TIMING AND PATTERN OF GROWTH FALTERING IN FIRST 1000 DAYS OF LIFE:

A retrospective cohort of 12–24-month-old Sri Lankan children

Sri Lanka College of Paediaticians

In collaboration with Family Health Bureau and UNICEF

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First Print: 2024

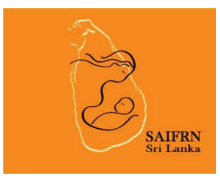
ISBN 978-955-52048-4-2

Page setting & Cover design by:
Sanu Creation
076-7502625

Published by:

Sri Lanka College of Paediatricians

Field work carried out by South Asia Infant Feeding Research Network (SAIFRN)



Message from President Sri Lanka College of Paediatricians

In the backdrop of the global COVID-19 pandemic, the journey towards achieving the Sustainable Development Goals (SDGs) outlined by the United Nations in 2015 has encountered unforeseen challenges. Despite commendable progress in the Eastern and Southern Asian regions since the adoption of these goals, the aftermath of the pandemic has left many economies, including Sri Lanka, grappling with profound repercussions on child health and healthcare.

As we navigate through these turbulent times, our commitment to addressing these urgent concerns and prioritizing sustainable development goals remains steadfast. Under the theme "In the Wake of Calamity, Let No Child Be Left Behind," we reaffirm our dedication to ensuring the well-being of every child. Each of the 17 sustainable development goals serves as a crucial compass guiding our endeavors at the Sri Lanka College of Paediatricians (SLCP) and throughout the South Asian region, directing us towards a brighter future.

The emergence of undernutrition among children under 5 years old following these crises has posed a significant setback to our efforts to achieve these targets. Therefore, it is imperative that we closely examine the patterns of growth faltering during the first 1000 days of life within the Sri Lankan population. This analysis will undoubtedly illuminate intervention strategies crucial for attaining our nutritional target by 2030.

I extend my heartfelt congratulations to Professor Pujitha Wickramasinghe and the dedicated study team for their exemplary efforts on behalf of the Sri Lanka College of Paediatricians. Furthermore, I express my sincere appreciation to UNICEF for their timely support in funding this essential project for our country.

Together, let us continue our journey towards a future where no child is left behind, where every child's right to health and well-being is safeguarded.

Dr Kosala Karunaratne
President
Sri Lanka College of Paediatricians

Message from the Unicef Country Representative

Malnutrition remains an important, yet unresolved public health issue in Sri Lanka. Clear evidence underscores the importance of early childhood nutrition in achieving optimum developmental outcomes for children. The first 1,000 days of life – from conception through two years of age - is considered the critical window of opportunity for optimum growth. In Sri Lanka however, the prevalence of stunting among children under five years has remained stagnant over the past two decades. It is well documented that many of the opportunities are not seized during the crucial period of these first 1,000 days.

Therefore, appropriate interventions during the first 1,000 days are of immense importance to prevent growth faltering. Optimum breastfeeding practices, introduction of well-timed, nutritionally adequate complementary feeding and continued feeding during illness are vital components that require consideration and implementation in preventing growth faltering.

Thanks to the generous funding from Latter-day Saint Charities (LDSC), which made this study possible, UNICEF is pleased to have provided technical and financial support to this significant research project. We appreciate the commitment of the research team, the Sri Lanka College of Paediatricians and the Family Health Bureau of the Sri Lanka Ministry of Health in producing this invaluable report and its pertinent recommendations to address critical issues related to timing and pattern of growth faltering during the first 1,000 days. We hope and wish that the insights gained from this research will enable the necessary adjustments to ongoing actions, ensuring that all children in Sri Lanka achieve their optimum growth potential.

Christian Skoog
Representative,
UNICEF Sri Lanka

Message from the Director, Family Health Bureau

Assessing the nutrition status of children, especially during the critical first 1000 days of life, is essential for evaluating the effectiveness of existing intervention programs. This period, spanning from conception to the child's second birthday, represents a crucial window of opportunity to ensure optimal growth, health, and neurodevelopment.

The outcomes of these assessments provide valuable insights into the impact of current interventions and help identify areas for improvement. By understanding the nutritional status of children during this vulnerable age group, we can tailor interventions to address specific needs and enhance overall health outcomes.

Furthermore, these findings serve as a foundation for developing and implementing more evidence-based strategies to improve nutrition services across the country. By leveraging this data, we may be able to prioritize resources, advocate for policy changes, and implement targeted interventions that address the unique nutritional challenges faced by children during this critical period.

