr>
<tr>
<td>Nuwara Eliya</td>
<td>17.5</td>
<td>20.1</td>
<td>22</td>
</tr>
<tr>
<td>Galle</td>
<td>16.8</td>
<td>18.5</td>
<td>26.8</td>
</tr>
<tr>
<td>Matara</td>
<td>10.7</td>
<td>18</td>
<td>25.9</td>
</tr>
<tr>
<td>Hambantota</td>
<td>10.3</td>
<td>19.6</td>
<td>28.8</td>
</tr>
<tr>
<td>Batticaloa</td>
<td>8.8</td>
<td>11.6</td>
<td>39</td>
</tr>
<tr>
<td>Ampara</td>
<td>8.6</td>
<td>15.1</td>
<td>30.2</td>
</tr>
<tr>
<td>Trincomalee</td>
<td>13.4</td>
<td>20.1</td>
<td>32.2</td>
</tr>
<tr>
<td>Kurunegala</td>
<td>9.9</td>
<td>18.6</td>
<td>23.9</td>
</tr>
<tr>
<td>Puttalam</td>
<td>7.8</td>
<td>12.8</td>
<td>38.6</td>
</tr>
<tr>
<td>Anuradhapura</td>
<td>9.7</td>
<td>16.8</td>
<td>27.3</td>
</tr>
<tr>
<td>Polonnaruwa</td>
<td>9.3</td>
<td>19.4</td>
<td>27.5</td>
</tr>
<tr>
<td>Badulla</td>
<td>11</td>
<td>18.6</td>
<td>22.8</td>
</tr>
<tr>
<td>Moneragala</td>
<td>9.7</td>
<td>25.5</td>
<td>19.4</td>
</tr>
<tr>
<td>Ratnapura</td>
<td>15.1</td>
<td>20.4</td>
<td>24.9</td>
</tr>
<tr>
<td>Kegalle</td>
<td>10.9</td>
<td>18.2</td>
<td>29.1</td>
</tr>
</tbody>
</table>

**Key to Figure 5.4**

<table>
<thead>
<tr>
<th>% Short stature</th>
<th>% Thinness</th>
<th>% Overweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 13</td>
<td>&gt; 20</td>
<td>&gt; 27</td>
</tr>
</tbody>
</table>
5.2.4 Determinants of PEM

- **Age**

Disaggregated DHS 2006-07 data by socio-demographic factors indicated that short stature was highest (14.2%) among the oldest category (40-49 years), whereas all thinness indicators were highest among the 15-19 year age category. Similarly, the NFSA 2009 identified that being thin was significantly more among women less than 30 years of age especially among the teenagers. Furthermore, in its multivariate analysis, increasing age of women was independently associated with lower risk of thinness. As for overweight and obesity, it was associated only with age over 30 years.

- **Education level**

The DHS 2006-07 indicated a clear pattern of decreasing trend of short stature as well as thinness with advancing education level. The multivariate analysis of NFSA 2009 found that higher level of education of the husband (OL and above OR=0.48) was associated with lower risk of thinness and higher risk of overweight/obesity among women.

- **Socio-economic status**

A clear pattern of decreasing trend of short stature was observed with advancing wealth quintile in DHS 2006-07. Thinness was more than five times higher among the lowest wealth quintile compared to highest quintile (DHS 2006-07). Two indicators of economic status were used in NFSA 2009 namely average household income per month and household wealth index. Thinness decreased with monthly household income and increased with increasing wealth quintiles. Overweight and obesity both showed a clear increasing trend with wealth quintiles.

In the NFSA 2009 assessment of correlates, being thin was significantly more among women living in households with an income of <Rs. 9000 per month, lowest income quintile and not having electricity in the household. On the other hand, overweight and obesity were also associated with coming from a household with highest monthly income of >Rs 32,000 per month, highest wealth quintile and having electricity in the household.
In the multivariate analysis of NFSA 2009, both higher family income (Rs. 14,000-19,999; OR=0.64) and higher wealth index (richest, OR=0.39) were associated with lower risk of thinness. Being in the highest wealth quintile was also a correlate of overweight/obesity in women.

- Food security

The NFSA 2009 assessed correlates of thinness related to food security and found that coming from a household which had ever adopted a food related coping strategy in the past or a household belonging to moderate-severe food insecure category were associated with thinness. However, none of the food security related factors were significantly associated with thinness or overweight/obesity in its multivariate analysis.

5.3 Elderly population

Sri Lanka has a rapidly expanding elderly population and healthy aging is a much desired goal. National level data on the nutritional status of the elderly were not available. However two studies have examined the problem at district level and two more for smaller areas.

5.3.1 Sources of data

Information on PEM of elders is not available at national or district level as such data is not routinely or periodically collected in surveys or FHB. Most of this data come from research studies.

5.3.2 Prevalence and geographical distribution of PEM

A study done in Kalutara among 1700 young elderly (60-74 years) living in urban and rural areas was perused. The sample was selected using a stratified multi-stage cluster sampling procedure to be representative of the district. The study found that nearly 13% of the population was underweight (BMI < 18.5 kg/m²) while 8.8% were overweight (BMI 25.0–29.9 kg/m²). 2.8% were found to be obese (BMI > 30.0 kg/m²) (De Silva, 2010).

A fairly large study carried out in Matale district to examine the health status of those over 60 years of age in the district has sampled 3,194 subjects (1,200 urban, 1,163 rural and 831 estate). As shown in table 5.7, under nutrition and over nutrition were both seen in all 3 sectors in this
study. In the urban sector, 22% were undernourished and a further 22% were over nourished (Jayakody, 2002).

### Table 5.7: Distribution of nutritional status by BMI and by sector in the Matale district

<table>
<thead>
<tr>
<th>Nutrition status by BMI</th>
<th>Urban</th>
<th>Rural</th>
<th>Estate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Under-nourished</td>
<td>250</td>
<td>22.3</td>
<td>448</td>
<td>40.1</td>
</tr>
<tr>
<td>Well-nourished</td>
<td>625</td>
<td>55.8</td>
<td>586</td>
<td>52.5</td>
</tr>
<tr>
<td>Over-nourished</td>
<td>246</td>
<td>21.9</td>
<td>82</td>
<td>7.4</td>
</tr>
</tbody>
</table>

*Source: Jayakody, 2002*

Another study done in the Mannar district assessed the nutritional status of the elderly in a small sample of 100 males and 100 females living in the community (Ithayaranjini & Chandrasekara, 2007). Fifty percent of males and 40% of females were malnourished. Education level and income were found to be inversely associated with the risk of underweight. A similar study in Vavuniya (N=100) found that 38% of men and 24% of women were underweight. In this study, 33% were overweight and 22% were obese. Overweight was more among men (38%) compared to women (29%). Obesity was commoner among the women (27%) compared to 16% in men. It is interesting to note that few in this population were nutritionally normal (20% of women and about 9% of women) (Arulkugan & Chandrasekara, 2007).

#### 5.3.3 Determinants of PEM

There were marked differences in overweight and obesity between the urban and rural sectors; overweight and obesity in the urban sector was 19.5% and 11.6%, respectively compared to the rural sector which was 8.8% and 2.8% (De Silva, 2010). Furthermore, more males were found to be underweight (14.8% males and 11.2% females) while the prevalence of overweight obesity in males was twice that seen in men. Overweight and obesity in men was 5.4 % and 1.8% respectively while that in women was 11.6% and 3.5%, respectively.
Summary

School children and adolescents

- Prevalence of stunting and thinness continue to be high in the school population. Stunting is seen to increase with increasing age from 10-16 years.
- It is seen that among girls 10-16 years, as age increases the mean height and weight for age falls away increasingly from the mean of the standard population. This suggests that the full potential of the pubertal growth spurt is not achieved.
- Overweight and obesity are emerging in urban school populations while under nutrition still persists.

Women in the reproductive age group

- Mean height of women was 152 cm and nearly 11% were <145 cm.
- Nearly 60% of ever married women were thin (DHS 2006-07). According to the NFSA 2009, nearly 18% of non-pregnant as well as pregnant women were thin.
- Routine data shows that around 25-26% of women are thin at the antenatal booking visit.

Elderly

- There is a high prevalence of underweight among the elderly population and men are more likely to be underweight compared to women. Over 50% of elderly persons on the estates are malnourished.
- The prevalence of overweight and obesity are higher in the urban sector and more among women.
Chapter 6

Anaemia

Anaemia is a condition in which Hb content in the blood is lowered. Nutritional anaemia results when the erythropoietic tissue is unable to maintain a normal Hb concentration because of an inadequate supply of one or more essential nutrients. Iron deficiency has been identified as the commonest cause of nutritional anaemia while deficits of folate and Vitamin B₁₂ also contribute to anaemia to a lesser extent.

6.1 Anaemia in children of 6-59 months

6.1.1 Sources of data

- **Surveys**
  A survey to assess anaemia was carried out after the main DHS 2006-07 survey among children selected from 1,453 clusters. A total of 4,640 children of 6-59 months were assessed and presents results in weighted data. In NFSA 2009, a total of 2,373 children were included in the assessment of anaemia. This survey has not presented data on different levels of anaemia.

- **Routine data**
  No data on anaemia are available from routine sources.

- **Research studies**
  Very few research evidence on anaemia was available for the period from 2006 to date.

6.1.2 Prevalence of anaemia

Prevalence of anaemia based on national data among 6-59 month old children is shown in table 6.1.
Table 6.1: Prevalence of anaemia in children of 6-59 months

<table>
<thead>
<tr>
<th>Source</th>
<th>Mild 10-10.9 g/dl</th>
<th>Moderate 7-9.9 g/dl</th>
<th>Severe &lt;7 g/dl</th>
<th>Any &lt;11 g/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFSA 2009</td>
<td></td>
<td></td>
<td></td>
<td>25.2</td>
</tr>
<tr>
<td>DHS 2006-07</td>
<td>21.5</td>
<td>10.8</td>
<td>0.3</td>
<td>32.6</td>
</tr>
</tbody>
</table>

Prevalence of anaemia seems to decrease gradually with age (figure 6.1), most likely due to increase in dietary diversity.

Figure 6.1: Prevalence of anaemia 6-59 months of age

Source: DHS, 2006-07

Among research studies that assessed the magnitude of anaemia among children less than 5 years, a household survey was conducted in 9 DS divisions across 5 districts (Anuradhapura, Polonnaruwa, Kurunegala, Ratnapura and Hambantota) (Malkanthi et al, 2010). Households primarily involved in subsistence paddy farming and having at least one child aged < 5 years were selected for the study. A total sample of 300 children 0-60 months of age were assessed for anaemia using haemocue method. Anaemia was defined as Hb level <11 g/dl. Overall, 52% of the children were anaemic and 18% were severely anaemic.

Another study focused on assessing anaemia and micronutrient deficiencies [iron, zinc (Zn), folate, calcium, caeruloplasmin, iodine, vitamins A and D] among 248 pre-school 3-5 year old children in a cross-sectional study in the district of Galle (Hettiarchchi & Liyanage, 2010a). The
prevalence of anaemia (Hb < 110.0 mg/l) was 34% in males and 33% in females (overall 33.5%; p = 0.9). Among these anaemic children, 7% of males and 15% of females were iron deficient (serum ferritin < 15.0 mg/l). Folate deficiency (< 3 ng/ml) was found in 41% and 33% of males and females, respectively. Zn deficiency (< 9.95 mmol/l) occurred in 57% and 50% of males and females, respectively. Serum vitamin D deficiency (< 35 nmol/l) was found in 26% and 25% of males and females, respectively. Only 7.3% of the children did not have any micronutrient deficiency; 38.3% were deficient in two micronutrients; 17.7% had three micronutrient deficiencies; and 6.0% had four or more micronutrient deficiencies. The study concluded that multiple micronutrient deficiencies are prevalent in Sri Lankan pre-school children.

6.1.3 Geographical distribution of anaemia

• Sectoral variation

Based on national surveys, the prevalence of overall anaemia among children was similar in all three sectors (Table 6.2). However, according to the multivariate analysis of NFSA 2009, children living in rural sector (OR=0.4) and estates (OR= 0.35) were at a lower risk of overall anaemia compared to children in the urban sector. Furthermore, when the degree of anaemia is considered, children in rural sector reported the highest percentage of severe anaemia while moderate anaemia was high in both rural and urban sectors. Urban sector recorded the highest prevalence of mild anaemia.

Table 6.2: Prevalence of anaemia among 6-59 month old children by sectors

<table>
<thead>
<tr>
<th>Source</th>
<th>Anaemia</th>
<th>Urban</th>
<th>Rural</th>
<th>Estate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS 2006-07</td>
<td>Mild (10-10.9g/dl)</td>
<td>20.7</td>
<td>10.7</td>
<td>0.6</td>
<td>21.5</td>
</tr>
<tr>
<td></td>
<td>Moderate (7-9.9g/dl)</td>
<td>10.7</td>
<td>10.8</td>
<td>0.2</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>Severe (&lt;7g/dl)</td>
<td>0.6</td>
<td>11.6</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Any</td>
<td>32.0</td>
<td>33.2</td>
<td>28.1</td>
<td>32.6</td>
</tr>
<tr>
<td></td>
<td>Any</td>
<td>26.7</td>
<td>24.7</td>
<td>25.2</td>
<td>25.2</td>
</tr>
<tr>
<td>NFSA 2009</td>
<td>Any</td>
<td>26.7</td>
<td>24.7</td>
<td>25.2</td>
<td>25.2</td>
</tr>
</tbody>
</table>

• District variation

According to DHS 2006-07, the prevalence of any anaemia among children was higher than the national level in Ampara, Batticaloa, Gampaha, Hambantota, Moneragala, Matale, Ratnapura and Galle districts (map 6.1).
Map 6.1: District distribution of any anaemia in children 6-59 months of age

Source of data: DHS, 2006-07

The NFSA 2009 showed districts of Jaffna, Ratnapura, Colombo MC and Trincomalee to have a high prevalence of anaemia. In comparison, both surveys commonly identified Ratnapura district as having a high proportion of anaemia. None of the districts of Ampara, Batticaloa, Gampaha, Moneragala, Matale and Galle that showed a high proportion of anaemia in the DHS were included in the NFSA 2009. Jaffna, a district that was not included in the DHS 2006-07, was found to have a high percentage of anaemia in the NSFA.

6.1.4 Determinants of anaemia

DHS 2006-07 data disaggregated by socio-demographic factors indicated that when mother’s level of education increased from no education to a level higher than passing OL examination, prevalence of any (irrespective of severity) anaemia decreased from 42% to 25%. The decline in prevalence of any anaemia with increasing wealth quintiles from the lowest (34%) to middle (32%) and highest (31.5%) was not so marked.
Among anaemic children, two thirds (66%) were classified as mild anaemia while the others were classified as moderate or severe in the DHS 2006-07. Mild anaemia was slightly higher among female children (68%) compared to males (64%). In contrast, moderate to severe anaemia was marginally higher (36%) among male children than among the female children (32%). Prevalence of moderate or severe anaemia increased according to mother’s education from no education (33%) to a primary level of education (42%) and steadily decreased up to 24% with education higher than OL Examination. It decreased from the lowest wealth quintile from 40% to the highest wealth quintile (26%).

The multivariate analysis of the NFSA 2009 identified being a female (OR=0.67), being in the richest wealth quintile (OR=0.56), spending 50-70% of expenditure on food (OR=0.51), individual dietary diversity score of 4 or more (OR=0.51) and increasing age of the child (<6 months OR=0.35 and 48-59 months OR=0.10) to be protective factors against any anaemia.

Authors have also found an unlikely association in that children of anaemic mothers (OR=0.31) were found to have a lower risk of anaemia and had recommended further exploration of this relationship.

Study by Malkanthi et al (2010) showed that haemoglobin level was positively correlated with age (r = 0.41, p < .001) and negatively correlated with duration of exclusive breastfeeding (r = -0.18, p < 0.001). Factors that were significantly associated with anaemia in a multivariate logistic regression included exclusive breastfeeding for 6 months or more, less educated fathers and low iron intake. Difficulties in meeting iron requirements during the age range 6-24 months are well recognized and not unique to developing countries (WHO, 2005). In a setting where anaemia is high in pregnant and lactating mothers, this situation needs close monitoring. The current DHS data could be further analysed to investigate this association in Sri Lanka, and such analysis could be incorporated into the routine results presented in future demographic and health surveys.

Anaemic males had a 3-fold (95% CI: 1.1–8.3) and 2.3-fold (95% CI: 0.8–6.6) risk of being underweight and thin, whereas the risk among anaemic females was 0.7-fold (95% CI: 0.3–1.8) and 0.9-fold (95% CI: 0.3–2.6) for being underweight and thin (Hettiarachchi & Liyanage, 2010a).
6.2 Anaemia in children and adolescents aged 5-19 years

6.2.1 Sources of data

There were several large-scale studies which had assessed the status of anaemia among schooling children and out-of-school adolescents, although some were not within the review period. However, a meaningful comparison between these studies was not possible due to differences in the age groups and study settings.

6.2.2 Prevalence of anaemia

Several studies assessed the prevalence of anaemia in children aged 5-15 years (table 6.3).

One of the large-scale studies carried out in 2002 among a randomly selected sub-sample of 3,143 primary school children aged 5-9 years using age specific WHO defined cut-off points with adjustments for altitude showed an average Hb level of 12.6 ranging from 12.2-12.8 g/dl (Jayatissa et al, 2002). The highest prevalence was observed at the age of 5 years (24.6%) among girls. However, boys (17.6%) were more anaemic than girls (15.3%) except among 5 and 7 years of age group.

Another study was carried out in the districts of Anuradhapura, Polonnaruwa, Badulla, Moneragala, Colombo, Hambantota, Kurunegala, Vavuniya, Ampara and Ratnapura among school children aged 5-15 years selected using a multi-stage stratified sampling technique (Jayatissa, 2002). Anaemia was assessed using Haemocue method among a randomly selected sub sample of 2,666 (1,701 primary school children and 965 adolescents). The cut-off to detect anaemia was taken as <11.5 g/dl for 5-12 year old children and <12g/dl for 12 year old children. Disaggregated by age groups, prevalence of anaemia decreased till age of 8 years (21.7%-11.8%), then increased to 15% among children of 9 years.
Table 6.3: Prevalence of anaemia in children and adolescents aged 5-19 years

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample size</th>
<th>Setting</th>
<th>Age group (in years)</th>
<th>Anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jayatissa et al, 2002</td>
<td>3,143</td>
<td>All 8 provinces</td>
<td>5 - 9</td>
<td>16.5%</td>
</tr>
<tr>
<td>Jayatissa, 2002</td>
<td>1,701</td>
<td>10 districts</td>
<td>5 - 9.9</td>
<td>16.3%</td>
</tr>
<tr>
<td></td>
<td>965</td>
<td></td>
<td>10 - 14.9</td>
<td>13.9%</td>
</tr>
<tr>
<td>Dissanayake, 2005</td>
<td>960</td>
<td>Kandy</td>
<td>13 - 15</td>
<td>9.9%</td>
</tr>
<tr>
<td>Lanerolle &amp; Atukorala, 2006</td>
<td>229</td>
<td></td>
<td>15 - 19</td>
<td>3.1%</td>
</tr>
<tr>
<td>Jayatissa &amp; Ranbanda, 2006</td>
<td>1,521</td>
<td>All districts</td>
<td>10 - 15</td>
<td>11.1%</td>
</tr>
<tr>
<td>Hettiarachchi et al, 2006</td>
<td>945</td>
<td>Galle</td>
<td>12 - 16</td>
<td>54.8%</td>
</tr>
<tr>
<td>de Lanerolle et al, 2010</td>
<td>613</td>
<td>Colombo</td>
<td>15 - 19</td>
<td>17.3%</td>
</tr>
</tbody>
</table>

Iron status and its associations with the educational performance and intelligence of school going adolescents in the district of Kandy was studied in 2005 (Dissanayake, 2005). A total of 960 adolescents from the age of 13 – 15 years in government schools of Kandy district were assessed for serum iron status and iron deficiency anaemia. Prevalence of iron deficiency anaemia (<12 g/dl) was found to be 9.9% while moderate to severe anaemia (<10 g/dl) was 3.4%. Girls had a significantly higher prevalence of iron deficiency anaemia (14.7%) when compared to boys (5.7%). Of the 20.5% of anaemics, only 39.2% had iron deficiency anaemia, of whom most were girls (30.4%). Study concluded that the common practice of approximating the prevalence of anaemia to the prevalence of iron deficiency anaemia is irrational.