Overall, assessing the nutrition status of children during the first 1000 days of life is essential to reach country’s goal to promote optimal growth, health, and development in children, laying the foundation for a healthy future generation.

Dr Chithamalee de Silva
Director,
Family Health Bureau

Acknowledgements

Permission to conduct this study was granted by the Director General of Health Services of the Ministry of Health. The Family Health Bureau of the Ministry of Health and the Sri Lanka College of Paediatricians facilitated this process. The authors especially acknowledge Dr. Chithramalee De Silva, Director MCH, Family Health Bureau, Dr. Kosala Karunarathne, the President SLCP, and Mr. Ranbanda Jayawardana at SLCP for their collaboration.

Authors wish to express their sincere gratitude to Latter-day Saint Charities (LDSC) and UNICEF Sri Lanka Country Office for financial and technical support.

Provincial Directors of Health Services (Western, Eastern, Northern, Southern, Central, North Central, and Uva Provinces) and Regional Directors of Health Services (Colombo, Gampaha, Ampara, Kilinochchi, Galle, Nuwaraeliya, Polonnaruwa, and Badulla districts) of the selected areas, Director General, and Director Health of the Plantation Human Development Trust, and the Chief MOH of the Colombo Municipal Council extended their fullest cooperation to conduct this study. The authors acknowledge with appreciation all the MOHs of the selected areas, Health Manager, and Regional Managers of the PHDT, Estate Managers and Public Health Midwives for their support at field level.

Authors wish to acknowledge the South Asia Infant Feeding Research Network (SAIFRN) for conducting the field work of this study, and especially Mr Dahami Wickramarathne, Mr. Nimal Ratnasiri, Mr. Buddhika Jayathilake, and all enumerators.

Professor Pujitha Wickramasinghe
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Suggested citation

Sri Lanka College of Paediatricians. Timing and pattern of growth faltering in first 1000 days of life: A retrospective cohort of 12–24-month-old Sri Lankan children. SLCP: Colombo, 2024.

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Sri Lanka College of Paediatricians, Family Health Bureau of the Ministry of Health, South Asia Infant Feeding Research Network, UNICEF Sri Lanka

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Abbreviations

BI	Birth and Immunization
BMC	Bio Med Central
BMI	Body Mass Index
CERC	Contingent Emergency Response Components
CF	Complementary Feeding
CHDR	Child Health and Development Records
CLAIM	Collaborating, Learning and Adapting in India Mechanism
CWC	Child Welfare Clinic
DGHS	Director General of Health Services
DOB	Date of Birth
ECCD	Early Childhood Care and Development
FHB	Family Health Bureau
GCE (O/L)	General Certificate of Education (ordinary level)
HIA	Health Impact Assessment
HPB	Health Promotion Bureau
ICTA	Information and Communication Technology Agency
INGOs	International Non-Governmental Organizations
IQR	Interquartile range
IYCF	Infant and Young Child Feeding
LFA	Length for Age
MCH	Maternal and Child Health

MOH	Medical Officer of Health
NCD	Non Communicable Diseases
NGOs	Non Governmental Organizations
OFC	Occipito-frontal circumference
OPD	Out Patient Department
PDHS	Provincial Director of Health Services
PHM	Public Health Midwives
PPS	Probability Propionate to Size
PSSP	Primary Health Care System Strengthening Project
RDHS	Regional Director of Health Services
RTI	Respiratory Tract Infection
SAIFRN	South Asia Infant Feeding Research Network
SD	Standard Deviation
SLCP	Sri Lanka College of Paediatricians
SLDHS	Sri Lanka Demographic and Health Survey
SPSS	Statistical Package for Social Sciences
UN	United Nations
UNICEF	United Nations Children's Emergency Fund
USAID	United States Agency for International Development
WFA	Weight for Age
WFL	Weight for Length
WHO	World Health Organization

Contents

Executive Summary

Undernutrition remains a challenging and unresolved public health problem in Sri Lanka, especially in the early childhood. The aim of the study is to assess the timing and pattern of growth faltering during the first 1000 days of life and to determine factors associated with it, including the existing service provisions related to child growth.