In a study by Lanerolle & Atukorala in 2006 among 229 adolescent school girls aged between 15-19 years, mean Hb was found to be 12.9 ± 12.8 g/dl. Seven girls (3.1%) were anaemic (Hb <120g/l) (Lanerolle & Atukorala, 2006).

‘Prevalence of challenging nutritional problems among adolescents in Sri Lanka’ by Jayatissa and Ranbanda published in 2006 was another source of data on anaemia in schooling children. 1,521 students of 10 to 15 years of age were selected from 144 public schools in the country using a multistage sampling technique with probability proportionate to school enrolment size. The overall prevalence of anaemia was 11.1%. The prevalence further increased with age except...
at the age of 11 years, and decreased from 14 to 15 years. It was also higher in boys than in girls (p > 0.05) except in the 14- and 15-year age groups. The highest was observed at the age of 14 years (37.7%) among girls.

In a cross-sectional study in the Galle district in 2003 among 945 school children aged 12 – 16 years, the prevalence of anaemia (Hb < 120.0 g/l) was 49.5% in males and 58.1% in females (overall 54.8%, P=0.004) (Hettiarachchi et al, 2006). In anaemic children, 30.2% of males and 47.8% of females were iron deficient (serum ferritin <30 μg/l). Folate deficiency (<6.80 nmol/l) was found in 54.6% and 52.5% of boys and girls, respectively, whereas Zn deficiency (<9.95 μmol/l) occurred in 51.5% and 58.3%. Anaemic boys had a 1.5 fold (95% CI: 0.9-2.6) and 1.6 fold (95% CI: 1.1-2.6) risk of being stunted and underweight, whereas the risk among anaemic girls was 1.7 (95% CI: 1.1-2.7) and 1.0 (95% CI: 0.7-1.5) for being stunted and underweight. The relative risks of having at least two deficiencies in iron, Zn and folate among anaemic children were 1.6 (95% CI: 0.6-4.2) among boys and 0.8 (95% CI: 0.5-1.5) among girls. Iron deficient children had a significantly higher risk of 1.8 (95% CI: 1.1-3.0) of being deficient in folate and 1.7 (95% CI: 1.2-2.6) of being deficient in Zn. Zn deficient children had a risk of 1.3 (95% CI: 1.0-1.8) being iron deficient and 1.2 (95% CI: 0.9-1.7) of being folate deficient. Study concluded that multiple micronutrient deficiencies are prevalent among Sri Lankan adolescents.

In the recently concluded cross-sectional study (de Lanerolle et al, 2010) among 15-19 year old out-of-school girls selected from an urban district and a rural district (N= 613), Hb was measured by cyanomethhaemoglobin method, and serum folate and vitamin B12 concentrations by radio isotopic methods. 17.3% were anaemic (Hb < 120 g/l), 28% had low folate (folate < 3μ/L), 2% had low vitamin B12 (B12 < 150 pg/ml) and 28.8% had low Zn (< 66µg/dl) concentrations. Of those who had low serum folate levels, 21.1% were also anaemic. Of the anaemic girls, 37.8% had low folate, 37% had low ferritin and 39.1% had low Zn concentrations. Among non-anaemic girls, 20% had two or more micronutrients in less than optimal concentrations. Of the underweight girls, 17.4% were anaemic, 28.4% had low folate, 27.7 % had low ferritin and 29.1% had low Zn concentrations. Even among overweight girls, 40.6% had low folate concentrations. The study concluded that multiple micronutrient deficiency is a problem in adolescent girls that may or may not be associated with anaemia.
6.2.3 Geographical distribution of anaemia

Jayatissa et al (2002) recorded a significant sectoral variation in anaemia (10.1% in urban and 17.5% in rural; p=0.000). Furthermore, anaemia was lowest in Western Province (9.4%) and highest in North Western Province (20.9%).

The other study by Jayatissa in 2002 indicated that the adolescent group from Colombo district had a low level of anaemia while other districts had a medium level of anaemia except Anuradhapura, Vavuniya, Ratnapura and Kurunegala districts, which had a high level of anaemia. None of the districts showed a very high prevalence of anaemia.

Based on the study by Jayatissa and Ranbanda 2006, it was concluded that the overall prevalence of anaemia was 11.1% and that it was equally prevalent among children from rural and urban schools (11.2% and 10.0%, respectively).

6.2.4 Determinants of anaemia

Other than age and sex, evidence on determinants of anaemia among children older than 5 years were not found in the literature perused.

As for out-of-school adolescent girls, de Lanerolle et al (2009b) study showed a significant urban-rural disparity in relation to the prevalence of vitamin B\textsubscript{12} but not with anaemia or low serum folate status.

6.3 Anaemia among non-pregnant women age 15-49 years

6.3.1 Source of data

- **Surveys**
  
  DHS 2006-07 and NFSA 2009 have assessed anaemia among non-pregnant women.

- **Routine data**
  
  There is no information on haemoglobin level in non-pregnant women.
• Research studies

The only large-scale study from which data on anaemia among non-pregnant women were available during the period under review is the baseline survey of the national nutrition surveillance system of Sri Lanka 2006 (Nutrition Coordination Division, 2006).

6.3.2 Prevalence of anaemia

Prevalence of anaemia (<12 g/dl) among non-pregnant women aged 15 - 49 yrs (N=10,540) was 39% in DHS 2006-07 [mild (10-11.9 g/dl) was 34%; moderate (7-9.9 g/dl) was 5%; and severe (<7 g/dl) was 0.3%].

The NFSA 2009 studied 921 lactating women and 1,218 non-pregnant non-lactating women in the assessment of anaemia. Among lactating mothers, anaemia was 20.5% while it was 22.2% when all non-pregnant women were taken together.

The study by Nutrition Coordination Division covered a total 5,164 households in 24 vulnerable DS divisions from 14 districts including 6 from unclear areas. Prevalence of anaemia among non-pregnant women having less than 5 year old children was 23.8%.

6.3.3 Geographical distribution of anaemia

Based on DHS 2006-07, women in the urban sector reported the highest prevalence (44%) of any anaemia compared to 38% in rural and 42% in estate sector. Women in the estate sector reported the highest percentages of moderate and severe anaemia 10.4% and 2.3% (urban-6.5% and 0.3%; rural-4.1% and 0.2%).

Districts with percentage of any anaemia higher than the national level were Galle, Ratnapura, Ampara, Colombo, Moneragala, Kalutara, Kurunegala, Gampaha and Puttalam (map 6.2). Severe anaemia was highest in Nuwara Eliya district (2.5%).
When all non-pregnant women are considered together, according to the NFSA 2009, the estate sector showed the highest prevalence of any anaemia (33.6%). Jaffna, Ratnapura, Colombo MC and Nuwara Eliya showed proportions higher than national average. Among lactating women, Jaffna, Anuradhapura, Colombo, Ratnapura and Colombo MC were the districts which showed values higher than the national average.

Bi-variate analysis from the NFSA 2009 shows that anaemia was significantly higher among women living in the estate sector or in the Jaffna district. In its multivariate analysis, risk of anaemia was shown to be 2.5 times more among estate women compared to those in urban sector. Living in Nuwara Eliya (OR=0.41), Hambantota (OR=0.52), Trincomalee (OR=0.49), Kurunegala (OR=0.49) and Badulla (OR=0.46) as opposed to living in Colombo MC was associated with a low risk of anaemia.

Baseline survey of the national nutrition surveillance system of Sri Lanka 2006 of the Nutrition Coordination Division identified that the highest prevalence of anaemia among women was in
MOH aea of Maskeliya (10.3%) and Kalpitiya (10.4%) (Nutrition Coordination Division, 2006).

6.3.4 Determinants of anaemia

DHS 2006-07 data disaggregated by socio-demographic factors indicated that the prevalence of any anaemia was higher with increasing age (15-19 years =31% to 40-49 years = 46%). Similarly, prevalence of mild and moderate anaemia also increased with increasing age (mild anaemia: 15-19 years -29% to 40-49 years 39% and moderate anaemia: 15-19 years -2.5% to 40-49 years 6.5%). However, severe anaemia did not change with age.

On disaggregating anaemia in women by the number of children born, it was shown that any anaemia (0 children- 35% 5 children 49%) and also mild (0 children- 29% 5 children 39%) and moderate (0 children- 3.5% 5 children 7.7%) anaemia was higher with the increasing number of children born to a woman. Mild anaemia fluctuated with increasing level of education of the women (no education = 33% to higher than passing Ordinary level = 34.5%) while prevalence of moderate and severe anaemia decreased with increasing level of education of women (moderate anaemia: no education 9.6% to higher than passing OL 3.1% and severe anaemia: no education 1.5% to higher than passing OL 0.0%).

Prevalence of mild anaemia was highest among women in highest wealth quintile (37%) while prevalence of moderate and severe anaemia was highest among women in lowest wealth quintiles (moderate =5% and severe =1).

DHS 2006-07 had described the determinants of the severity of anaemia among anaemic non-pregnant women. Prevalence of mild anaemia decreased with increasing age among anaemic women (15-19 years 92% and 84% 40-49 years). In contrast, moderate or severe anaemia among them increased with increasing age (15-19 years 8% and 15.6% 40-49 years). On disaggregating anaemia by the number of children born, it was shown that mild anaemia was highest among the anaemic women with only one child (90%). Prevalence of moderate or severe anaemia was highest among women with 4-5 children (18%). Mild anaemia among anaemics increased with their increasing level of education (no education = 74.7% to higher than passing OL = 92%) while prevalence of moderate or severe anaemia decreased with increasing level of education (no education = 25% to higher than passing OL = 8%). Prevalence of mild anaemia among anaemic women was highest among those in the fourth wealth quintile.
(90%) while prevalence of moderate or severe anaemia was highest among women in the lowest wealth quintile (17%).

In the multivariate analysis of NFSA 2009, more than 90% expenditure on food as a percentage of household income (OR=1.86) was found to be the only independent significant risk factor.

6.4 Anaemia among pregnant women

6.4.1 Source of data

• Surveys

DHS 2006-07 and NFSA 2009 have assessed anaemia among pregnant women. However, the sample sizes were small.

• Routine data

Based on MCH returns from MOH areas (H509), FHB provided data on prevalence of anaemia of the pregnant mothers who utilize field health clinics in the state preventive health services. Hb assessments of these women were during any time of their pregnancy and tested in different laboratories throughout the country. Therefore, this data were not considered for mapping.

• Research studies

No research evidence was found on anaemia of pregnant mothers.

6.4.2 Prevalence of anaemia

Based on FHB data, moderate anaemia among pregnant women was 5.6 % in 2007, 7.25% in 2008 and 9.1% in 2009. Severe anaemia among pregnant mothers in the same years was 1.5 %, 1.3% and 1.1%, respectively. As shown in table 6.4, 34% were found to have anaemia in DHS 2006-07 in contrast to 16.7% in NFSA 2009. This difference may be due to a lower cut-off value used in NFSA (< 11 g/dl) compared to DHS 2006-07 (< 12 g/dl).
Table 6.4: Comparison of anaemia among pregnant women

<table>
<thead>
<tr>
<th>Source</th>
<th>Mild 10-11.9 g/dl</th>
<th>Moderate 7-9.9 g/dl</th>
<th>Severe &lt;7 g/dl</th>
<th>Any</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFSA 2009 (N=228)</td>
<td></td>
<td></td>
<td></td>
<td>16.7</td>
</tr>
<tr>
<td>FHB 2011</td>
<td></td>
<td>9.1</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>DHS 2006-07 (N=715)</td>
<td>20.7</td>
<td>13.3</td>
<td>34.0</td>
<td></td>
</tr>
</tbody>
</table>

Variation in the prevalence of anaemia should be interpreted cautiously in the light of small sample sizes of pregnant women included.

6.4.3 Geographical distribution of anaemia

The DHS 2006-07 has not disaggregated data on anaemia among pregnant women by sectors or districts.

Based on NFSA 2009, the prevalence of anaemia among pregnant women was highest in the urban sector (19.3%) with the lowest in the estate sector (8.3%). Inter-district comparisons had indicated that Colombo MC had the highest prevalence (28.6%). Anuradhapura (25%), Badulla (21.7%), Ratnapura (21.4%) and Hambantota (20%) were the other districts with prevalence of anaemia higher than the national level. However, the authors have cautioned the readers regarding interpretation of the comparisons due to small number of study units.

6.4.4 Determinants of anaemia

Only NSFA 2009 has attempted to describe the determinants of anaemia among pregnant women. The prevalence of anaemia is seen to increase with increasing age (<20 years = 13.3% to 30-39 years = 17.8%). No consistent pattern was seen with the education level of the pregnant woman, wealth quintiles and monthly income categories.
6.5 Anaemia among lactating women

6.5.1 Source of data

Information on anaemia among lactating women was available only from the NFSA 2009.

6.5.2 Prevalence of anaemia

Among lactating women (N=921) included in the NSFA 2009, 20.5% were anaemic.

6.5.3 Geographical distribution of anaemia

The highest prevalence of anaemia was seen in the estate sector (30.2%) and in districts of Jaffna, Anuradhapura, Colombo and Colombo MC area.

6.5.4 Determinants of anaemia

There was a steady decline of the prevalence of anaemia with increasing level of education (no school = 27.3% and higher than passing OL = 15.7%). Monthly household income and wealth quintile did not show a consistent pattern.
Summary

- Anaemia pervades the life circle.

Pre-school children
- Prevalence of anaemia among pre-schoolers is shown to be in the range of 25-35%. Of these, approximately two thirds are only mildly anaemic.
- Urban sector recorded the highest prevalence of mild anaemia while moderate and severe anaemia were highest in the rural sector.
- Uni-variate analysis shows that low level of education in the mother, being in the lowest wealth quintiles and low individual dietary diversity were significantly associated with anaemia among pre-schoolers. Multivariate analysis showed poor dietary diversity to be a risk factor.

School age children
- In the absence of national level data on anaemia among school age children, the prevalence data presented are from research studies. They differed on age ranges of study units, study settings and cut-off values used. Prevalence of anaemia ranged from 16.3% among 5-9 year olds, 9.9 - 13.9% among 10-15 years and 54% among 12-16 year olds.

Reproductive age women
- Review findings revealed that anaemia among reproductive age women ranged from 22.2 - 39%. Women in the urban sector reported the highest prevalence of mild anaemia while women in the estate sector reported the highest percentages of moderate and severe anaemia. Prevalence of anaemia was high among older women, with more children and among women in the lowest wealth quintiles.
- Pregnant women recorded prevalence of anaemia ranging from 16.7% to 34.0% in different surveys. The prevalence was highest in the urban sector.
Chapter 7
Vitamin A and Iodine deficiency disorders

7.1 Vitamin A Deficiency (VAD)

VAD is the single most important cause of preventable childhood blindness especially in the developing countries. In keeping with the global recommendations, Sri Lanka set the goal of elimination of VAD and its consequences including blindness by the year 2000. In 2001, an island-wide vitamin A mega dose supplementation programme was initiated for children of 6-60 months of age and for post-partum mothers within 4 weeks of delivery.

A deficient status is identified by clinical signs and symptoms such as Keratomalacia, Bitot’s spots and night blindness. However, marginal vitamin A status is not associated with clinical features and thus assessed bio-chemically using serum retinol level.

7.1.1 Sources of data

- **Surveys**

Main sources of national and district level data on VAD are:

2. Vitamin A deficiency status of children in Sri Lanka 1995-96 was used for comparison

Two major surveys have been carried out to assess VAD in Sri Lanka. The initial survey was done in 1995/6 among 1,750 children aged 6-71 months, excluding North and East provinces (Medical Research Institute, 1998). The more recent survey was conducted in 2006, 5 years after the initiation of vitamin A mega dose supplementation programme (Jayatissa & Gunathilaka, 2006a). For this survey, a sample of 900 children aged 6-60 months was selected from 20 districts excluding Jaffna, Kilinochchi, Mullaitivu, Mannar and Batticaloa. A three-stage sampling method was used to identify 36 clusters of MOH areas using PPS technique and 25 children selected from child welfare clinics in each cluster. All children who participated in the survey were tested for Bitot’s spots and night blindness while 768 blood samples of them were analysed for serum retinol.
• **Routine data**

Routine data on VAD are not available. However, the FHB collates information available at MOH level on the number of vitamin A mega doses given by children.

• **Research studies**

Information on VAD is available from a research study carried out by the Nutrition Division of MRI (Jayatissa et al, 2002). It was a large survey among 7,200 primary school children aged 5-9 years, of which a sub-sample of 800 children underwent clinical examination to identify vitamin A deficiency.

### 7.1.2 Prevalence and geographical distribution of VAD

It is worthy to note that Keratomalacia as a cause for blindness was seen in 60% of children in 1930. Mainly as a result of feeding programmes initiated since late 1940s such as retinol palmitate added non-fat dried milk given to all children aged 1-5 years, Keratomalacia was reduced to 0.2% by 1970 (De Mel, 1970). The prevalence of Bitot’s spots was 0.8% in the 1995-96 survey, which was above the threshold of 0.5 for defining VAD as a public health problem. By the time the school survey (Jayatissa et al, 2002) was carried out in 2002, the prevalence of Bitot’s spots had come down to 0.3%. In the 2006 survey, children did not show any clinical features of VAD such as night blindness and Bitot’s spots, indicating the success of interventions carried out over years through the MCH programme.

The 2006 survey showed bio-chemical evidence of VAD. The sample had a mean serum retinol level of 23.8 µg/dl (SD=7.6) with no wide variation in relation to age. Children with VAD was 29.3% (95% CI: 26.1-32.5%), of whom 2.3% had severe deficiency (table 7.1). In comparison, the 1995/6 survey reported 9% of the sample to have severe deficiency. If a country has greater than 20% of children having biochemical VAD, it is considered as a public health problem. These results demonstrate that although VAD has remained a public health problem even in 2006, its severity has certainly improved over time from 1995/6 to 2006. The survey does not show an improvement in moderate VAD (27.0%) compared to findings in 1995/6 (26.7%).
Table 7.1: Comparison of the prevalence of VAD among 6-60 month old children

<table>
<thead>
<tr>
<th>Source</th>
<th>Normal ≥ 20µg/d serum retinol</th>
<th>Moderate 10-19.9µg/d serum retinol</th>
<th>Severe &lt; 10µg/d serum retinol</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI 1995-96</td>
<td>65.4%</td>
<td>26.3%</td>
<td>9.0%</td>
</tr>
<tr>
<td>MRI 2006</td>
<td>70.7%</td>
<td>27.0%</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

In the 2006 survey, mean serum retinol level of mothers with children aged 6-60 months was 29.8 µg/dl (SD=9.1). VAD was detected in 14.9% of them and interestingly, the highest prevalence was seen among mothers with adequate nutritional status and lowest among obese mothers.

Overall VAD showed a wide district variation from 12% of VAD in Matara to 40.4% in Vavuniya and an increase with increasing age up to 35 months. In addition, severe forms were mostly observed in girls and among children aged 6-11 months. All these findings indicate the need for interventions targeting specific groups among the 6-60 month old children.

7.1.3 Determinants of VAD

According to the survey conducted in 2006, risk factors associated with vitamin A status in Sri Lanka include only respiratory tract infections, with significantly more children with VAD having respiratory infections (32.7%). Diarrhoea was significantly more only among children with severe forms of VAD. There was no significant association of VAD with stunting (30.6%), wasting (29.0%) and underweight (29.2%), being a girl, on vitamin A supplementation, LBW baby, currently breast-fed and consuming vitamin A rich food sources during last 7 days. However, compared to the non-breast fed, breast fed children aged up to 23 months had a serum retinol level above the mean 23.8 µg/dl.
7.2 Iodine Deficiency Disorders (IDD)

Aetiology of goitre remains a topic of debate, the main factor identified worldwide is deficiency of iodine. Goitre is part of a spectrum of disorders, the most severe forms being mental retardation and cretinism. All the conditions are collectively referred to as IDD.

7.2.1 Sources of data
- Surveys
A series of surveys by the MRI (reports published in 2001, 2003 and 2006) have reported goitre prevalence and urinary iodine excretion in Sri Lanka.

- Routine data
Routine data on IDD are not available.

- Research studies
Published and unpublished research data on prevalence of goitre were perused. In addition, research data related to the background of initiation of universal iodization of salt programme in Sri Lanka were perused, even though these were beyond the period considered for the desk review.

7.2.2 Prevalence and geographical distribution of IDD

- Pre-iodisation period
Until the landmark study by Fernando et al (1989), endemic goitre in Sri Lanka was believed to be confined to a goitre belt consisting of Western, Sabaragamuwa, Southern and Uva Provinces, where the incidence was higher than in the rest of the country. The study by Fernando et al (1989) consisted of 59,158 school children of the age group 5-19 years sampled from 17 of the 24 districts of Sri Lanka. The overall goitre prevalence rate was 18.8% but varied from 30.2% in Kalutara to 6.5% in Matale. As shown in map 7.1, the key findings of the study were that the endemic area extended beyond what was defined by previous workers. High prevalence areas were the districts of Kalutara, Moneragala, Nuwara Eliya, Ratnapura, Badulla, Kegalla and Kandy while the low prevalence areas (<10%) were Colombo, Anuradhapura, Polonnaruwa and Matale. The study also highlighted the fact that there was a wide variation even within districts in the prevalence between schools. This suggested that endemicity was not uniform but occurred in
pockets. Such pockets were not observed in the low endemic areas. The study further confirmed that 13 districts of the country showed a prevalence of >10% and estimated that 66% of the country’s population was at risk and called for intervention by the authorities.

**Map 7.1: Prevalence of goitres by Provinces in 1989**

![Map of Sri Lanka showing goitre prevalence by province in 1989](image)

*Source: Fernando et al, 1989*

An unpublished study conducted by the MRI in 1987-89 and cited in Jayatissa et al (2005) reported a goitre prevalence of 63% among 1,641 pregnant women attending antenatal clinics in the Kalutara district.

In view of the findings of above studies, necessary legislation was formulated and universal iodisation was introduced in 1995.

**Post-iodisation period**

In the post iodisation phase, three large national surveys have been conducted by Jayatissa et al (2001, 2003 and 2006b). These surveys have examined urinary iodine excretion in addition to goitre prevalence.

Based on the 2001 MRI survey data (conducted on 6,574 children aged 8-10 years selected from all nine provinces), the island-wide distribution of goitre was different from the earlier study by Fernando et al (1989). Maps 7.2-7.3 illustrate the prevalence of goitre and median urinary
iodine levels. The highest prevalence was found in the North Central province (26.2%), which was considered a non-endemic area in the first study. The lowest prevalence of 16.3% was found in the Western Province. All provinces except Uva province had mean urinary iodine concentrations of over 100 μg/l suggesting adequacy of iodine in diets. Uva province had 35% and 14% below the mean urinary iodine levels suggestive of mild and moderate deficiency, respectively. The Eastern province had 4.6% with low levels of urinary iodine suggestive of severe efficiency. A noteworthy feature is that the North Central Province 27% and 32% with levels of urine iodine indicative of more than adequate and excessive iodine intake, respectively.

Map 7.2: Prevalence of goitres by Provinces in 2000-01

Map 7.3: Median urinary iodine levels by Provinces in 2000-01

Source: Jayatissa & Gunathilaka, 2001

The 2003 report by Jayatissa et al presents data for 11 of the 24 districts of 4,117 school children aged 8-10 years. The prevalence of goitre varied from 19.5% in Badulla to 1.2% in Ampara. The districts Hambantota, Kurunegala, Anuradhapura, Polonnaruwa, Badulla and Moneragala had prevalence exceeding 10%. The urinary iodine studies showed that the median urinary iodine concentration was high in Colombo, Anuradhapura, Kalutara and Vavuniya districts. In the latter two districts, 45% of the population was exposed to excessive iodine intake. In the districts of Colombo and Anuradhapura, 38% and 37% of persons were exposed to...
excessive iodine intake. The report states that the urinary iodine levels and goitre rates suggest that the districts of Colombo, Kalutara, Ampara and Vavuniya have achieved the goal of eliminating iodine deficiency.

The prevalence survey in 2006 showed that the overall goitre prevalence had decreased from 18.2% before salt iodisation to 3.8% (maps 7.4-7.5). The median urinary iodine level was 154.4 μg/l while the percentage of households receiving adequately iodised salt has increased to 91%. These findings suggest that the goal of elimination of iodine deficiency has been achieved in respect of all three indicators at a national level. However, in the Central (10.3%), Western (7.3%) and Uva (7.8%) provinces, the total goitre rate remains above the desired prevalence of <5% (map 7.3). It is further important to note that while the median urinary iodine levels were above the lower cut off of the desired range (≥ 100μg/l) in all provinces, the urinary iodine levels even above the upper cut off of 199 μg/l were seen in Northern (283.4 μg/l) and North Central (230 μg/l) provinces. In these two provinces, 43.5% and 33.1% of the population were exposed to excessive iodine intake while in a further 25.5% in each of these two provinces were receiving more than adequate iodine intake.

Map 7.4: Prevalence of goitres by Provinces in 2006

Map 7.5: Median urinary iodine levels by Provinces in 2006

Source: Jayatissa & Gunathilaka, 2006b
Unpublished data (Fernando R, personal communication,) are available from a more recent community-based study done in 2009-10. Here, the island was divided into five areas based on rainfall and elevation, namely wet zone coastal, wet zone hills, intermediate zone east, intermediate zone west, dry zone east and dry zone north central (annex IV). In each zone, a sample of 864 persons above 10 years of age were chosen from 18 GN divisions using a multistage, cluster sampling procedure with probability proportional to size of the population. A cluster in each GN division consisted of 50 persons chosen as 5 sub clusters so as to distribute the sample within the GN division. In this sample of 5,200, there were 426 goitres detected. As shown in figure 7.1, the highest prevalence was seen in the wet zone hills. The age and zone adjusted national rate was 6.8% (95% CI: 6.0-7.6%).

**Figure 7.1: Age and sex adjusted prevalence of goitre by zone**

![Age and sex adjusted prevalence of goitre by zone](image)

*Source:* Fernando R (personal communication)

Another important finding is that the study identified pockets where the goitre prevalence was high. A total of 28 GN divisions showed goitre prevalence more than 10% and in 11 of these, the prevalence was over 15% and was located within 8 DS divisions. Maps 7.6-7.7 show the goitre prevalence among males and females in the study.
Map 7.6: Goitre prevalence among males in the DS divisions included in the study

Source: Fernando R (personal communication)

Map 7.7: Goitre prevalence among females in the DS divisions included in the study

Source: Fernando R (personal communication)
Map 7.8: DS divisions with goitre prevalence higher than 15% in Sri Lanka

Source: Fernando R (personal communication)

The findings on map 7.8 highlight the need to focus on such clusters and identify possible alternate aetiology for goitre in these areas.

7.3 Other iodisation related issues

Literature suggests that excess iodine may cause auto-immune thyroiditis, hyperthyroidism and probably an increase in papillary carcinoma of thyroid.

7.3.1 Sources of data

A few research studies that had assessed the iodisation related issues were perused.
7.3.2 Auto-immune thyroiditis

A study by Premawardhana et al (2000) examined 367 school girls of 11-16 years selected from three different regions of the country classified as low, intermediate and high goitre prevalence in the 1987 study, with a view to examining the beneficial and harmful effects of iodisation. It showed that the prevalence of Thyro Peroxidase Antibody (TPA) was 10% or less among the children studied. Their median thyroid volume estimated using ultrasonography, urinary iodine concentration and thyroid functions (TSH, free T4 and freeT3) were normal. However, the prevalence of thyroglobulin antibodies (TgAb) was markedly raised. The authors suggest that excessive iodisation of TgAb may increase the immunogenicity and this be the likely explanation of their findings.

In the recent study cited earlier (2009-10), Fernando offered Fine Needle Aspiration and Cytology (FNAC) to all persons detected with goitre. A total of 308 FNAC were carried out, of which 226 were diagnostic. The histology suggested that auto-immune thyroiditis was present in 49.6% of cases. Blood was also collected from a sub-sample of 153 out of the 426 with goitre and was tested for TPA. The antibody levels suggested that auto-immune thyroiditis was present in 37.9% of those with goitre. The study also examined the thyroid status clinically as well as using TSH levels. Nearly 16% of the persons with goitre had high TSH levels suggestive of hypothyroidism and 30% had low TSH levels.

Increasing goitre prevalence is seen to be related to the increasing prevalence of thyroiditis (figure 7.2). It is further shown that thyroiditis is highest in the intermediate zone - North followed by the dry zone - North Central.
Figure 7.2: Goitre prevalence by prevalence of thyroiditis in different zones

Source: Fernando R (personal communication)

In the same study, thyroiditis was seen to be related to urinary iodine levels (figure 7.3).

Figure 7.3: Relationship between urine iodine concentration and thyroiditis

Source: Fernando R (personal communication)

Urine iodine was estimated in all with goitre and in a sub-sample of those without goitre. The distribution of urine iodine of those with and without goitre by zone is shown in figure 7.4. Urinary iodine was found to be high in areas where it had been noted to be high in the earlier
surveys. Interestingly, the prevalence of thyroiditis was also seen to be high in these areas. These findings need further study.

**Figure 7.4: Urine iodine of those with and without goitre in different zones**

![Boxplot showing urine iodine content in different zones with or without goitre](image)

*Source: Fernando R (personal communication)*

### 7.3.3 Thyroid cancer

Hospital based data on cancers are available from the Cancer registry (National Cancer Control programme, 2009) and has shown an increase in the reported cases of thyroid cancer (figure 7.5). However, it is not possible to say whether this is a true increase or due to increased detection.

**Figure 7.5: Rates of thyroid cancer in Sri Lanka 1985-2005**

![Graph showing thyroid cancer rates 1985-2005](image)

*Source: National Cancer Control Programme, 2009*
Ratnatunga et al (2003) reported that there has been a change in the histological pattern of cancers in Kandy, in that there has been a reduction in anaplastic cancers and an increase in the papillary carcinoma. In the year 2005, 67% of all thyroid cancers reported to the cancer registry were papillary carcinomas, only 5% being anaplastic. These changes are in keeping with the expected pattern of disease in the post-iodisation phase. However, a possible increase in the rate of thyroid cancer needs to be monitored.

These studies highlight the importance of monitoring adequacy as well as possible risks of universal iodisation.
Summary

Vitamin A

• Clinical signs of vitamin A deficiency were not seen in the 2006 survey. However, biochemical evidence of vitamin A deficiency was seen in 29.3% of children and of these, 2.3% had severe deficiency. Vitamin A deficiency can therefore be considered to be a public health problem in the country.
• Nearly 15% of mothers with children 6-60 months of age had vitamin A deficiency.
• Prevalence of vitamin A deficiency showed wide district variations.
• The survey also showed that 33% of children with VAD reported respiratory infections in the two weeks preceding the survey. This highlights the importance of vitamin A supplementation as a factor that would contribute to improved PEM through reduction in infections.

IDD

• An IDD prevalence survey in 2005 showed that the overall goitre prevalence had decreased from 18.2% before salt iodisation to 3.8%. A median urinary iodine level was 154.4μg/l and the percentage of households receiving adequately iodised salt had increased to 91%. It appeared that the goal of elimination of iodine deficiency had been achieved in respect of all three indicators at national level.
• Although the national levels were low (2005 survey), Central, Western and Uva provinces reported total goitre rates above the desired prevalence of < 5%.
• A more recent survey 2009-10 showed a national goitre prevalence rate of 6.8% (95% CI: 6.0-7.6%) in those above 10 years of age. This figure has been corrected for age, sex and the sampling design used.
• The study highlighted clustering of goitre in geographic areas and a high prevalence of thyroiditis (histology suggestive of thyroiditis in 49.6% and raised TPA in 37.9%) among the people with goitre. Nearly 16% of persons with goitre showed increased TSH levels suggestive of hypothyroidism.
• Thyroiditis was seen to increase with increasing urinary iodine.
• All surveys over time had noted that urinary iodine excretion had been high in the North Central province and some parts of the Northern province.
• An increase in the incidence of thyroid carcinoma is observed during the period 1985-2005.
• Close surveillance of the situation described above is advocated.
Nutritional status of a person is an outcome of the process of acquiring, consuming and utilizing food. The World Declaration on Nutrition and Plan of Action for Nutrition serve as a guide to the technical issues of nutrition policy and programme development in a country (WHO/FAO, 1992). In this Plan of Action, improving household food security is referred to as one of the key principles for achieving national level nutritional intervention goals. Sri Lankan health authorities too have identified it as a priority area.

Food security includes at a minimum, the ready availability of nutritionally adequate and safe foods, and the ability to acquire acceptable foods in socially acceptable ways. An assessment of the role played by food insecurity is likely to yield useful information on planning broad–based nutritional interventions.

Household (HH) food security is assessed on three dimensions:

- **Household food utilization**
  - Meal frequency
  - Food consumption patterns
  - Dietary diversity at HH level
- **Food access**
- **Food availability**
8.1 Sources of data

8.1.1 Surveys

National and district level data on food security are available from the following sources:

- HIES 2006-07 and 2009-10 (Preliminary Report)
- NFSA 2009
- SLCFS 2008
- DHS 2006-07

Data from the national surveys given above have been collated by the MoH and UNICEF to provide district profiles on Maternal, Newborn & Child Health and Nutrition for Survival and Development (Ministry of Health, 2010a-x).

8.1.2 Routine data

Routinely collected data on food security are limited to food balance sheets that provide information on per capita availability of food items in the country, crop exports, etc.

8.1.3 Research studies

One of the key research studies on food security includes the Emergency Food Security Assessment 2009.

8.2 Meal frequency

According to the NFSA 2009, approximately 98% of the HH members aged 5-59 years and 95% of those aged 60 years and above consumed 3 or more than 3 main meals a day. These rates did not vary markedly in relation to the number of family members, sector and district of residence, monthly HH income and wealth quintiles.

Nearly 35% of children under 24 months were bottle fed and these rates increased with the increasing level of maternal education, HH income and wealth indicators (NFSA 2009). In the age group 6-23 months, 53.4% of the breast-fed and 26% of the non breast-fed children were fed at a frequency recommended for age. This percentage amongst the breast fed children increased with increasing parental income and higher wealth quintiles. This percentage was lower in the estate sector.
8.3 Food consumption patterns

8.3.1 Food consumption patterns at national level

Table 8.1 shows the trend in per-capita calorie intake from main food items per day in Sri Lanka based on HIES data collected during 1991-2007 year period. The overall calorie intake has not drastically changed over years but shows a slight drop for specific food items such as wheat flour, bread and coconut.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>1061</td>
<td>970</td>
<td>988</td>
<td>1000.1</td>
</tr>
<tr>
<td>Wheat Flour</td>
<td>62</td>
<td>75</td>
<td>89</td>
<td>49.1</td>
</tr>
<tr>
<td>Bread</td>
<td>168</td>
<td>224</td>
<td>192</td>
<td>133.8</td>
</tr>
<tr>
<td>Sugar</td>
<td>199</td>
<td>166</td>
<td>168</td>
<td>172.1</td>
</tr>
<tr>
<td>Coconut</td>
<td>207</td>
<td>183</td>
<td>251</td>
<td>159</td>
</tr>
<tr>
<td>Total</td>
<td>1697</td>
<td>1618</td>
<td>1688</td>
<td>1514</td>
</tr>
</tbody>
</table>

Source: HIES, 2006-07

8.3.2 Food consumption patterns at household level

HIES 2006-07 reveals that the average daily energy consumption per person was 2,118 Kcal in 2006, with the highest reported from Nuwara Eliya (2,383 Kcal) and the lowest from Colombo (1,920 Kcal) districts. Even among the poor HHs, the urban sector including Colombo district showed lower energy consumption compared to the estate sector. According to district profiles of maternal, newborn & child health and nutrition for survival and development 2010, the proportion of population below the minimum level of daily energy consumption (i.e. 2,030 kcal) was 50.7%. This proportion was higher in districts such as Colombo, Gampaha, Kegalle, Kalutara and Galle.

When main food groups consumed by HHs at least on 5 days during the week preceding the survey were assessed, the consumption of rice and rice based products, sugar/jaggery, and coconut was nearly 100% in almost all districts; vegetables/leaves was 74.9%; oils and fats was 60.4%; milk and milk products was 54.2%; meat/poultry/fish/dry fish was 49.1%; and bread and wheat products, nuts and pulses, fruits, and eggs was < 30% (NFSA 2009).
As evident by findings of the surveys, HH food consumption patterns seemed to vary by district, sector and HH income (HIES 2006-07 and 2009-10; NFSA 2009).

Although rice, wheat flour and bread are the favourite food items in Sri Lankan HHS, an inter-sector disparity has been shown in the HIES 2009-10. HHS in the estate sector consumed more wheat flour, rice (Nadu) and cow’s milk in contrast to more bread, rice (Samba), chicken, beef and fresh fish in the urban sector. The rural sector consumes more rice (Kekulu), dried fish, coconut and chilly.

In the NFSA 2009, a wide district variation was seen for certain food items. Hambantota reported the lowest consumption of bread/wheat products and the highest consumption of meat/poultry/fish/dry fish. Jaffna district reported low consumption of vegetables, fruits, meat/poultry/fish/dry fish and milk/dairy products. In comparison, Trincomalee district performed better in consumption of all food items other than nuts/pulses. Consumption of fruits ranged between 23.7 - 38.4% in the districts with two exceptions seen in Colombo (45%) and Jaffna (7.8%) districts.

A higher consumption of fruits, meat/poultry/fish/dry fish and dairy products seen with increasing income in the NFSA 2009 reflects the less affordability of such food items. In the estate sector, consumption of vegetables/leaves (60.6%), fruits (12.9%), eggs (5.6%) and meat/poultry/fish/dry fish (23.8%) was relatively lower than in the other two sectors. However, their bread/wheat product consumption was much higher (> 50%) compared to rural sector (11.9%). In areas where paddy is cultivated such as Anuradhapura, Hambantota, Kurunegala and Ratnapura districts, the consumption of bread seemed to be below 13%.

A reliable indicator of HH food consumption is the mean Household Food Consumption Adequacy Score (HFCAS) developed for each HH based on the weight and frequency consumption of all food types eaten during last seven days. Mean HFCAS for all HH surveyed in the NFSA 2009 was 67.7 (SD=16.0) with lower scores seen in the rural sector. Higher scores were associated with increasing HH income and wealth. The majority of HH surveyed belonged to the ‘adequate’ (HFCAS >35) food consumption group (97.6%). Although this score showed no variation in relation to sector or district, an upward trend was seen with increasing education level of the head of the HH, income and wealth. Similarly, in the emergency food security assessment conducted in Ampara and Vanni districts in 2009, nearly all HHS (96.6%) in both
districts showed ‘adequate’ (HFCAS >35) food consumption (World Food Programme, 2009a and 2009b)

8.3.3 Food consumption patterns in different age groups

- 6-59 month old children

Types of food items consumed

DHS 2006-07 gathered information about complementary feeding of the youngest child under three years of age in each household. Of these children, 3,404 were also being breast-fed while 593 were not. Among the breast fed children aged 4-5 months, approximately 30% had been given food made from rice, bread or noodles while 16% were also fed with infant formula. Above six months of age, there is a marked increase in the types of food given to infants. Of the children aged 6-8 months, 62% consumed vitamin A rich fruits and vegetables while only 39% received meat, fish, poultry and eggs (DHS 2006-07).

NFSA 2009 revealed that almost 95% children aged 6-59 months were given grains/tubers/roots while only 70-80% were given vitamin A rich fruits and vegetables and meat/fish/poultry/organ meat within the 24 hours preceding the survey. Children receiving eggs, dairy products and food cooked with oil or fat were relatively low. Nearly one-third had been given fortified food (<45%). 78% of children receiving sugary food is noteworthy.