A retrospective cohort study was conducted among mother-child pairs of term babies (born at 37 weeks of gestation or later) aged 12 to 24 months. A sample of 1875 children were selected using multi-stage cluster sampling method, stratified by 3 residential sectors namely urban, rural and estate. In the first stage of sampling, 3 districts from the urban (Colombo, Gampaha and Galle) and rural (Kilinochchi, Polonnaruwa and Ampara), and 2 districts from estate (Nuwaraeliya and Badulla) sectors were selected. In the second stage, a total of 43 clusters (Medical Officer of Health areas) were sampled from the selected districts. In the final stage, around 40-50 mother child pairs were sampled systematically from each cluster using the Birth and Immunization registers of the Public Health Midwives. A structured data collection tool was used to gather data through interview of mothers and scrutiny of the Pregnancy Records and Child Health and Development Records. Weight and length of the child were measured using the standard techniques on the day of interview. Ethics clearance was obtained from the Ethics Review Committee of the Sri Lanka College of Paediatricians (ERC Ref No: SLCP/ERC/2023/08). Growth faltering was defined as >0.25 downward deviation of weight-for-age Z score (WAZ) from the birth WAZ. Visual inspection of the weight charts were also carried out to detect growth faltering.

Results revealed that the majority of mothers of the children were housewives (76.8%) and less than 40 years of age (94.7%). The proportion mothers and fathers completing General Certificate of Examinations (Ordinary Level) education was 69% and 63.7%, respectively. Seventeen percent of mothers were underweight, while 33.3% were either overweight or obese at the time of registering for antenatal care of the index child. Only 58.7% had used of folic acid during the pre-pregnancy period. Proportions of mothers having diabetes before and during pregnancy were 1.7% and 9.6% respectively, and those with hypertension were 1.9% and 7.6%, respectively. Use of iron, folic acid, calcium and vitamin C during pregnancy at least 4-6 times a week was around 95%. Inadequate weight gain was high especially in those with a pre-pregnancy BMI less than 18.5kg/m2 (72.2%). Of the sample, 46.4% indicated that they have extended family support for child care.

Of the children, 49.2% were girls, 42.5% were the first-born children in their family, and 34.2% were born by Caesarean section. The mean birth weight was 2917g (SD 406), with the proportion of low birth weight (less than 2500 g) being 13.0%. The proportion of LBW was higher in the estate sector (20.8%) than in the rural (9.5%) and urban (8.7%) sectors. The proportion of low birth weight was high (16.0%) among those mothers who had inadequate weight gain during pregnancy according to their BMI. The proportion of babies with birth weight of ≥3500g was high (16.6%) among those who had excess weight gain. The commonest morbidity reported during 4-6 months of age was acute respiratory illness (52.1%), followed by fever (15.0%) and diarrhoea (8.4%). Around 10-12 months of age, 55.7% of children reported acute respiratory illness, 16.4% fever, and 10.2% diarrhoea indicating high burden of acute illness during infancy.

The proportion ever breast-fed was 99.8%, with early initiation of breastfeeding being 99.7%. Exclusive breastfeeding rate was 89.3% during the first 2 days after birth, 86.4% by the end of 4 months and 59.3% by the end of 6 months of life. By 3 months 5.5% were fed artificial formula milk, which increased to 15.1% by the end of the 6th month. Fruit juices were introduced around 4th month to 4.7% of infants, and the rate increased to 57.5% by 6th month. Few children had solid food during 4th and 5th months, however there is an upward trend since 6th month onwards. The minimum dietary diversity (receiving at least 5 food items out of the 8 food groups) has sharply increased from 46.5% in the 6th month of life through 92.2% in the 9th month to 99.5% by the first year. The MDD in this report is based on longitudinal data, and refers to feeding of these items in a given month, hence not comparable with the MDD measured through cross-sectional studies such as DHS survey. The results also show that 72.9% of parents maintain a regular mealtime to feed, 58.9% feed child after recognizing that the child is hungry, 87.1% talks to the child lovingly to encourage feeding. Only 50.6% allow or assist the child to eat by herself/himself, and 35.8% keep a fixed place for eating. It was seen that 19.3% of the parents feed the child against the wishes of the child, and 5.1% talks to the child harshly during feeding.

A drop of WAZ of more than 0.25 from birth Z score was considered as growth faltering. On average, onset of growth faltering was detected around 3 months of age, with some variation across sectors. It occurs earlier in urban children (2.9 months) in contrast to estates (3.2 months) and rural sectors (3.5 months). In contrast, visual identification of growth faltering indicated its onset around the 5th month on average. Significant predictors of growth faltering were household poverty, having early growth faltering at 3 or 6 months, and discontinuation breastfeeding after one year.

The overall prevalence of underweight was 17.8% with the highest proportion being observed in the estate sector (24.2%). The underweight proportion was extremely high (38.5%) among children with low birth weight. Underweight was significantly high in boys compared to girls, mothers educated below GCE (O/L), or mothers employed as casual workers and those in the poorest wealth quintile. Proportion of underweight was significantly high among the mothers with pre-pregnancy BMI of <18.5 kg/m^2 or inadequate weight gain during pregnancy.