Jayatissa & Gunathilaka (2006a) have shown that the consumption of animal food sources rich in vitamin A on more than 4 days per week among children aged 6-60 months (N=900) was 62.3% while both animal and vegetable food sources on more than 6 days per week was 61.3%. Both these indicators were below the acceptable threshold of 70%. In 1995 too, the intake of vitamin A rich food had been on the margin of inadequacy (Medical Research Institute, 1998), indicating that dietary interventions to prevent VAD have not yet been completely addressed.

Infant and Young Child Feeding (IYCF) practices

DHS 2006-07 also assessed IYCF practices in respect of frequency of feeding and diversity of food among 6-23 month old children. Among children who were breast-fed (N=1,928), 89% consumed food from four or more of the recommended food groups while 88% were fed at least the minimum number of times recommended. Of the same age children who were not breast-fed (N=190), 77% consumed food from recommended four or more food groups per day while 72% were fed four or more times a day.
Disaggregated by sector, it was shown that food frequency and diversity were least satisfactory in the estate sector (59%) compared to urban (79%) and rural (83%) (DHS 2006-07). The districts with lower than national average in these appropriate IYC practices were Batticaloa, Trincomalee, Puttalam, Anuradhapura, Kandy, Polonnaruwa and Badulla districts. The percentage of children who are fed according to the recommended IYCF practices increased with increasing child’s age and mother’s education.

• Reproductive age women

DHS 2006-07 used a 24 hour dietary recall to assess the food consumption pattern of mothers with a child less than 3 years (N=3,997).

Women in lower education levels, in the lowest quintile and living in Nuwara Eliya, Matale and Trincomalee districts showed low consumption rates of animal proteins compared to the national level. Furthermore, consumption of all key protein sources – milk, meat, legumes, cheese and yoghurt – was lower among mothers in estates. The pattern did not vary much with their age.

Consumption of foods made with oil/fat/butter was high in older age groups and in the urban sector (about three times higher than the estate). Colombo, Gampaha, Trincomalee, Ampara, Galle, Ratnapura and Kegalle districts were consuming these foods more than the national average. It should also be noted that the former three districts were among the districts that showed high overweight/obese proportions in the same survey.

Sugary food consumption was highest in the urban sector. Matara, Kegalle, Galle, Kandy and Matale also showed high proportion of women consuming sugary foods. In DHS 2006-07, Kandy was found to have high proportion of overweight.

According to the DHS 2006-07, proportions consuming Vitamin A rich foods (97%) and iron rich foods (85.6%) were very high among mothers. Vitamin A rich food consumption was low in estates and in the districts of Puttalam, Trincomalee and Galle. It was also low in young age, low education level categories and lowest wealth quintile. In comparison, a study conducted among 15-19 year old out-of-school adoelscent girls (de Lanerolle et al, 2009c) showed that urban girls reported a higher consumption of processed food, animal food, bread and deep fried food with a lower consumption of micronutrient rich food such as fruits and dark green leafy vegetables.
when compared with rural girls. Consumption of snacks and eating meals from street vendors and food outlets was common among urban girls while it was reported that rural girls mainly consumed home cooked meals. High consumption of rice and rice products, as well as drinking tea during and after meals was commonly seen in the rural areas. Both urban and rural girls had inadequate knowledge and negative attitudes towards the importance of good nutrition. The adolescent girls were not aware of the importance of micronutrients such as Iron, Folate, vitamins A and B\textsubscript{12} and Zinc. Their mothers and health volunteers also displayed limited knowledge. As expected, the PHM had adequate knowledge on these aspects. Poor time and financial management, as well as inadequate knowledge on good nutrition and cooking practices were constraints to healthy eating in both groups. Land for home gardening and fire wood as cooking fuel was available for the rural girls, where as the urban girls had no space for home gardening and cooking fuel had to be purchased in the form of fire wood or kerosene.

### Adults

Two studies on individual food consumption patterns that were published during the review period were identified.

A cross-sectional study was conducted among 340 adults aged 18-44 years residing in the DS division of Gampaha to assess the physical activity and its association with dietary practices in a district undergoing rapid urbanization (Perera, 2010). The majority used thick coconut milk as their cooking method (78.5%), coconut oil as their cooking oil (96.8%) and had home-cooked meals (84.4%). In both urban and rural sectors, over 60% had healthy consumption of vegetables and whole grain products but not fruits; less than 10% had unhealthy consumption of whole milk/dairy products, whole eggs/products and red & processed meat; but not deep fried food and sugar-sweetened beverages. Unhealthy consumption of fruits, vegetables and whole grain products was much higher in adults living in urban areas than in rural sector. There was no such difference in relation to all types of energy-dense foods.

In another study, calcium intake and sources of dietary calcium was assessed among young adults (de Silva et al, 2011). This was a cross-sectional study conducted in the universities of Colombo and Kelaniya among female medical school entrants (N=186) using a modified validated 40-item food frequency questionnaire. The number of portions of food rich in calcium per week was also recorded and analysed. Mean calcium intake was 528.3 mg/day. Only 18.8% of the participants achieved the recommended daily allowance for calcium. When considering
the respondents who met the RDA, 14% were not taking calcium in the form of supplements while 4.8% were taking calcium supplemen-
tations. The top calcium providing food groups were milk, tea and milk, yoghurt, small fish, rice and cheese.

8.4 Dietary diversity

HH dietary diversity is a proxy measure of HH consuming a variety of food that indicates a ‘nutritionally satisfactory’ diet. It is measured using HH Dietary Diversity Score (HDDS).

According to the NFSA 2009, the mean HDDS was 7.8 and it ranged according to income and wealth quintiles. Marginally lower scores were seen in the districts having a large estate population (7.5) compared to Colombo MC that had the highest score (8.8). The mean HDDS of HHs in the highest income quintile was 8.7. In the areas surveyed, 63.5% of HHs were yet to achieve this mean HDDS score (74.4% in estate sector; 43.4% in urban sector). Districts that achieved this target in more than 50% of their HHs were Colombo and CMC. This percentage increased consistently with income and wealth quintiles.

The NFSA 2009 showed that the Individual Dietary Diversity Score (IDDS) calculated for 6-59 month old children was 4.8 with relatively low values in the estate sector. As for children aged 6-23 months, the mean IDDS was 4.2. These values were indicative of a diet with minimum diversity (IDDS > 4). IDDS in both groups of these children under 5 years was seen to increase with maternal education level, income and wealth quintiles. In summarising the overall feeding performance of children aged 6-23 months, a combination of minimum meal frequency and minimum dietary diversity was considered to calculate the ‘minimum acceptable diet’. Accordingly, only one third of these children (32.9%) received a minimum acceptable diet. This rate was low in the estate sector and increased with income and wealth.

In the SLCFS 2008, 62% of 6-9 month old children met the minimum dietary diversity, as assessed by the proportion of children less than 2 years who received food from 4 or more food groups. However, with increasing age, this proportion decreased to 35% in 9-12 month olds and to 42% among 18-24 year olds. By 18-24 months, nearly 46% of urban, 41% rural and 38% of estate breast-fed children met this minimum food diversity requirement. As for non breast-fed children, only 20% of children met the requirement.
In the DHS 2006-07, above six months aged infants showed a marked variation in the types of food given. Of the children aged 6-8 months, 62% consumed vitamin A rich fruits and vegetables while 39% received meat, fish, poultry and eggs.

8.5 Food access at HH level

Food access is defined by USAID as individuals having adequate income or other resources to purchase or obtain food needed to maintain consumption of an adequate diet/ nutritional level. It is shown that the HH expenditure pattern is one of the key parameters to determine its food security status.

As shown in figure 8.1, the monthly HH income in Sri Lanka has been Rs. 35,495 in 2009 according to the preliminary report of HIES 2009-10 (urban: Rs. 46,196; rural: Rs. 34,329; and estate: Rs. 25,649). Widening of the inequality in income was apparent over the years, with the richest receiving nearly 52% of the total HH income of Sri Lanka while the poorest receiving only 4.7%.

Figure 8.1: Average monthly real and nominal mean household income by survey

![Average monthly real and nominal mean household income by survey](source: HIES 2009-10)

Figure 8.2 further shows the district variation of the percentage increase in monthly household income. As seen, the increase was not apparent in already urbanized areas while those in the transition have by wealth of a district.
The HIES 2009-10 further revealed that the average monthly HH expenditure for food and drink in Sri Lanka has been Rs. 12,918 in 2009. Rice, wheat flour and bread have been the favourite food items in Sri Lankan HHs. When sectors are compared, rural (20.2%) and estate (31.7%) sectors spent relatively a larger proportion of their total HH expenditure on cereals such as rice and wheat flour, whereas the urban sector spent mostly on prepared food such as bread and buns (15.5%).

Food ratio (i.e. food and drink expenditure/ total expenditure) was 39.8% for Sri Lanka and as high as 49.5% in estate sector (figure 8.3). Food ratios of Central, Southern, Eastern, North-Western, North-Central, Uva and Sabaragamuwa provinces were all higher than the national level. It has further shown that average food and drink expenditure of the poorest 10% of the HHs exceeds the income by 29%. In contrast, the average food and drink expenditure of the richest 10% of the HHs was only 13.9% of their total income.
The emergency food security assessment conducted in nutritionally vulnerable districts assessed the HH expenditure on food. In Vanni district, the average HH expenditure was Rs. 16,759, of which nearly 51% was spent on food. The main food commodities purchased were fish (10.4%) and vegetables (9.9%). In Ampara district, the average HH expenditure was much higher (Rs. 9,136.00), of which 62% was spent on food. The main food commodities purchased were rice (15.9%), pulses, meat, coconut, milk powder and vegetables.

According to the NFSA 2009, both food purchase and domestic food production were used as the main sources through which food was accessed at HH level. Main items that were produced on their own were fruits, coconuts, rice and vegetables. Based on HH expenditure for one month, 37.9% of the total HH monthly income was found to have been spent on food while it was double (60.6%) in the estate sector. Districts that spent more than 40% of their income on food were Colombo, CMC, Jaffna, Nuwara Eliya, Ratnapura and Trincomalee while Anuradhapura, Badulla, Hambantota and Kurunegala spent less than 40%. This percentage expenditure on food decreased with increasing number of family members and increasing level of education, income and wealth quintiles.

In a study conducted among fathers, mothers and children in an urban poor area in Kandy district revealed that fathers had the highest and children the lowest mean calorie adequacy ratios. Regression analysis of data showed that income of mother and family size had significant positive and negative impacts, respectively on mother’s calorie allocation. It further showed
that there was age and gender based calorie allocation within the family and that income of mother had a negative effect on children’s calorie allocation (Ratnayake & Weerahewa, 2002).

8.5 Food availability at HH level

Figure 8.4 illustrates the trend in availability of calories per person per day based on food balance sheets of Sri Lanka over the last 5 years.

Figure 8.4: Per capita availability of calories per day from various food groups (2005 – 2009)

Source of data: Food Balance Sheets, Dept. of Census & Statistics, 2010

According to the Sri Lanka food security assessment, the availability of rice has increased over years but remains insufficient to meet the per capita requirement of the country. Country’s overall food availability therefore depends on other secondary domestic production such as tubers (manioc and sweet potatoes) and imports of wheat. While spatial disparities in rice production exist among districts, the main rice surplus areas are located in the North Central and Eastern districts. Out of twenty-five districts, sixteen located mostly in the Northern, Western, Central and Southern provinces are rice deficit. Production of secondary food crops such as tubers (manioc and sweet potatoes) has been declining over the last decade (1996-2005) (World food Programme, 2007).

In the NFSA 2009, HH level food availability via domestic production, purchase or donors was assessed in each district. Percentage of HHs that did not have adequate food in the past 12
months compared to the food stocks that were available in the preceding year was 31.6%. In the estate and rural sectors and in some districts (Jaffna, Badulla, Nuwara Eliya), this percentage was higher than 40%. 63.6% of the total HHs were not beneficiaries under any food aid programme. This percentage was higher in the estate sector and with increasing income and wealth.

A study on the nutritional status of children under 5 years was conducted at the DS division level in Weeraketiya, Pottuvil and Thirukkovil areas. 80-85% of families had an income of Rs. 5000 or less. Families having some land for cultivation and worst period in terms of not having adequate food varied between the three areas. Samurdhi and Poshana malla were in operation in all three areas and 50-65% of families received one of the two (Wijesinghe & Chandrasekara, 2007a and 2007b)

8.6.1 Food prices

In the NFSA 2009, the most expensive food items were meat/poultry and fish. Sector or district variation was not seen in relation to food prices.

When trend in the inflation of food prices in Sri Lanka is considered, food prices have almost doubled within a period of 10 years for essential food items such as rice, bread, sugar and coconut.

Table 8.2: Trend in the inflation of food prices in Sri Lanka during 1991-2007

<table>
<thead>
<tr>
<th>Food Item</th>
<th>2006-2007</th>
<th>2002</th>
<th>1990-91</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity</td>
<td>Unit price</td>
<td>Quantity</td>
</tr>
<tr>
<td></td>
<td>Kg</td>
<td>Rs.</td>
<td>Kg</td>
</tr>
<tr>
<td>Rice</td>
<td>36.6</td>
<td>32.70</td>
<td>35.3</td>
</tr>
<tr>
<td>Wheat Flour</td>
<td>2.4</td>
<td>40.40</td>
<td>3.3</td>
</tr>
<tr>
<td>Bread</td>
<td>6.2</td>
<td>24.41</td>
<td>10.2</td>
</tr>
<tr>
<td>Sugar</td>
<td>5.2</td>
<td>60.52</td>
<td>5.3</td>
</tr>
<tr>
<td>Coconut</td>
<td>30</td>
<td>15.72</td>
<td>30</td>
</tr>
</tbody>
</table>

*Source:* HIES 2006-07
A case study was carried out in the district of Colombo among middle income and slum populations on the effects of the global financial crisis on food security of urban HHs (Atukorala et al, 2010). It showed that almost all HHs were aware of food price changes. Their coping strategies were largely through reducing the quality and quantity of food, as over 50% of HHs spent more than half of their income on food. Since they were shown to be heavily dependent on commercially available food and not on domestic food production, price increases have directly translated into reduced consumption. 27% women in the middle income group and 34% women in the slum group have reduced food intake in the past year while >50% have omitted some vital food items from their diet. Both quality and quantity of food have been reduced in 24% of the HHs in the middle income group and 30% in the slum population. Majority in both areas ate three meals a day. However, the number of meals has also reduced in a small but significant number of HHs (10% middle income and 15% slum). 25% and 32% in each area had changed the type of foods that they were eating. Around 10 % in both areas got a second job to supplement income.

8.6.2 Coping strategies adopted by HHs

Coping strategies adopted by the HHs at a time of limitation of food availability are either food related (consuming less preferred food, purchasing food on credit, borrowing food or reducing meal size) or non-food related (borrowing money pawning jewellery or using savings).

The NFSA 2009 provided information on coping strategies adopted by the sample during the previous month. 35.1% of HH adopted at least one coping strategy during the periods of limited food availability. Common strategies used were related to food: rely on less preferred food (29.6%); purchased food on credit (27.9%); borrowed food or reduced meal size (18-20%). Other non-food coping strategies were: borrowing money from relatives/neighbours (20.2%); pawning jewellery (17.2%); and using savings (12.2%).

In the emergency food security assessment in 2009 (World Food Programme, 2009a and 2009b), nearly 64% of the HHs surveyed in the Ampara district did not use any coping strategies while 13% belonged to medium - very high coping strategy groups. In Vanni, the WFP dry ration was their main source of rice (83%) followed by food aid for lentils (88.5%), oils (73%), wheat flour (75.9%) and sugar (50.6%). Market purchase was the second source of HH food especially for non-relief items including vegetable and animal proteins.
In a HH food insecurity study in the rural subsistence paddy farming sector, about 20% of HHs used coping strategies such as borrowing food and changing eating habits: borrowing food or money (37%); changing the eating habits (21%); consume, mortgage or sell assets (36%); and defer monthly instalments on loans and deplete savings (6%) (Malkanthi et al, 2007).

8.7 Food insecurity

Food insecurity is assessed based on food consumption (assessed by HFCAS) and food access (assessed by food expenditure as a % of the total HH expenditure), as specified by the WFP. Four levels of food insecurity include insecure HH (severely insecure, moderately insecure and mildly insecure) and secure HH. Three surveys had reported food insecurity based on the above classification.

Table 8.3: Summary of the distribution of household food security in Sri Lanka

<table>
<thead>
<tr>
<th>Source</th>
<th>Severely insecure</th>
<th>Moderately insecure</th>
<th>Mildly insecure</th>
<th>Secure</th>
<th>No. HH surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFSA 2009</td>
<td>0.5%</td>
<td>11.8%</td>
<td></td>
<td>87.6%</td>
<td>2397</td>
</tr>
<tr>
<td>SLCFS 2008</td>
<td>6.5%</td>
<td>9.0%</td>
<td>10.6%</td>
<td>73.9%</td>
<td>1805</td>
</tr>
<tr>
<td>Niranga et al, 2007</td>
<td></td>
<td></td>
<td></td>
<td>71.0%</td>
<td>300</td>
</tr>
<tr>
<td>Malkanthi et al, 2007</td>
<td>2.5%</td>
<td>17.5%</td>
<td>55.0%</td>
<td>25.0%</td>
<td>80</td>
</tr>
</tbody>
</table>

In SLCFS 2008, a significantly higher proportion of HHs from the estate sector (18.9%) and Eastern (15%) and Uva (13%) provinces showed severe food insecurity. Mild food insecurity was similar in both rural (11.0%) and estate (12.4%) sectors, suggesting that they had a more monotonous diet than in urban sector. In certain provinces, stunting, wasting and underweight increased as the HH food security became worse. For example, 18% stunted in food secure HHs in the Uva province (27% and 67% in mild and severe food insecurity, respectively). This study identifies two patterns: prevalence of underweight or stunting in food secured HHs could be attributed to certain care practices such as late initiation of complementary feeding while it could be directly related to hunger and availability of quality food in food insecure HHs. In such HHs, special attention needs to be paid to both macro and micro-nutrient needs of the young children.
In the NFSA 2009, when moderate and severe food insecurity groups were combined, only 12.4% of HH were of food insecurity. However, the inter-sectoral differences were marked with 19% of insecure HH in the estate sector compared to 5.4% in the urban sector and the lowest in Colombo MC. Percentage of HH with food insecurity over 12% was seen in Jaffna, Nuwara Eliya, Badulla, Hambantota and Anuradhapura districts.

In a study on food security in HH in the rural subsistence paddy farming sector, 71% of the HHs were found to have food insecurity based on USDA core food security module. Prevalence of stunting (22%), underweight (30%), wasting (20%) and anaemia (57%) was high while 78% and 60% did not receive energy and protein adequacy, respectively. Low DD with low consumption of animal proteins was observed in HHs. The study concluded that high prevalence of undernutrition and low DD reflect the food insecurity that exists among rural paddy farming HH in Sri Lanka (Niranga et al, 2007).

In another study in a similar setting, results showed that 75% of the HHs were found to have food insecurity. Prevalence of food secure, food insecure without hunger, food insecure with moderate hunger and food insecure with severe hunger in HHs were 25%, 55%, 17.5% and 2.5%, respectively. A significantly higher prevalence of adolescent thinness and maternal underweight was seen in food insecure HHs compared to those in food secured HHs. The study concluded that high prevalence of chronic malnutrition among children, underweight females reflect the long term food deprivation. Limited DD and low income are associated with high prevalence of malnutrition and food insecurity in rural paddy farming communities (Malkanthi et al, 2007).
Summary

Meal frequency

• Almost all aged 5 years and above in Sri Lankan HHs consume at least 3 main meals a day. These rates do not vary markedly in relation to the number of family members, sector and district of residence, monthly HH income and wealth quintiles.

• In the age group 6-23 months, 26% of the non breast-fed and 53% of the breast-fed children were fed at a frequency recommended for age. The proportion in the latter group increased with increasing parental income and higher wealth quintiles and was lower in the estate sector.

Food consumption

• The average calorie intake of Sri Lankans has not drastically changed over years but shows a slight drop for specific food items such as wheat flour, bread and coconut. Almost half of the population (50.7%) remained below the minimum level of energy consumption per day. Energy consumption was higher in the estate sector compared to the urban sector including Colombo district.

• HH food consumption patterns varied by district, sector and HH income. Although rice, wheat flour and bread are the favourite food items in Sri Lankan HHs, a wide sectoral and district variation is seen for certain food items such as fruits, meat/poultry/fish/dry fish and dairy products. Consumption patterns reflected the less affordability of these food items especially in the estate sector. Food availability also influenced consumption patterns, as shown by higher consumption of bread/wheat product in the estates in contrast to rice in the rural sector.

• Mean Household Food Consumption Adequacy Score (HFCAS) was 67.7 (SD=16.0) reflecting an ‘adequate’ level of food consumption in HHs. No district or sectoral variation was observed although an upward trend was seen with increasing education level of the head of the HH, income and wealth.

• DHS 2006-07 shows that 89% and 88% of infants above six months of age who were breast fed met the IYCF criteria in respect of variety and frequent. In non breast fed children, these percentages were 77% and 72%, respectively. Adherence to recommended IYCF was least satisfactory in the estate sector and increased with increasing child’s age and mother’s education.
• Reproductive age women in lower education level and wealth quintiles and living in Nuwara Eliya, Matale and Trincomalee districts showed low consumption rates of animal proteins compared to the national level. Furthermore, consumption of all key protein sources – milk, meat, legumes, cheese and yoghurt – was lower among mothers in estates but did not seem to vary much with their age.

• Unhealthy consumption patterns such as low consumption of fruits, vegetables and whole grain products was much higher among adults living in urban areas than in rural sector. However, there was no such difference in relation to energy-dense foods.

Dietary diversity
• Mean HDDS (indicating a ‘nutritionally satisfactory’ diet) was 7.8 and ranged according to income and wealth quintiles. The percentage of HHs in the surveyed areas yet to achieve this mean score was 63.5% (74.4% in estate sector; 43.4% in urban sector). Districts that achieved this target in more than 50% of the HHs were Colombo and CMC.

• Among 6-59 month old children, an average IDDS of 4.8 indicated in general a ‘diet with minimum diversity’. These values were relatively low in the estate sector. Only one third of children age 6-23 months received a ‘minimum acceptable diet’. This proportion was low in the estate sector and increased with income and wealth.

• 62% of the 6-9 month old children met the ‘minimum dietary diversity’. However, with increasing age, this proportion decreased to 35% in 9-12 month olds and to 42% among 18-24 year olds.

Food access
• When sectors are compared, rural and estate sectors spent relatively a larger proportion of their total HH expenditure on cereals such as rice and wheat flour, whereas the urban sector spent mostly on prepared food such as bread and buns.

• Food ratio was 39.8% for Sri Lanka and as high as 49.5% in estate sector. Food ratios of Central, Southern, Eastern, North-Western, North-Central, Uva and Sabaragamuwa provinces were all higher than the national level of 39.8%.
Maternal income and family size had significantly positive and negative impacts, respectively on the calorie allocation of mother. In addition, age and gender-based calorie allocation was observed within the family while income of mother had a negative effect on children’s calorie allocation.

**Food availability**

- The availability of rice has increased over the years but remains insufficient to meet the per capita requirement of the country.
- Common coping strategies related to food that were used during the periods of limited food availability were relying on less preferred food, purchasing food on credit and borrowing food or reduced meal size. Other non-food coping strategies were borrowing money from relatives/neighbours, pawning jewellery and using savings.
- A significantly higher proportion of HHs from the estate sector and Eastern and Uva provinces showed severe food insecurity. Proportion of HHs with mild food insecurity was similar in rural and estate sectors, suggesting that they had a more monotonous diet than in urban sector. In certain provinces, stunting, wasting and underweight increased as the HH food security became worse.
- High prevalence of under nutrition and low DD reflect the food insecurity that exists among rural paddy farming HH in Sri Lanka.
Chapter 9

Interventions

9.1 Introduction

Direct and indirect nutritional intervention programmes in the country can be divided into broad areas as follows;

- Integrated MCH and nutrition programmes
- Food/micronutrient supplementation programmes
- Food subsidies and poverty alleviation programmes

This review included evaluations of the on-going nutritional intervention programmes at national level and evidence from research conducted during the period under study.

9.2 Integrated MCH and nutrition programmes

Traditionally, the health sector has taken responsibility for nutrition issues. This has its advantages but also the disadvantage that the coordination and inputs necessary from many other sectors have been marginalised. The greatest strength of the health system is its network of physical infra-structure, manpower that can reach the community and processes in place for monitoring programs. This makes the integrated MCH programme a key intervention that can be fine-tuned to improve nutrition, especially maternal and young child nutrition.

Integrated MCH programmes are provided through the government health care sector and the coverage is universal. The programme includes a full range of services from maternal care during pregnancy and lactation to services for the newborn, pre-school child and adolescents. Programmes that have a direct impact on nutrition are; education on nutrition and promotion of care practices that have an impact on nutrition (ECCD), monitoring of weight gain during pregnancy, breast feeding promotion, growth monitoring of infants and pre-school children, provision of micro-nutrient supplements, anti-helminthic therapy and distribution of Thripsha to identified target populations.
The integrated MCH programme is monitored by the FHB through regular returns and quarterly MCH reviews. The majority of indicators used in the monitoring process are on coverage while indicators on the quality of care are few in number.

The routine monitoring data are reported in the Annual Report on Family Health. Evaluation in terms of impact on nutrition are; % mothers with a BMI < 18.5kg/m² at booking visit, % of LBW babies and % of children below 2 SD of weight for age. The percentage of mothers with Hb < 11g/dl is also included in the return. However, this indicator has limited value since the information reported is on Hb assessed during any time during the antenatal period. In addition, methods used for estimation of Hb as well as quality may vary and are not known. The outcome data on anaemia is therefore limited to large national level surveys.

An external review of the National Maternal and New born Health programme was carried out in 2007 (Ministry of Health, 2007b). This review highlighted the need for improvement in quality of care and strengthening the FHB as a centre of excellence for the national MCH programme. The requirement of a nutrition unit within the FHB was identified. The review also noted that the skills necessary for behaviour change communication was lacking amongst most of the field staff.

Weaknesses that exist within the MCH programme in relation to information, education and communication have been highlighted during reviews. The SLCFS 2008 highlighted that only half of the mothers with LBW babies were informed that their children had a low birth weight. In addition, advice regarding the special needs of their child has been very poor while knowledge and care practices of mothers on different aspects of young child feeding were unsatisfactory. Both a review of the Infant and Young Child Feeding (IYCF) programme (UNICEF, 2009) and an evaluation of the Early Childhood Care and Development (ECCD) programme (Institute of Policy Studies, 2008) identified low skills in behaviour change communication among field staff.

One of the integrated programmes of the MoH that addresses all the components necessary to facilitate improvements in the maternal and young child nutrition is the ECCD programme. A mid-term evaluation carried out in the programme areas has shown measurable nutrition impacts though not very high (Rodrigo, 2004). At this stage, the programme was limited to 12 MOH areas (2002-2007) and had intense inputs from the district as well as from the centre.

A post-intervention evaluation was conducted by the Institute of Policy Studies in 2008, by which time the programme had been extended to over 200 MOH areas. The review found that
in relation to nutrition, exclusive breast feeding in infants under 6 months of age had improved in the ECCD areas. However, complementary feeding, especially responsive feeding and dietary diversity had not much improved while the participation of husbands had not been a success. It also highlighted the need for continued development of human resources, and strengthening of monitoring and evaluation activities at all levels. However, it should be noted that in a programme of this nature with multiple levels and linkages it is difficult to attribute or quantify improvements in a specific outcome. There are many outcomes of the programme such as emotional, cognitive and behavioural changes within the family and in the child that contribute to improved nutrition, which are not incorporated into monitoring and evaluation indicators. Developing appropriate approaches and tools for objective measurement of such changes is a challenge.

In 2009, the UNICEF carried out a review of IYCF in Sri Lanka. Although Sri Lanka has achieved much, the study identified that there was “unfinished business to attend to” (UNICEF, 2009). The country does not have an IYCF policy or strategy although elements of IYCF are found incorporated into the MCH programme. Programme gaps identified were; fragmentation of nutrition within the MoH, inadequate staff at the FHB, inadequate behaviour change communication skills of service providers, insufficient monitoring of the breast feeding code and the Baby Friendly Hospital Initiative (BFHI). The review identified that issues related to complementary feeding were not adequately addressed in training and that in-service training was ad hoc and uncoordinated. Lack of supervision at field level as well as service areas and populations too large for an individual PHM to handle were the other problems in services that were identified.

The Integrated Nutrition Package (INP) implemented in 6 districts of the country specifically addresses key nutrition issues using a life cycle approach. A comprehensive manual for health workers has been developed, which includes flow charts for action, self evaluation tools and returns for monitoring and evaluation.

In the districts where the INP programme is being implemented, cohorts of children with Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) were identified and given supplementation (BP 100, plumpy nut, high energy biscuits, thriposha, CSB, multiple multi-nutrient packages) for one year since January 2010. At the end of one year, the nutritional status of these children was assessed. The results showed that there was some reduction in SAM and MAM in these cohorts but to varying degrees (District presentations made at the
National Nutrition review, FHB, 21 March 2011, unpublished data). The presentations identified difficulties and irregularities of supplies as well as acceptance of the supplement given. Data did not attempt to relate these issues to nutritional outcomes in the cohort study.

Jayatissa (National Nutrition review, FHB, 21 March 2011, unpublished data) carrying out a mid-term evaluation of the INP programme examined the effectiveness of the programme in reducing child malnutrition and coverage of specific programme components. The evaluation was based on a field survey where in each district, 10 clusters of 30 children were selected from among the original 30 clusters selected for the baseline survey. The evaluation included 1,776 children under five years of age. It was reported that the prevalence of MAM had increased in all districts while SAM had increased in all districts except two, i.e. Nuwara Eliya and Batticaloa. Compared to the baseline, global acute malnutrition had increased while stunting had decreased in all districts. Information on acute infections was not available in the data presented. Except in the Badulla and Moneragala districts, anaemia among children 6-59 months had increased in all districts while the prevalence of LBW had declined by varying degrees in all districts other than Trincomalee (figure 9.1). In children above one year, varying proportions (16-34%) of children had not received a single dose of vitamin A while 34-15% of children had never received de-worming treatment (figure 9.2). It also showed poor compliance with multiple micro-nutrient programmes.

Figure 9.1: Prevalence of LBW by district compared to the baseline survey (N=1761)

Source: Jayatissa, National Nutrition review, FHB, 21 March 2011, unpublished data
9.3 Food/micronutrient supplementation programmes

9.3.1 Thriposha programme

The Thriposha programme is an island-wide comprehensive supplementary feeding scheme, which has been in existence for over three decades. Conceptually, it is an ideal intervention for providing the most vulnerable groups with a mix of foods that would address PEM as well as micro-nutrient deficiencies.

During the period under review, there were research studies that examined the efficacy of Thriposha in improving micro-nutrient status of children and these are presented below.

Hettiarachchi and Liyanage (2010b) examined the effect of Thriposha on micronutrient status of young children using haematological and biochemical indicators. Pre-school children aged 3-5 years from two child welfare clinics were grouped into an interventional (N=137) arm and a control (N=130) arm. Children in the intervention group were fed 50g of conventional Thriposha a day for a period of nine months while the control group of children were fed with 50g of Thriposha made without mineral and vitamin premix. Serum Hb, ferritin and caeruloplasmin levels were measured before and one week after completing the intervention. The baseline Hb levels of the intervention and control groups were 113.2 g/l (SD = 10.9) and 112.3 g/l (SD = 9.0), respectively. At the end of the experimental period, the intervention group showed a significant improvement (repeated measures ANOVA, p=0.02) in the mean Hb level (118.1 g/l (SD=7.7)
compared to 114.7 g/l (SD=7.0) in the control arm). The prevalence of anaemia dropped from 37% to 15% in the intervention group (p=0.03). Serum ferritin and caeruloplasmin levels also improved. The authors concluded that regular consumption of conventional Thriposha for 9 months led to improvements in Hb, ferritin and ceruloplasmin levels in the blood.

Another study assessed the bioavailability of iron and Zn from Thriposha formula at two different molar ratios of Zn: iron in order to determine its effect on iron and Zn absorption (Hettiarachchi et al, 2010a). Children aged 4–7 years (N=53) were given a meal prepared with 50 g of Thriposha containing 1·5mg Zn in the form of Zn sulphate and either 9mg (high iron concentration (HiFe)) or 4·5mg (low Fe concentration (LoFe)) Fe in the form of ferrous fumarate. Percentage absorption of Zn and iron was measured using stable isotopes by tracer: tracer ratio and by incorporation of erythrocytes, respectively. Percent iron absorption from the two meals was similar (6-6% versus 4-8%; p = 0·15), but the total iron absorption was significantly higher from the HiFe meal [0·59 mg (SD=0·43)] than the LoFe meal [0·20mg (SD=0·12)] (p = 0·01). There was no significant difference between the two groups in relation to Zn absorption (10-7% versus 8-8%; p = 0·13). Decreasing the amount of iron in Thriposha did not cause a significant change in the percent absorption of iron and Zn, but significantly lowered the total amount of absorbed iron. The results demonstrate the utility of maintaining a higher iron content in this supplement. The authors recommended that further studies to examine increase in Zn content while maintaining a high iron concentration is warranted.

A randomised controlled trial assessed the effectiveness of calcium and vitamin D3 in the Thriposha on bone mineralisation among pre-school children of 3-5 years (Hettiarachchi et al, 2010b). The study group (N=30) were fed with conventional Thriposha while the control group (N=30) was fed a supplement without the mineral and vitamin pre-mix (Corn Soya blend) for a period of nine months. Dual energy X-ray absorptiometry (DXA) of the total spine was measured at the baseline and after intervention. The mean baseline total spine Bone Mineral Density (BMD) was 0·464 g/cm² (SD=0·05) in the intervention group and 0·453 g/cm² (SD=0·035) in the control group (p=0.09). At the end of the study, the BMD levels were 0·487 (SD=0·047) and 0·454 (SD=0·031) g/cm² (p<0.001), respectively. It was proven that daily supplementation with Thriposha over a period of nine months improved the total spine BMD.

The Thriposha programme has been evaluated from time to time and there were two such evaluations during the period under review (Jayatissa, 2005; Silva, 2008). These evaluations have shown that only around half the beneficiary group receive the intervention, targeting of
beneficiaries is poor and supplies at point of distribution are irregular. Thripasha is accepted by both mothers and children and is considered tasty and nutritious. It was also shown that at household level the food is often shared by all.

Jayatissa (2005) states that the impact of the programme on the nutrition outcomes are carried out on a sporadic basis and “the programme is faced with a wide range of problems”. Silva (2008) concluded that the “Thripasha programme is a socio-politically sustainable food supplementation programme but its success in relation to achieving objectives, especially in relation to nutritional impact has not been achieved due to irregular supply and households practices”.

9.3.2 Supplementation with Corn Soya Blend

The WFP distributed a fortified corn soya blend similar to Thripasha in 33 MOH areas where food vulnerability was high. The areas have been identified after a vulnerability mapping exercise. Monitoring and evaluation is in-built as an integral part of the programme. The supplementation programme had not shown any improvement of nutritional outcomes as well as nutrition related behaviour. Baseline and post intervention surveys showed that: the breast feeding and complementary feeding had improved in the programme areas; the prevalence of stunting and underweight in preschool children had improved in both the intervention and control areas; and there was no improvement in knowledge pertaining to food. Here too, it was found that the supplement was shared with the rest of the family (Atukorala, 2006).

9.3.3 Micronutrient supplementation programmes

• Iron

Iron supplementation for pregnant women and administration of vitamin A mega dose to children and postpartum mothers are two of the major programmes that have been implemented throughout the country by the MoH. In addition, de-worming after first trimester of pregnancy and giving iron, folate and vitamin C to pregnant and lactating mothers has long been implemented through the MCH services.

Jayatissa et al (2004) conducted a rapid assessment to evaluate the coverage of iron supplementation programme in five phases. Antenatal clinic based assessments for pregnant women on iron supplementation were conducted through: interviews and focus group discussions; observation of the clinic process on technique; advice given and the storage of
supplementation by using check-lists. The coverage of vitamin A mega dose supplementation among school children of grades 2, 5 and 8 was assessed through information on distribution of vitamin A mega dose from the implementers of the supplementation programme and the position of stocks status at the level of divisional drug store, medical officers of health and clinics. A total of 68 clinics were visited island-wide and 2161 pregnant women were interviewed. The national coverage of the iron supplementation among pregnant women was 92.9%. The usage of iron tablets by pregnant women was 87.8% ranging from 81.1% to 92.4% in different provinces. It was found that only 35% received education and instructions on enhancers and inhibitors of iron absorption and side effects of iron tablets at the time of distribution.

This rapid assessment also included 120 schools across the country (Jayatissa et al, 2004). A total of 18,340 schoolchildren were interviewed on the distribution of vitamin A mega dose. The national coverage of vitamin A mega dose among schoolchildren was 36.1%, ranging from 12.3 to 73.6% in different provinces. The coverage of vitamin A mega dose among postpartum mothers was 35.7%. This assessment was based on the information given by the head of the institutions who were implementing the programme. A total of 7,098 infants and 6,555 pre-schoolers had obtained the clinic services for measles and 4th DPT vaccination, respectively from the 68 clinics visited during the study. The coverage of the vitamin A mega dose for the year 2003 was 35.7% among infants and 29.6% among pre-schoolers.

The stock position of supplementation was adequate at the level of divisional drug stores and stores run by MOH. Inadequate stock position was observed at the level of clinics due to wrong estimates. This assessment concluded that coverage of iron supplementation among pregnant women who attended antenatal clinics was ‘good’. It further commented that the vitamin A mega dose programme is still at a primitive stage even after 3 years of commencement. Among their recommendations were: better coordination between medical supplies division and FHB on the issues of tablets; the distribution of vitamin A mega dose to be revised or addressed appropriately to increase the coverage; and improving awareness among all health staff about nutritional policies for better implementation.

De-worming after the first trimester of pregnancy and giving iron, folate and vitamin C to pregnant and lactating mothers have been implemented through MCH services over a long period of time. Coverage of the programme is reported to be high (DHS 2006-07). However, these figures are not compatible with the level of anaemia seen in the population. This
identifies the need to study iron on absorption from the local mixed diets which are often deficient in animal proteins and rich in substances that may inhibit or reduce absorption.

- **Vitamin A**

A large scale study conducted on vitamin A status in Sri Lanka in 2006 (Jayatissa & Gunathilaka 2006a) showed that 65% of children had received vitamin A mega dose at least once with the highest coverage among the 12 -23 aged children (76.3%) and lowest among children above 48 months (60.6%). According to DHS 2006-07, 58% of the women with a child born in the 5 years preceding the survey claimed to have received a mega dose of vitamin A during the postpartum period.

In the NFSA 2009, 86.3% of children aged 9-59 months had received one mega dose of vitamin A at completion of 9 months. The percentages of children who received a vitamin A mega dose at 18 and 36 months were 85% and 77.7%, respectively. Nearly 75% of children aged 36-59 months had been given all 3 mega doses of vitamin A while only 9% had never received a single dose. In general, the coverage was poor in the estate sector, only 49% of children 36-59 months had received all three doses of vitamin A compared to 76% and 79% in the rural and urban sectors. Nuwara Eliya, Jaffna and Trincomalee districts reported low coverage at 9 months, 18 months and 36 months. These districts also reported high proportions of those who had not received even a single dose of vitamin A.

### 9.4 Food subsidies and poverty alleviation programmes

Sri Lanka has a long history of food subsidies and poverty alleviation programmes; from the food ration schemes from after the Second World War. “Poshana Malla” (a bag of nutritious food) is a supplementation that is given to all pregnant and lactating women in Sumurdi beneficiary families (families with income less than Rs.5000 per month) in the most vulnerable districts for a period of 18 months (6 months before delivery and 12 months after delivery). This and the “Kiri Weeduruwa” (a glass of milk) given to under five children in low income households are two programmes that have been initiated recently. The programme is implemented through the Samurdhi programme by the Ministry of Samurdhi and Poverty Alleviation. Nutrition outcomes of these programmes have not been evaluated. However, the programme implementation has been examined and has shown that there are problems related to targeting and distribution, especially the “Kiri Weeduruwa” (Piyasena, 2007).
The school feeding programme is currently implemented only in some parts of the country. The objective was also to attract children to come to school and remain in the education process. Coverage and impact of these programmes on the nutritional status of children have not been evaluated.

The NFSA examined the relationship of “food aid” to PEM and found that stunting, wasting and underweight were marginally higher in these households, probably a reflection of the fact that the households with higher prevalence of PEM have been targeted for food aid. The survey highlighted the fact that those who received food aid did not do so regularly. In the six months preceding the survey, the average number of times that food aid was received was less than expected [WFP aid - 4, Samurdhi - 4.1, Food basket - 4.2, CSB - 4, Thriposha - 2.5, Food for work - 3.5].

The impact of poverty alleviation programs such as the Samurdhi programme, on the nutrition of individuals, families or communities has not been studied. The experience in other countries have shown that increasing the income does not necessarily translate into an increase in food intake or better nutrition.

9.5 Experimental studies on nutrition related interventions

Experimental studies on nutrition related interventions published during the period under review are described below.

9.5.1 Interventions on Iron and vitamin supplementation

Five intervention studies have attempted to improve the anaemia status among school children through iron supplementation.

Jayatissa and Piyasena (2000) carried out a randomised trial of daily and weekly iron supplementation. 659 adolescent school girls were divided into 3 groups and were studied for a period of 8 weeks. One group received 60mg of iron, 250µg of folic acid, and 100mg of vitamin C daily. The second group was given the same doses on a weekly basis. The third group was given a placebo. All participants were de-wormed at the beginning of the study. The prevalence of anaemia was reduced from 25% to 9.5% by weekly supplementation and from 18.5% to 8.6% by
daily supplementation. Difference in the haemoglobin levels between the two groups receiving supplementation was not significant. The daily administration of iron produced a greater increase in serum ferritin than weekly administration. The unit cost of weekly supplementation was Rs. 3.24, which was equivalent to US$ 0.05. The results show that long-term weekly doses of iron are suitable for the prevention of iron-deficiency anaemia in adolescents and that using the school as the administration channel ensures compliance.

An intervention of a weekly iron supplementation for a period of 6 months was carried out and the effectiveness was assessed using a pre-post design with no control group (Jayatissa, 2003). The study was carried out in Moneragala, Hambantota, Vavuniya, Ampara and Ratnapura districts. All school children of grades 7 and 10 were given a weekly dose of iron, folate and vitamin C for 6 months under the supervision of teachers. On the first day, vitamin A mega dose and mebendazole were given. Effectiveness was assessed in terms of coverage of supplementation and changes in Hb level in a sample of 900 children. The highest coverage of supplementation for 6 months was reported in Vavuniya district (49.8%). Ampara had the lowest coverage (16.4%) due to non-initiation of supplementation or shortage of tablets. 40.3% of children had taken tablets even during the vacation. Pre and post levels of anaemia were: Ratnapura (15% and 12%), Ampara (23.7% and 14.2%) and Hambantota (28% and 12%). The study estimated the supplementation cost per child to be Rs. 18. The study concluded that if more than 30% of school children take 6 months of supplementation, the prevalence of anaemia can be significantly decreased. It recommended a properly conducted weekly iron supplementation for a period of 6 months to be initiated in schools without delay as a long term intervention.

The effectiveness of combined iron and Zn over the iron or Zn only supplementation in correcting the deficiency status and possible interactive effects was assessed in a group of adolescent school children using a randomised, double blind controlled trial (Hettiarachchi et al, 2007). A sample of school children (N=821) aged 12–16 years was randomized into four groups and were supplemented with either iron (50 mg/day), Zn (14 mg/day), iron and Zn together or placebo capsules on 5 days per week for 24 weeks. Serum Hb, Zn and ferritin concentrations were determined before and after the intervention. Despite the random allocation of children to treatment groups, serum Hb, ferritin and Zn concentrations in the groups were significantly different at baseline. The mean Hb concentration was shown to be significantly higher in the placebo group.
Micronutrient supplementation resulted in significant within-group increases in serum Hb, ferritin and Zn in all 4 groups except ferritin in the placebo group. The iron only group had a mean Hb increase of 18.2 g/l compared to an increase of 11g/l in the combination supplemented group. The prevalence of anaemia in the iron only group was reduced to 14.5% from 70.3%. In the combination supplemented group, the prevalence of anaemia was reduced to 19.3% from 64.8%; from 52.6% to 26.1% in the Zn supplemented group; and a marginal increase from 38.9% to 43.1% in the placebo group.

At baseline, both iron and combination supplemented groups were similar in serum ferritin levels. In the iron supplemented group, the iron deficiency improved from 80.5% to 7.3% while in the combination supplemented group, it was reduced from 65.3% to 6.5%. In the Zn supplemented group and the placebo group, the prevalence of iron deficiency remained around 35% even after the intervention.

Similar to the improvements in iron stores in the iron supplemented groups, Zn levels improved in the Zn supplemented groups. The Zn only group had a marginally higher mean change compared to the combination group (4.3 μmol/l compared to 4.0 μmol/l.) The prevalence of Zn deficiency was reduced from 73.2 % to 25.3% in the Zn only group while in the combination group, it fell from 62% to 17.8%. The non-Zn supplemented groups showed only a slight reduction in Zn levels.

The researchers concluded that iron supplementation was successful in reducing severe and moderate anaemia and in improving iron stores. Initial high prevalence of low Zn was significantly improved after supplementation. The study further concluded that Zn alone or in combination with iron did not improve growth of adolescents significantly.

The authors reported the effects of supplementation on anthropometry indicators from the same study after a longer period of follow up (36 weeks) (Hettiarachchi & Liyanage, 2010c). The mean change of weight and height in the placebo group were 0.53 kg and 0.73 cm. iron alone group had 0.89 kg gain in weight and 1.0 cm in height. Zn alone group had a higher gain in weight (2.27 kg) and height (2.37cm), whereas 1.52 kg and 1.63 cm gain was observed with combination supplemented group. BMI of the supplemented groups significantly increased from their respective baseline status (0.32 in supplemented versus 0.04 in placebo; p < 0.001). The increase in z scores of weight-for-age and height-for-age in Zn supplemented groups was marginally significant when compared with the placebo group (p < 0.05). After correcting for
confounding effects of age and the respective baseline values of weight, height and BMI, the group supplemented with Zn alone had the best anthropometric improvement. The authors concluded that long term Zn supplementation has a positive impact on the growth of children.

Effectiveness of iron supplementation to improve iron status and reduce morbidity in children with or without Upper Respiratory Tract Infections (URTI) was assessed in a randomised control trial (De Silva et al, 2003). Children aged 5–10 years were recruited from outpatient clinics of the Lady Ridgeway Children’s Hospital, Colombo. Clinical, inflammatory, nutritional and iron status was determined at baseline and after the intervention. Children with a history of recurrent URTI and with laboratory and clinical evidence of a current URTI (N=179), and children without infection (N=184) constituted the sample. Subjects in both groups were supplemented with ferrous sulfate (60 mg iron) or placebo once daily for 8 weeks. Morbidity from URTI, the number of gastro-intestinal infections and compliance were recorded every 2 weeks. The overall prevalence of anaemia was 52.6%. Iron supplementation significantly improved the iron status by increasing Hb (p < 0.001) and serum ferritin (p < 0.001) concentration from baseline values in the children with or without infection. There was no significant improvement in iron status in the children who received placebo. In both the infection and control groups, the mean number of URTI episodes and the total number of days sick with an URTI during the period of intervention were significantly lower (p < 0.005 and p < 0.001, respectively) in the children who received iron supplements than in those who received placebo. It was proven that iron supplementation significantly improves iron status and reduces morbidity from URTI in children with or without infection.

9.5.2 Interventions using rice and wheat flour fortification

The desk review included two randomized control trials to improve anaemia status by fortification of rice flour and another on fortification of wheat flour.

Effectiveness of Na2EDTA fortification of rice flour to enhance the absorption of iron and Zn was assessed in a randomized control trial among 53 school children aged 6–10 years (Hettiarachchi et al, 2004). Rice flour was proposed as a vehicle for iron and Zn fortification in Sri Lanka. Although widely consumed, rice flour has not been evaluated as a fortified food and the absorption of minerals including iron and Zn from this flour was unknown. The 53 study units were randomly divided into 4 groups that consumed a local dish prepared with 25 g of fortified rice flour labelled with one of the following: 1) 58FeSO4 2) 58FeSO4 _ Na2EDTA 3) 58FeSO4 _
67ZnO or, 4) 58FeSO4 _ Na2EDTA _ 67ZnO. The levels of iron and Zn were 60 mg/kg; the rice flour also contained folate at 2 mg/kg in each group. Na2EDTA was added at a Fe: Na2EDTA, 1:1 molar ratio. A total of 48 children completed the trial. Absorption of 58Fe from a meal was significantly greater (p = 0.01) in the groups administered FeSO4 _ Na2EDTA (4.7 _ 3.6%) than in those administered FeSO4 without Na2EDTA (2.2 _ 1.3%). Fractional absorption of Zn was 13.5 - 6.0% in the FeSO4 _ Na2EDTA group and 8.8- 2.0% in the FeSO4 group (p = 0.037). Although Zn absorption was low, the results demonstrated a benefit in using Na2EDTA to improve both iron and Zn absorption. Authors conclude that the fortification of rice flour is feasible, although additional strategies such as dephytinization or an increase in the level of iron and Zn fortification should be considered to obtain a higher proportion of the daily requirement of total absorbed iron and Zn. The feasibility of implementing the findings needs to be tested in the field situation taking into consideration the pattern of consumption of rice flour.

The use of iron-fortified wheat flour to reduce anaemia among the estate population in Sri Lanka was assessed in a double blind controlled trial (Nestel et al, 2004). The use of flour fortified with 66 mg/kg of electrolytic or reduced iron to reduce the prevalence of anaemia was determined in a two-year, double-blind, controlled trial among preschoolers between 9 and 71 months old, primary schoolers 6 to 11 years old, and non-pregnant women. The results showed that 18.4% of the preschoolers were anaemic and fortification had no effect on Hb concentration. Among the preschoolers 7% were anaemic but fortification had no effect on Hb concentration. Even among the 29% of women were anaemic there was no evidence that fortification had an effect on Hb. Authors concluded that fortification of flour with electrolytic iron or reduced iron was not beneficial in reducing anaemia in this population. This was probably due to the low prevalence of anaemia and low bioavailability of the fortificant iron. Conclusions related to iron supplementation in all RCT indicated that iron supplementation can be recommended for prevention as well as for correction of anaemia among schooling children.

9.5.3 Interventions on the quality of weaning food

A study by De Silva et al assessed the efficacy of home-made energy dense weaning food (De Silva et al, 2007). A sample of 182 infants who had been born as full term babies were enrolled and followed up for one year, 152 infants completing the study. The intervention consisted of teaching mothers to prepare home-based complementary food made of red rice, red lentils and vegetable oil, and the supply of a stainless steel hand held mechanical blender to mash the product to the appropriate consistency. The food had an energy density of 110-130 kcal in 100
ml and the iron and Zn contents were 0.6 mg and 0.3 mg per meal. The cost of each meal was estimated at about Rs. 3.00. The feeding frequency varied as appropriate with age. The control group received the foods usually given in the community. Growth in the two groups of children was compared at the end of one year. The results showed that the mean weight gain by the intervention group was significantly higher (2.43 kg; SD = 0.72) than the control group. However, the weight-for-age Z scores showed that there was a drop in the mean Z scores in both groups but this was less marked in the intervention group.

9.5.4 Interventions on responsive feeding

Not only the food per se but also the way in which the food is given is also an important determinant of nutritional status. Responsive feeding is also an important component of the ECCD programme.

A study examining the improvement in growth following an intervention to improve responsive feeding practices in 12-23 month old children showed that the knowledge of care givers improved following the programme while feeding practices and eating behaviour of children also improved considerably compared to the children from the control area (Jayawickrema, 2006). There was a significant effect on growth of children in the intervention group, the mean increments in Z scores were higher in this group (weight-for-age 0.25 versus 0.09; height for age 0.37 versus 0.14). This was an intervention that was implemented through improving the knowledge of PHM and one that can be scaled up without much difficulty. Responsive feeding is also an important component of the ECCD programme.

9.5.6. Educational interventions to improve nutrition among adolescents

Nutrition education is an area, which is deficient in the routine MCH programme. The effects of an education programme aimed at dietary diversification were tested among school children aged 15-19 years of age. Impact on the nutrition-related knowledge, food consumption pattern and serum retinol levels were examined. The educational intervention consisted of lectures, inter-active group discussions and four methods of reinforcement methods. The before and after assessment of the outcome indicators showed a significant increase in all indictors demonstrating the usefulness of the approach in improving diets and in reducing vitamin A deficiency (Lanerolle and Atukorale, 2006). The educational intervention that was tried out was very intense and difficulties are likely to arise in the scaling up of such an intervention. However,
in the school setting if incorporated in to the educational process, the programme could be scaled up.

A study on preferred nutrition-education methods for out-of-school adolescent girls indicated that group education using an activity-based workbook and leaflets/posters as supportive educational material was preferred. PHMs were preferred as facilitators over health volunteers of the area. Incentives for participation were establishing contact and continued interactions with health-care-personnel. Interactive sessions on food preparation, cookery demonstrations using locally available foods, vegetarian meals and home-gardening were suggested to be included in the education package. Educational messages highlighting consequences of under and over-nutrition and micronutrient deficiencies, nutrition in relation to appearance, food preparation by preserving micronutrients and the “height for weight” concept were requested. Identified problems for participation were financial constraints for girls in both areas, transportation problems to participate for rural girls, negative attitude from the community for urban girls and time-constraints to participate by working girls in both areas (de Lanerolle et al, 2009d).

9.5.7 Health promotion approach for improving the nutritional status in the community

Presentations made at scientific meetings have indicated that the health promotion approach has resulted in improved nutrition in young children in small community settings where the method has been used (Gamage, personal communication). The evidence presented is from a project carried out by the health promotion team of the University of Rajarata in a village in Medawachchi MOH area. Intervention village was Kudagama while Prabodhagama served as the control village. Progress of the project is presented as “case studies” where improvements in growth of young children have been demonstrated using the CHDR (figures 10.3 a-c). Comparison of weight gain in children under 5 years in the two areas are shown in figure 10.4.
Figures 9.3 (a-c): Growth charts of three children in the intervention village

a. 4 year 10 month old child  
b. 4 year 10 month old child  
c. 5 year 7 month old child

Figure 9.4: Comparison of the progress in weight before and after intervention in children between intervention and control villages

Source: Gamage D, personal communication
Further quantitative data on programme outcomes are available from an on-going community-based project on health promotion for empowering individuals and their families towards healthy behaviour for prevention of diabetes (Arambepola, 2011). This programme is conducted by the Sri Lanka Medical Association in two suburban MOH areas (Kotte and Kolonnawa) in over 100 settings in the community, work places and schools. In each setting, 15-20 group members led by a Health Promotion Facilitator (HPF) who is a volunteer living/working in the same setting. Capacity building of HPF on how to run the process, to develop indicators for measuring changes and to expand the target group is undertaken by a group of experts in health promotion. The objectives of HPF and group members are to identify their own/family risk behaviour related to diet, physical activity, mental stress and tobacco/alcohol consumption; to change risk behaviour while addressing the underlying determinants; and to continuously measure their changes.

Mid-term progress of the programme was presented recently using some objective indicators developed by the participants themselves. Some of these indicators were: weight reduction (% of overweight adults who reduced weight-30% in Kolonnawa and 54% in Kotte areas), on healthy dietary habits (before the programme-88, now-650), initiation of regular physical activity (before the programme-164, now-887), consumption of alcohol/tobacco among fathers (before the programme-177, now-89), alcohol related behaviour (before the programme-177, now-78), television viewing for >2 hours a day (before the programme-2670, now-678), engage in activities that enhance physical and mental wellbeing (before the programme-192, now-822) and money spent in HH for alcohol and tobacco consumption (before the programme-177, now-35). In addition, the number of settings has expanded from 30 to 120, of which 27 are autonomously functioning settings. This programme highlights the gains in health promotion through programmes focusing on community ownership.

The approach attempts to improve many aspects that are difficult to measure objectively such as “happiness” “love and security” in the home environment. They also address basic determinants of malnutrition such as alcohol use and effective use of household resources. It is worthwhile to try out the method in an experimental setting and generate evidence on nutritional outcomes.
Chapter 10

Conclusions and recommendations

10.1 Key issues to address

At present, the political commitment in addressing nutrition issues is high. This is demonstrated by the appointment of a multi-sectoral Nutrition Council chaired by His Excellency the President. A nutrition policy has been adopted and a national strategic plan of action plan is in place.

The review identified that malnutrition particularly PEM and anaemia pervades the life cycle. While it is important to focus on all stages of the life cycle in dealing with malnutrition, it is crucial to attack one point so as to break the vicious circle of events. The obvious point for focused and intense interventions appears to be the period from beginning of pregnancy to the end of 2nd year of life.

Addressing nutritional problems needs a closely supervised, well-coordinated as well as an integrated approach with adequate support from all non-health sectors that are directly or indirectly involved with improving the nutrition of the vulnerable groups. In Sri Lanka, the health sector has had a very special institutional role in this effort. While focusing on establishing multi-sectoral approaches at national and sub national levels, main streaming the nutrition related actions within the health sector appears to be a rational approach. However, within the MoH and the FHB, there is fragmentation of nutrition functions among different directorates and units, which is not conducive to cohesive efforts. Considering the fact that all nutrition programmes reach the community through the public health staff especially the midwives and as part of the MCH package, it is crucial to strengthen this component within the Directorate of MCH.

Development of a service at district or MOH level similar to the existing lactation management services, where referral can be made by field staff whenever nutrition advice is needed has to be considered. Such a person can develop, demonstrate and make available menu options (giving quantities as well as number of meals) using locally and seasonally available food to help people to achieve nutrition adequacy.
10.2 LBW

The data perused in the review clearly identify that the mother’s nutritional status has a direct effect on LBW and that LBW in turn has an effect on child PEM, both underweight and stunting.

Although both pre-pregnancy BMI and pregnancy weight gain are important determinants of birth weight, data suggests that the effects of low pre-pregnancy BMI could be mitigated by adequate pregnancy weight gain. Furthermore, data on family formation patterns suggest that the interval between marriage and first pregnancy is short. Therefore, from a programmatic point of view, while educating the population on the need for an adequate pre-pregnancy BMI, ensuring adequate weight gain during pregnancy should be an immediate priority goal.

Although the relationship of pregnancy interval with LBW could not be established using local analysis, this is well documented in literature. Examining the trends in birth interval, it was noted that the proportion of women with birth intervals that are associated with a higher risk of LBW has shown an increase. Re-vitalisation of the family planning programmes to address these issues would be important.

The review identified the importance of work during pregnancy in relation to LBW. Studies have shown that standing for 2.5 hours or more per day in the second or third trimester or both, sleeping equal to or less than 8 hours per day to be predictors of LBW and needs attention in education programmes. In this respect, both cooperation of the family through education and special arrangements in the work setting are important to reduce the effects on LBW. Targeted nutrition supplementation programmes sufficient to meet the increased nutrition needs of working women especially energy may mitigate some of the effects.

Multiple micro-nutrient supplementations have been shown to be effective in reducing LBW. The cost effectiveness of such a programmes as well as its performance in reducing LBW in the local setting has to be evaluated prior to scaling up to a national programme.

Scientific literature has identified indoor air pollution to be a risk factor for LBW. Although local data on this is not available, given the high percentage of households that use fire wood for cooking and the poor structure of housing, efforts to develop smoke free hearths is worthwhile. The National Engineering Research Division (NERD) has already developed a rice cooker and a kettle that optimise the use of firewood and is smoke free. Feasibility of using alternatives such as small bio gas units based on household waste, especially in settings where firewood is
purchased, need to be explored. However, these innovations have to be offered to the public at affordable prices and the operational costs less than what a household currently spends on fuel. Affordability of fuel also has implications for the use of boiled cooled water as advised by health care workers.

10.3 PEM in children under 5 years of age

The review identified that PEM sets in early in life, even before 6 months of age and the maximum deviation in weight-for-age from the median of the standard population occurs during the first 2 years of life. Therefore, attention to infant and young child feeding and specially meeting the needs of LBW children is of utmost importance.

Breast feeding practices have improved from the DHS 2000 to DHS 2006-07. Analysis showed that BF is strongly influenced by the health care system especially the work of the PHM and continued inputs are necessary to protect and improve on these achievements. This necessitates pre-service as well as continuing education of all categories of health workers including specialists in the relevant fields. The review identified that in-service training is ad hoc and uncoordinated and does not meet the requirements imposed upon by transfer of personnel. The quality of the training at district level is not monitored or evaluated.

The analysis of breast feeding data from the DHS 2006-07 pointed out that being born in a private institution, caesarean section, and living in the estate sector were risk factors for a child being not exclusively breast fed for 6 months of age. The Baby Friendly Hospital Initiative needs to be revitalised to address these issues and a system of accreditation of institutions should be initiated.

Although there is a code for marketing of breast milk substitutes, implementation and monitoring especially at district level is important. Enforcement of the code needs strengthening.

The review identified that there are many areas in which complementary feeding has to be improved. It is important to note that there is no IYCF policy or strategy at present. Given the scale of the problem, the development of a detailed plan of action is an urgent need. There is
also an urgent need to develop expertise in this regard at various levels of the MoH structure especially at district and local levels.

The time of initiation, quantity, quality, consistency, frequency and behaviours and practices of complementary feeding all aspects need attention.

Studies show that dietary diversity is low. Health care workers should be trained in assessment of dietary diversity and encouraged to use the information obtained to advise mothers as part of the growth monitoring programme. Improving dietary diversity may need approaches like promotion of home gardening in addition to education. Working with the agricultural sector to promote families to grow foods that will add diversity to their diets is important.

From studies available, it appears that many mothers are unaware of satiety and hunger cues. Inappropriate feeding between meals has been observed. Feeding during illness is still very poor. In this respect, it is also important to focus on respiratory and other infections together with diarrhoeal diseases.

Given the fact that women are increasingly involved in work outside the home, the development of a low cost easy to use complementary food that meet the nutrition, hygienic and sensory criteria is a challenge that should be addressed by the food technologists.

The review identified that PEM is a problem throughout the life cycle. Among women of the reproductive age group both underweight and overweight are problems. Determinants that have been identified are related to socio-economic status reinforcing importance of poverty alleviation development programmes as a long term strategy to address the issues. The nutritional messages for young women should address the importance of improving pre-pregnant weight and also the health advantages in maintaining appropriate weight during the middle age.

10.4 Anaemia

Among preschoolers, prevalence of anaemia in the different sectors is similar. However, more severe forms of anaemia are seen among the rural population. One study reported that a higher proportion of infants exclusively breast fed for 6 months was anaemic compared to non-
exclusively breast fed infants. Difficulties in meeting iron requirements during the age range 6-24 months are well recognised and not unique to developing countries. In a setting where anaemia is high in pregnant and lactating mothers, this situation needs close monitoring. The current DHS data could be further analysed to investigate this association in Sri Lanka and such analysis could be incorporated in to the routine results presented in future Demographic and Health Surveys.

Studies have shown that de-worming and iron supplementation carried out through the school under the supervision of the teacher to be a feasible strategy to reduce anaemia among school children. Innovative education programs also have shown results in adolescents and may be appropriately modified and replicated.

Multivariate analysis showed poor dietary diversity to be a risk factor. Among women, the DHS reported the highest percentage of anaemia in the rural setting and more severe forms among estate women. The determinant identified in the multivariate analysis of probable causes among women was spending more than 90% of the income on food. This may reflect poverty and lack of diversity in diets.

Prevalence of anaemia among pregnant and lactating women is not compatible with the reported coverage of iron supplementation programmes. Reasons for this need to be explored using experimental as well as socio-ethnographic approaches.

10.5 Vitamin A and Iodine deficiencies

Coverage of the vitamin A supplementation programme among pre-school children in the estate sector needs to be improved as well as the overall coverage of the third dose.

IDD appears to have been controlled in most geographic areas with the use of iodised salt but continuing surveillance of the goitre situation especially in the pockets of disease, as well as the monitoring of the iodine content of salt at production and at household level is important.

Special attention needs to be paid to the increasing prevalence of thyroiditis. The high levels of urinary iodine that have been observed in all surveys in the North Central Province and in some
parts of the Northern Province need close monitoring. It is important to study the progression of the thyroiditis observed.

10.6 Food security

An integrated, multi-sectoral approach has to be developed at community level to improve household food security; both domestic food production and purchasing power.

There are many poverty alleviation and development programmes already existing at the level of the GN division. A multi-disciplinary approach will help strengthen and focus on components of such programmes that would impact nutrition.

In the short term, there is a need to identify food insecure households and provide a safety net. However, there must be clear criteria for exit from such short term measures.

Dietary diversity of all age groups needs improvement. Studies on food consumption patterns have identified deficiencies in energy and nutrient intakes. Education, especially on management of money and other resources available at household level to meet nutrition needs of the family have to be addressed.

10.7 Behaviour modification for better nutrition

A particularly weak component of the current MCH package is the behaviour change communication component. Social marketing strategies that have been proved effective in other preventive situations should be employed to engage the general public, families and communities supported by focused education through the existing channels. Uniformity of messages from all categories of health workers including specialists is of the utmost importance. A planned programme is important for developing and maintaining expertise in behaviour change communication in all categories of field staff.

The health promotion approach has been used in the modification of behavioural determinants of disease and has been found to be effective in improving child nutrition and development outcomes. This approach is different from health education and behaviour change
communication. Most of the programmes have been evaluated using qualitative methods but limited quantitative data on nutrition outcomes are available from some programmes. The health promotion methodology would lend itself well towards engaging members of the family, particularly husbands, in the ante natal and child care processes to ensure good nutrition. Examining the usefulness of this approach in addressing nutrition issues in the community, the feasibility and sustainability of a scaled up programme is worthwhile.

10.8 **Strengthening routine data collection for effective monitoring**

There is a large body of information that is in the Health Management Information System (HMIS) at present. The majority are performance indicators that have been developed initially as self assessment tools for field staff and for monitoring by supervisory staff. Nutrition outcome data in the system are limited and are rarely used for routine supervision or monitoring at MOH or district level.

Given the high variability of malnutrition observed within a district, it would be important to map some indicators of malnutrition by the smallest geographic area possible. Routine data is timely, can be disaggregated to the level of a PHM area and can be used to map malnutrition so that areas with problems can be identified. It is therefore important to ensure the quality of this data and to collect the information in a way that would conform to boundaries of GN divisions mapped by the Survey General. This has the added advantage that data from sources other than the health sector can also be used in an integrated manner in the analysis.

The suggested indicators are:

- % with a pre-pregnancy BMI < 18.5 Kg/m\(^2\) per quarter (denominator being number of mothers registered for ante natal care during the quarter)
- % who have achieved an adequate weight gain (those with low and normal BMI both) per quarter (adequate weight gain defined as per guidelines of the MoH)
- % of LBW (out of all births per quarter, neonatal deaths have to be included both in the numerator and the denominator)
- % of infants below 2 SD weight-for-age during a randomly selected month per quarter
- % of children 12-23 months of age below 2 SD weight-for-age during a randomly selected month per quarter
Breast feeding and IYCF indicators can be added after training of the required personnel and can be collected bi-annually at the level of the MOH and used for monitoring and evaluation.

Processes for special monitoring of growth and development of LBW children need to be developed.

The indicators should be mapped at the level of the MOH area by PHM area and used to monitor performance by the MOH at a monthly conference on a quarterly basis and reasons for poor performance discussed. This would also help to identify determinants that are specific to localities. Review of nutrition outcomes should be made an agenda item at the MOMCH reviews at district and national levels.

10.9 Integrated multi-sectoral policies/programmes focused on increasing food and nutrition security in vulnerable households

Food security at household level is a key factor that influences nutritional outcomes. While strengthening and mainstreaming nutrition interventions through the MoH, it is important to work in collaboration with other sectors to improve food security at household level.

Poverty reduction strategies especially measures to minimise income inequalities that may occur in the process of development have to be addressed collectively. Direct income transfer schemes and food supplementation programmes, although conceptually appropriate have had low effectiveness, high costs and little demonstrable impact on the nutrition situation. However, it is also important to identify and provide safety nets to food insecure households and vulnerable groups. Proper targeting and linking programmes to specific nutrition outcomes may help. This would need development of improved ways of identification, monitoring and evaluation.

10.10 Evaluation of interventions

The multi-factorial nature of malnutrition per se makes it difficult to evaluate the effectiveness of a programme in terms of its impact on a given nutritional outcome. However, it is important to develop methodologies to do so especially before introducing or scaling up new interventions. Evaluation methods as well as time scales should be built into the programme itself in the planning stages. It is ideal if the cost benefit of programmes also could be examined.
10.11 Gaps in knowledge

Even in socio-demographic groupings that have a high prevalence of malnutrition, a larger percentage of people in that group have prevented their children falling into malnutrition. It would be appropriate to study the ways in which this has been achieved and identify lessons that can be replicated.

Little is known about the socio-cultural beliefs and behaviour during pregnancy that may influence birth weight in the local setting. Knowledge of the proportion of LBW infants who fall into preterm, IUGR and a combination of the two in the local setting is also not available and is useful in planning prevention.

It should be noted that all except one multivariate analysis perused were based on data from the DHS 2000 and causal analysis is constrained by the type of data available. The data are from cross-sectional surveys and have limitations for causal analysis. Attempts have been made to use UNICEF’s causative model of malnutrition but variables needed to explore the complete model are often insufficient and use of proxy variables pose limitations in interpretation. Timeliness of further analysis of large datasets and also the use of analytical strategies that would focus on points for action would be useful. Feasibility of acquiring longitudinal data on growth of infants and young children at least during the first 2 years in life needs to be explored.

The iron supplementation programmes have been in existence for a long period of time. Coverage of the program is reported to be good but is not reflected in the level of anaemia seen in the population. Reasons for this are not obvious and this is an area that needs investigation.

The estate population has special socio-economic conditions and cultural beliefs and practices that influence nutrition. Health care provision as well as the socio-cultural milieu is in a state of change. Women though major income earners, have little influence on how money is spent and management of earnings is poor. Housing conditions, water and sanitation and personal hygienic practices are documented to be poorer than in the other sectors. Alcoholism is documented to be high among both men and women. Given these differences, it may be worthwhile studying the relative importance of determinants of malnutrition in the sector and tailor programmes to address their specific needs.

Taking the key findings of the desk review, an integrated and focused package of interventions is proposed in the following 3 pages.
**Operation Head Start**

**Give your child the early advantage**

**Special focus on conception to 2 years – First Thousand Days of Life**

<table>
<thead>
<tr>
<th>Pre-pregnancy</th>
<th>Pregnancy</th>
<th>Post-partum mother</th>
<th>First two years of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned pregnancy (adequate interval)</td>
<td>Adequate weight gain</td>
<td>Vitamin A post partum</td>
<td>Early initiation of BF</td>
</tr>
<tr>
<td>BMI between 18.5-24.9 kg/m² at conception</td>
<td>Rest – not more than 2.5 hours standing at a time</td>
<td>Continue supplementation; food, vitamins and minerals</td>
<td>Exclusive breast feeding for the first 6 months</td>
</tr>
<tr>
<td>Haemoglobin level ≥ 12 mg/dl</td>
<td>Moderate exercise</td>
<td>Support lactation</td>
<td>Complementary feeding: viz. quantity, frequency, diversity, consistency, responsive feeding</td>
</tr>
<tr>
<td>Folic acid</td>
<td>8 hours sleep</td>
<td>Good personal hygiene practices</td>
<td>Hygienic preparation of food</td>
</tr>
<tr>
<td>Protected against rubella</td>
<td>Iron, folic acid, calcium and vitamin C (multiple micronutrient supplementation)</td>
<td></td>
<td>Continued breast feeding until end of 2 years</td>
</tr>
<tr>
<td></td>
<td>Food supplementation</td>
<td></td>
<td>Proper feeding during infections</td>
</tr>
<tr>
<td></td>
<td>Reduce / eliminate exposure to wood or other smoke</td>
<td></td>
<td>Growth monitoring / risk detection and early intervention: appropriate food supplementation</td>
</tr>
<tr>
<td></td>
<td>Preparation for breast feeding</td>
<td></td>
<td>Monitor food intake and appropriate advice on food</td>
</tr>
<tr>
<td></td>
<td>Regular antenatal care with participation of husband</td>
<td></td>
<td>Immunization</td>
</tr>
<tr>
<td></td>
<td>Detect and treat UTI</td>
<td></td>
<td>Vitamin A supplementation</td>
</tr>
<tr>
<td></td>
<td>Loving care and sharing of work</td>
<td></td>
<td>Good personal hygiene practices</td>
</tr>
</tbody>
</table>

**Love care and stimulation**
An integrated and focused package of interventions

Infant and young child feeding
- Early initiation and exclusive breast feeding up to 6 months
- Complementary feeding: viz. quantity, frequency, diversity, consistency
- Good feeding practices and behaviours (promote responsive feeding) and proper feeding during illness
- Growth monitoring
- Monitor food intake regularly
- Stimulation and loving care

Good nutrition in pre-school children
- Prevent / reduce LBW
- Focus on adequate weight gain

Morbidity
- Early diagnosis and treatment of infections
- Prevent infections through:
  - Good personal hygiene practices
  - Food hygiene
  - Immunization
  - Vitamin A supplementation (lactating mother and child)

Improve food security and diversity at household level
- Home gardening
- Home livestock production
- Improved livelihoods
- Food supplementation
- Easy to use energy dense food based on local produce (dual purpose; as complementary food and convenient nutrient supplement for women working in the field
- Food supplementation (adequate amounts)

Easy access to adequate amounts of water for HHs
- Improved sanitation
- Improved housing
  - Adequate ventilation
  - Low exposure to indoor smoke
  - Reduce overcrowding in sleeping areas

BF – Continued attention to maintain gains and improve practice
- Monitoring code violations
- Periodic accreditation for baby friendly institutions

IYCF – Develop policy / strategy and national training program

Special food and nutrition expertise at MOH / district
- Promote ECCD package

Problems of alcohol consumption, poor management of resources at household level, type of work women undertake, gender based violence

Study local myths and practices detrimental to nutrition and educate to overcome
- Study good practices and replicate
Implementation of Programme

- “One size does not fit all” -

1. Focus on households with problems and the period from conception to end of 2 years
   - Identify in the community households with:
     - a pregnant woman with a BMI less than 18.5 kg./m² at booking visit
     - a woman who failed to gain adequate weight at last visit
     - a child under 5 years who was born with a LBW
     - a child under 5 years who shows growth flattening or weight below -2SD in a given GN area
   - At the level of MOH, identify areas where all 4 indicators are poor (map) and monitor.

2. PHM, health volunteers, GN, Samurdhi Niladhari and the agriculture extension officer (“poshana kamituwa” at GN level) collectively identify any determinants special to the area and plan appropriate action to improve food security and consumption at household level.

3. Strengthen the food and nutrition related components of existing programmes such as “divi neguma” and ‘samurdhi” at community level.

4. Health promotion should be utilized at the community level.

5. Develop appropriate process indicators to monitor plans.

6. Regular monitoring by appropriate service providers at field level.

7. Development of a digital monitoring system for mapping would be helpful in monitoring.

8. Monthly monitoring of process indicators at district “poshana kamituwa” and make necessary adjustments to the programme, and by MOH at monthly conference.

9. Monitoring of outcome indicators by MOH and MO/MCH at quarterly meetings.
References

Abeysena, C., 1995. A study of maternal psychosocial factors affecting low birth weight among babies born at Colombo North General Hospital, Ragama, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Chandrasekara, KPSDS., 2003. Study of the nutritional status and some selected factors affecting the nutritional status of children of age 1-3 years in a fishing community in DDHS area Ambalangoda, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


De Silva, AASH., 2006. The nutritional status, dietary habits and associated factors of grade 11 school children in MOH area Kaluthara, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


De Silva, P., 2010. Functional disability, health related quality of life and healthcare cost profile of young elderly in urban and rural areas of Kalutara district, MD thesis, Postgraduate Institute of Medicine, University of Colombo.


Dissanayake, D., 2005. The iron status & its associations with the educational performance & the intelligence of school going adolescent in the district of Kandy, MD thesis, Postgraduate Institute of Medicine, University of Colombo.


Gamage, D., 2011. Personal Communication


Ibralebbe, MS., 1995. On some factors that may affect the birth weight of babies born at Base Hospital, Avissawella, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Jayakody, KWGG., 2002. Physical health status of the elderly in the district of Matale and risk factors for undernutrition among the rural elderly, MD thesis, Postgraduate Institute of Medicine, University of Colombo.


Jayatissa, R., 2003. *Iron Supplementation For School Children Grade 7 and 10 In Sri Lanka*, Department of Nutrition, Medical Research Institute in collaboration with Family Health Bureau and UNICEF.


Jazeelul Ilahi, MMS., 2007. Prevalence of low birth weight and selected associated factors among babies born at General Hospital Ampara, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Ministry of Health, 2010g. *Maternal, Newborn and Child Health and Nutrition For Survival and Development; Gampaha*.


Perera, TAUAP., 2007. Prevalence and risk factors for overweight in grade five students in Medical Officer of Health Area, Gampaha, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.

Piyasena, C., 2007. Evaluation of Samurdhi Nutrition Intervention Package; Basket of Foods (POSHANA MALLA) and Glass of Milk (KIRI WEEDURUWA), Department of Nutrition, Medical Research Institute (unpublished data).


Samaraweera, P., 2004. The influence of television advertisements on food items on the Nutritional Status and the dietary pattern among grade six children of Ambalangoda Urban Council Area, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Sudasinghe, SPBH., 2005. Prevalence and some associated factors of overweight in year 8 students of girls only schools in the Gampaha Municipal Council, MSc Dissertation, Postgraduate Institute of Medicine, University of Colombo.


Abeyseka, C., 1995. A study of maternal psychosocial factors affecting low birth weight among babies born at Colombo North General Hospital, Ragama, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Arambepola, C., 2010. Hospital based study on unintended pregnancies in Sri Lanka, UNFPA.


Atukorala, S., Lanerolle, P., De Silva, A., 2010. Effects of the global financial crisis on the food security of poor urban households; CASE STUDY COLOMBO, SRI LANKA, Faculty of Medicine, University of Colombo, Sri Lanka and RUAF Foundation, Leusden.


Chandrasekara, KPSDS., 2003. Study of the nutritional status and some selected factors affecting te nutritional status of children of age 1-3 years in a fishing community in DDHS area Ambalangoda, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


De Mel, 1970. , Department of Nutrition, Medical Research Institute (unpublished data).


De Silva, AASH., 2006. The nutritional status, dietary habits and associated factors of grade 11 school children in MOH area Kaluthara, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


De Silva, P., 2010. Functional disability, health related quality of life and healthcare cost profile of young elderly in urban and rural areas of Kalutara district, MD thesis, Postgraduate Institute of Medicine, University of Colombo.


Department of Census and Statistics, 2000. Nutritional Status of Pre-School Children in Sri Lanka (Based on a further analysis of Demographic and Health Survey data conducted by the Research and Special Studies Division).


Department of Census and Statistics & World Food Programme, 2004. Vulnerability of GN Divisions to Food Insecurity; Moneragala district.


Department of the Commissioner General of Samurdhi, 2011. Circular 21 by Department of Commissioner general of Samurdhi, reporting system, application form.


Dissanayake, D., 2005. The iron status & its associations with the educational performance & the intelligence of school going adolescent in the district of Kandy, MD thesis, Postgraduate Institute of Medicine, University of Colombo.


Food and Agriculture Organization, The International Conference on Nutrition, viewed 01 June 2011, "http://www.fao.org/docrep/V7700T/v7700t02.htm"


Ibralebbe, MS., 1995. On some factors that may affect the birth weight of babies born at Base Hospital, Avissawella, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Jayakody, KWGG., 2002. Physical health status of the elderly in the district of Matale and risk factors for undernutrition among the rural elderly, MD thesis, Postgraduate Institute of Medicine, University of Colombo.


Jayatissa, R., 2003. Iron supplementation for school children grade 7 and 10 in Sri Lanka, Department of Nutrition, Medical Research Institute in collaboration with Family Health Bureau and UNCEF.


Jazeelul Ilahi, MMS., 2007. Prevalence of low birth weight and selected associated factors among babies born at General Hospital Ampara, MSc dissertation, Post graduate Institute of Medicine, University of Colombo.


Medical Statistics Unit, Department of Census and Statistics 2004. Low Birth Weight Statistics (unpublished data).

Medical Statistics Unit, Department of Census and Statistics 2008. Low Birth Weight Values (unpublished data).


Nandasena, YLS., 2006. The pattern selected factors affecting growth & feeding practices of infants at the age 9 months in MOH area Panadura, MsC, Postgraduate institue of Medicine, University of Colombo.


Niranga, HAG., Malkanthi, RLDK., Silva, KDRR., Jayasinghe, JMUK., 2007. Food and nutrition security in rural subsistence paddy farming sector in SriLanka and use of geographic information system for mapping food and nutrition insecurity, Abstract of the Scientific Sessions, Faculty of Livestock, Fisheries and Nutrition, University of Wayamba.


Perera, TAUAP., 2007. Prevalence and risk factors for overweight in grade five students in Medical Officer of Health Area, Gampaha, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.

Piyasena, C., 2007. Evaluation of Samurdhi nutrition intervention package; basket of foods (POSHANA MALLA) and glass of milk (KIRI WEEDURUWA), Department of Nutrition, Medical Research Institute (unpublished data).


Samaraweera, P., 2004. The influence of television advertisements on food items on the Nutritional Status and the dietary pattern among grade six children of Ambalangoda Urban Council Area, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Soloman, C.S, 2007. Factors influencing complementary feeding practices among infants aged Six to nine months, In Trincomalee MOH area, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


Sudasinghe, SPBH., 2005. Prevalence and some associated factors of overweight in year 8 students of girls only schools in the Gampaha Municipal Council, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


University of Kelaniya, 2009. Ragama Health Study; Follow Up Risk Factor Survey - Annual report 2009, JICA.


Wickrematilake, MSK., 2007. Safety of street vended food and the effectiveness of an intervention to improve hygienic practices among street food vendors in the District of Kandy, MD thesis, Postgraduate Institute of Medicine, University of Colombo.

Wijesekara, HMADA., 2009. Nutritional status of 2-5 year old children attending day care centres and those looked after at home in MOH Gampaha, MSc dissertation, Postgraduate Institute of Medicine, University of Colombo.


World Bank, 2006. Repositioning Nutrition as Central to Development; A Strategy for Large Scale Action.


Yathunanthan, G., 2009. Overweight concurrent with stunting among preschool children in an urban Tamil community, Final Report, Faculty of Livestock, Fisheries and Nutrition, University of Wayamba.
# Information collation for the desk review: January 2006 - April 2011

## Nutritional status in Sri Lanka, determinants and interventions

<table>
<thead>
<tr>
<th>Places Visited and People Met</th>
<th>Data Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Dula de Silva</td>
<td></td>
</tr>
<tr>
<td>Mr. Laksiri Nanayakkara</td>
<td></td>
</tr>
<tr>
<td>Mr. Thushara Keerthiratne</td>
<td></td>
</tr>
<tr>
<td>Mr. Bandulasena</td>
<td></td>
</tr>
<tr>
<td>Mrs. Indu Bandara</td>
<td></td>
</tr>
<tr>
<td>Mrs. Pushpa Gunesekara</td>
<td></td>
</tr>
<tr>
<td>Dr. Renuka Jayatissa</td>
<td></td>
</tr>
</tbody>
</table>
2. Circulars on midday meal and circular for canteens at school |
|----------------------|-------------------------------------------------------------------------------------------------|
2. Nutritional status of the children under five years, pregnant, Lactating mothers and adolescent girls in welfare centres in Mannar district – 2001  
3. Nutritional baseline survey; Integrated food security programme in Vavuniya – 2004 |
| World Health Organization | 1. National Nutrition Policy of Sri Lanka  
2. National nutrition surveillance, system of Sri Lanka  
3. Identification of Nutritionally Vulnerable Populations in Sri Lanka  
6. Effectiveness of Nutrition Education Programme on Reducing Obesity and Overweight among Primary School children in Colombo district: Pilot test  
7. Assessment on preschool nutritional programme (Sinhala)  
8. Thriposha Coverage 2009/2010  
9. Nutritional Month – June 2010; on adolescent nutrition |
| Nutrition Co-ordination Unit | 1. CHILD UNDER NUTRITION IN SRI LANKA CAUSAL ANALYSIS – 2006  
2. EVALUATION OF SAMURDHI NUTRITION INTERVENTION PACKAGE BASKET OF FOODS (POSHANA MALLA) AND GLASS OF MILK (KIRI WEEDURUWA) 2007  
4. Rapid assessment among Post conflict Displaced Children in Jaffna and Trincomalee  
<table>
<thead>
<tr>
<th>JICA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrs. Keiko Nishino</td>
</tr>
</tbody>
</table>
| 1. Ragama health study (follow up risk factor survey)  
Ragama health study (second follow up risk factor survey) – awaiting report |

<table>
<thead>
<tr>
<th>World Vision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrs. Dilka</td>
</tr>
<tr>
<td>1. Report on nutritional status assessment of less than 5 year old children in Lunugamwehara 2007 by Dr. Renuka Silva</td>
</tr>
<tr>
<td>5. Nutritional assessment survey Vellavalie -2008 by Dr. Padmal de Silva</td>
</tr>
<tr>
<td>6. Kabithigollewa nutritional assessment survey -2009 by Dr. Padmal de Silva</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Department of Commissioner General of Samurdhi</th>
</tr>
</thead>
</table>
| Mr. Jagath Ravisinghe  
Mr. Padmapriya |
| 1. Circular 21 by Department of Commissioner general of Samurdhi; reporting system + application form |
| 4. Approved Beneficiary Level & Dispatches for year 2009/ year 2010 up to August |

<table>
<thead>
<tr>
<th>Family Health Bureau</th>
</tr>
</thead>
</table>
| Dr. Deepthi Perera  
Dr. Chithramalee de Silva  
Dr. Nirosha Lansakkara  
Chief Librarian |
| 1. Annual reports 2000,  
2. Annual reports 2001  
3. Annual reports 2002/03  
4. Annual reports 2004/05  
5. Annual reports 2006/ 2007  
6. 2008/2009/2010 routine data collected via H509 for all MOH areas |

<table>
<thead>
<tr>
<th>Hector Kobbekaduwa Research &amp; Training Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Wasantha Wickramasinghe</td>
</tr>
<tr>
<td>1. Food consumption patterns of Sri Lanka</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Colombo Municipal Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Champika Ramanayake</td>
</tr>
</tbody>
</table>
| 1. Urban heart – 2008  
2. Routine data from H509 for 2009, 2010  
4. H527 by PHM – 2010 Jan |
Dr. Wijeratne  
Mr. Karunaratne  
2. Agstat – Pocket book of Agriculture statistics (Department of Agriculture) |
|-----------|-------------------------------------------------------------------------------------------------|
| Paddy Marketing Board | 1. Annual report - 2008  
Mr. Jayasinghe  
2. Official stocks of paddy for 2010.10.26 |
| National Science Foundation | 1. Access to library  
Dr. Dilani Jayaweera  
Chief Librarian |
| Ministry of Health | 1. Steps survey  
Medical Statistics Unit  
See under department of census and statistics |
| NCD Unit | 1. Steps survey  
Dr. Anura Jayasinghe |
Dr. Chithra Karunaratne |
| Industrial Technology Institute | 1. Unpublished data  
Dr. Janaki Gooneratne |
| University of Colombo | 1. Evaluation of nutrition education for improving iron status in combination with daily iron supplementation -2000  
Prof. Sunethra Athukorala  
Dr. Pulani Lanerolle  
Dr. Maduka de Lanerolle  
Dr. Angela de Silva  
Dr. Pujitha Wockramasinghe  
Dr. Upul Senarath  
Dr. Carukshi Arambepola  
3. Iron supplementation improves iron status and reduces morbidity in children with or without upper respiratory tract infections: a randomized controlled study in Colombo, Sri Lanka - 2003  
6. SITUATIONAL ANALYSIS OF THE NUTRITION SERVICES AND NEEDS IN ESTATE AND RURAL SECTORS (EAST) – |
<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Authors/Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>7. Effects of the global financial crisis on the food security of poor urban households; CASE STUDY COLOMBO, SRI LANKA - 2010</td>
<td></td>
</tr>
<tr>
<td></td>
<td>University of Sri Jayewardene</td>
<td>Prof. Sagarika Ekanayake</td>
</tr>
<tr>
<td></td>
<td>University of Ruhuna</td>
<td>Prof. Chandrani Liyanage</td>
</tr>
<tr>
<td></td>
<td>University of Kelaniya</td>
<td>Prof. Paranagama</td>
</tr>
<tr>
<td></td>
<td>SLMA</td>
<td>Dr. Carukshi Arambepola</td>
</tr>
<tr>
<td></td>
<td>Nutrition Society</td>
<td>Scientific Sessions of the Nutrition Society of Sri Lanka</td>
</tr>
<tr>
<td></td>
<td>Postharvest Technology Institute</td>
<td>Postgraduate Institute of Medicine</td>
</tr>
<tr>
<td></td>
<td>Sports Ministry</td>
<td>Dr. Shiromi Pilapitiya</td>
</tr>
<tr>
<td></td>
<td>Postgraduate Institute of Medicine</td>
<td>Jayakody, KWGG</td>
</tr>
<tr>
<td></td>
<td>Postgraduate Institute of Medicine</td>
<td>Wijayathilaka, HVBS</td>
</tr>
<tr>
<td></td>
<td>Postgraduate Institute of Medicine</td>
<td>Samaratweera, P</td>
</tr>
<tr>
<td></td>
<td>Postgraduate Institute of Medicine</td>
<td>SPBH Sudasinghe</td>
</tr>
<tr>
<td></td>
<td>Postgraduate Institute of Medicine</td>
<td>Devani Dissanayake</td>
</tr>
<tr>
<td></td>
<td>University of Sri Jayewardene</td>
<td>1. Access to library</td>
</tr>
<tr>
<td></td>
<td>NIROGI Lanka Project of the NCD Sub-Committee</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>Assessment of Growth Monitoring and activities Related to the Growth Promotion of Children aged one to three years in Colombo Municiple Council Area. 2002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The influence of television advertisements on food items on the Nutritional Status and the dietary pattern among grade six children of Ambalangoda Urban Council Area. 2004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prevalence and some associated factors of overweight in year 8 students of girls only schools in the Gampaha Municipal Council in 2005</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The iron status &amp; its associations with the educational performance &amp; the intelligence of school going adolescent in the district of Kandy, 2005</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>YLS Nandasena</td>
<td>The pattern, selected factors affecting growth &amp; feeding practices of infants at the age 9 months in MOH area Panadura 2006</td>
<td></td>
</tr>
<tr>
<td>AASH De Silva</td>
<td>The nutritional status, dietary habits and associated factors of grade 11 school children in MOH area Kaluthara, 2006</td>
<td></td>
</tr>
<tr>
<td>HS Jayawickrama</td>
<td>Impact of responsive feeding on feeding behaviour and growth of young children, 2006</td>
<td></td>
</tr>
<tr>
<td>MSK Wickrematilake</td>
<td>Safety of street vended food and the effectiveness of an intervention to improve hygienic practices among street food vendors in the District of Kandy. 2007</td>
<td></td>
</tr>
<tr>
<td>CS Soloman</td>
<td>Factors influencing complementary feeding practices among infants aged Six to nine months, In Trincomalee MOH area, 2007</td>
<td></td>
</tr>
<tr>
<td>TAUAP Perera</td>
<td>Prevalence and risk factors for overweight in grade five students in Medical Officer of Health Area, Gampaha in 2007</td>
<td></td>
</tr>
<tr>
<td>HMADA Wijesekara</td>
<td>Nutritional status of 2-5 year old children attending day care centres and those looked after at home in MOH Gampaha 2009</td>
<td></td>
</tr>
<tr>
<td>A Lathaharan</td>
<td>Prevalence and associated factors of stunting among children in second year of life in Nuwara Eliya MOH area in 2009</td>
<td></td>
</tr>
<tr>
<td>AMS Nirangala</td>
<td>Prevalence of PEM and associated factors among females aged 13-16 yrs plantation sector in Haliela, 2009</td>
<td></td>
</tr>
<tr>
<td><strong>Postgraduate Institute of Agriculture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDR Peiris</td>
<td>Nutritional Status of under 5 Year-Old Children and its Relationship with Maternal Nutrition Knowledge in Weeraketiya DS division of Sri Lanka</td>
<td></td>
</tr>
<tr>
<td>DGNG Wijesinghe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr. Jayakodi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ishara Rathnayake</td>
<td>An assessment of Intra-household allocation of food: A case study of the urban poor in Kandy, 2002</td>
<td></td>
</tr>
<tr>
<td>Jeevika Weerahewa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPMSH Perera</td>
<td>Effect of Maternal Third Trimester energy and protein intake on pregnancy weight gain and newborn weight, 2007</td>
<td></td>
</tr>
<tr>
<td>DGNG Wijesinghe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RMTK Ranathunga</td>
<td>Calcium Intake and Bone Mineral variables among adolescent schoolgirls in Rural and Urban areas of Sri Lanka, 2008</td>
<td></td>
</tr>
<tr>
<td>KDRR Silva</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KN Balasuriya</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Sivakanesan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STC Mahawithanage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| University of Wayamba | WHKN Fernando  
DGNG Wijesinghe | Assessment of Nutritional Status and Disease Prevalence among Elderly Population in Elderly Homes in Kandy, 2010 |
|-----------------------|-----------------------------------------------|
| Dr. KDRR Silva  
Mrs. RDLK Malkanthi | PWMLHK Marambe  
R Sivakanesan  
KDRR Silva | A study in Kulyapitiya to ascertain public awareness of the lipid composition of edible coconut kernel products and their effect on Health, 2005 |
|                      | GAP Chandrasekara  
KDRR Silva | Determinants of the Nutritional status of preschool Children in an Urban and Peri-urban setting: A case of kununegala Municipal area Sri Lanka 2005 |
|                      | RLDK Malkanthi  
KDRR Silva  
GAP Chandrasekara  
JMUK Jayasinghe | High prevalence of Malnutrition and household food insecurity in the Rural Subsistence Paddy Farming sector, 2007 |
|                      | HAG Niranga  
RLDK Malkanthi  
KDRR Silva  
JMUK Jayasinghe | Food and nutrition security in rural subsistence paddy farming sector in Sri Lanka and use of geographic information system for mapping food and nutrition insecurity, 2007 |
|                      | KDRR Silva | Report on Evaluation of Thriposha Food Supplementation Programme, 2008 |
|                      | RLDK Malkanthi  
KDRR Silva  
Uditha K Jayasinghe-Mudasige | Risk factors associated with high prevalence of anemia among children under 5 years of age in paddy farming households in Sri Lanka, 2010 |
| Ceylon Medical Journal | M Hettiarchchi  
C Liyanage | Nutrient intake and growth of adolescents in southern Sri Lank, 2003 |
|                      | KWijewardene  
MR MOHideen,  
S Mendis,  
DSFernando,  
DS Kulathilaka,DSWeerasekara and  
P Uluwitta | Prevalence of hypertension, diabetes and obesity: baseline findings of a population based survey in four provinces in Sri Lanka, 2005 |
|                      | VP Wickramasinghe,  
Sanath Lamabadusuriya,  
N Atapattu,  
G Sathyadas,  
Kuruparananthan,  
P Karunarathne | Dietary and physical activity patterns of school children in an urban area of SriLanka, 2005 |
|                      | Channa R Jayasekara | Nutritional status of children under five in three State foster care institutions in Sri Lanka, 2006 |
|                      | DG Harendra de Silva,  
Shaman Rajindrajith,  
A Pathmeswaran,  
Wasantha Karunasekara | An intervention study to monitor weight gain in infants using a home based complementary food recipe and a hand blender, 2007 |
<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>M Hettiarachchi, C Liyanage</td>
<td>Dietary macro- and micro-nutrient intake among a cohort of pre-school children from southern Sri Lanka, 2010</td>
</tr>
<tr>
<td>Renuka Jayatissa and R. M. Ranbanda</td>
<td>Prevalence of challenging nutritional problems among adolescents in Sri Lanka, 2005</td>
</tr>
<tr>
<td>Ishara M. Rathnayake and Jeevika Weerahewa</td>
<td>Maternal employment and income affect dietary calorie adequacy in households in Sri Lanka, 2005</td>
</tr>
<tr>
<td>M Hettiarachchi, C Liyanage, R Wickremasinghe, DC Hilmers SA Abrams</td>
<td>The efficacy of micronutrient supplementation in reducing the prevalence of anaemia and deficiencies of zinc and iron among adolescents in Sri Lanka: 2007</td>
</tr>
<tr>
<td>M Hettiarachchi, C Liyanage</td>
<td>Efficacy of ‘Thripasha’ supplementation in improving the micronutrient status of preschool children, 2009</td>
</tr>
<tr>
<td>RE Ediriweera de Silva, KDK Gunathilaka, P fernando, I Athukorala, NMIA Seneviratna and WLSP Perer</td>
<td>Calcium intake and sources of dietary calcium - a study among young female medical school entrants 2009</td>
</tr>
</tbody>
</table>
**Who Global Database on child growth and malnutrition, 1997**

- **Wasting (based on weight for height)**
  
<table>
<thead>
<tr>
<th>Percentage</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5%</td>
<td>Low</td>
</tr>
<tr>
<td>5-9%</td>
<td>Moderate</td>
</tr>
<tr>
<td>10-14%</td>
<td>High</td>
</tr>
<tr>
<td>≥ 15%</td>
<td>Very high</td>
</tr>
</tbody>
</table>

- **Stunting (based on height for age)**
  
<table>
<thead>
<tr>
<th>Percentage</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20%</td>
<td>Low</td>
</tr>
<tr>
<td>20-29%</td>
<td>Moderate</td>
</tr>
<tr>
<td>30-39%</td>
<td>High</td>
</tr>
<tr>
<td>≥ 40%</td>
<td>Very high</td>
</tr>
</tbody>
</table>

- **Underweight (based on weight for age)**
  
<table>
<thead>
<tr>
<th>Percentage</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10%</td>
<td>Low</td>
</tr>
<tr>
<td>10-19%</td>
<td>Moderate</td>
</tr>
<tr>
<td>20-29%</td>
<td>High</td>
</tr>
<tr>
<td>≥ 30%</td>
<td>Very high</td>
</tr>
</tbody>
</table>
UNICEF conceptual framework for malnutrition

- **Child Malnutrition**
- **Morbidity**
- **Food Intake**
- **Household food security**
- **Care of Mother & children**
- **Environment and services**

**Resources for food security**
- Food production
- Income
- Transfers of food in kind

**Resources for Care**
- Caregiver knowledge and beliefs
- Caregiver physical and mental status
- Control of resources and autonomy

**Resources for Health**
- Safe water supply
- Adequate Sanitation
- Healthcare availability
- Environmental safety/Shelter

**POVERTY**
- Political and Economic structure
- Socio-cultural environment

**Potential Resources:** Environment, Technology, People
Map of Sri Lanka with average annual rainfall and elevation

Source: Fernando R. (unpublished)