The overall prevalence of stunting was 15.8% with the highest observed from the estate sector (28.5%.) The prevalence of stunting was significantly higher in low birth weight children (35.4%). The stunting was also significantly higher in boys compared to girls, and those children in the poorest wealth quintile. Children not achieving a minimum dietary diversity at 8 months reported a significantly higher rate of stunting.

The overall prevalence of wasting was 13.7%, the highest proportion observed in the urban sector (14.3%). Low birth weight children had a significantly higher prevalence of wasting. Wasting was higher among boys than girls, and among those children whose mother had inadequate weight gain during pregnancy.

The proportion of children who received vitamin A supplementation at 6 months, 12 months and 18 months showed a reducing trend with age, with proportions being 92.9%, 87.3% and 79.8 % respectively. The children who received MMN were comparatively low. The proportion of children who received MMN at 6, 12, and 18 months was 42.9%, 47.5% and 41.6% respectively. Weight recordings in CHDR B portion was inadequate, where it was observed, that almost half of the CHDR B portions did not have weight recordings every month. At least 2 length recordings (excluding birth length) was found only in 25% of CHDR B portions.

Poverty was reported by 23.7% of the families with the highest being in the estate sector (36.9%) followed by rural sector (20.1%). Not having a permanent place of residence was reported by 20.7% of the families. Substance abuse by mother, father or the principal caregiver was seen among 7.6% of the families, while violence was reported by 4.1% of the families.

Findings indicate that the interventions to achieve optimum BMI during pre-pregnancy/ interpregnancy period be carried-out targeting both underweight and overweight/obese women. Findings also suggest the importance of achieving optimum weight gain during pregnancy, especially targeting the low BMI mothers and promoting dietary and other interventions. In consistent with previous studies, low birth weight was found to be a

strong determinant of underweight, stunting, and wasting. Improving undernutrition would not be possible unless measures are taken to increase the birth weight.

Growth faltering identified as a negative deviation of WAZ of more than 0.25 from birth weight Z score was observed among nearly 40-45% of children during the first 6 months. Early growth faltering predisposes a child for underweight and wasting, while longstanding growth faltering leads to stunting. Therefore, early detection of growth faltering and timely interventions would prevent a child leading to undernutrition. In case of prolonged growth faltering, investigation of causes, and implementation of health and non-health interventions should be carried out without delay.

This cohort has a wealth of longitudinal data from preconception period. It would be useful to do further analysis to understand the interplay between factors associated with growth faltering and anthropometric status. Continuation of the cohort prospectively is recommended in order to understand the long-term outcomes.

CHAPTER - 1

Introduction

1.1 Background and rationale

Sri Lanka is recognized for achieving good health outcomes at low cost and with low levels of per capita income. However, undernutrition remains a challenging and unresolved public health problem in the country, especially in the early childhood where the impact of nutrition on development outcomes is well recognized.

The term 'faltering growth' is widely used to refer to a slower rate of weight/height gain in childhood than expected for age and sex (National Guideline Alliance (UK), 2017). This may indicate the first flag in undernutrition and provides a window of opportunity for intervention. Globally, the growth monitoring programmes have shown that Growth faltering of children occur mainly during the first 23 months of age from birth (Alderman and Headey, 2018). WHO Global Database on Child Growth and Malnutrition from developing countries shows that mean weight starts to falter at about 3 months of age and continues to decline until the catch-up growth is observed only after 18 months (Shrimpton et al., 2001). If not promptly corrected this may lead to underweight, wasting and stunting among children.

According to Sri Lanka Demographic and Health Survey (SLDHS) 2016, the prevalence of stunting in children aged less than 5 years has remained relatively unchanged from 2006 - 2016 at a rate of 17.3% with its severe form at 4%. When observing the stunting by age, it is seen that much of the insult occurs during the first 1000 days of life: 'The critical window of opportunity for optimum growth'. Wasting (15.1%) and severe wasting (3.0%) also appear to have marginally increased from 2006 to 2016. The 2016 SLDHS also reported that one in five children below the age of 5 years was underweight (20.5%), and there were notable differences in the changes within sectors, provinces and districts. Although not much of a difference is seen in the rates of stunting between 2006 and 2016 in the urban and rural sectors, the estate sector has shown a marked reduction in both stunting and severe stunting.

Hence, serial monitoring of anthropometric parameters, especially weight for age of children is needed to detect any deviation from the growth trajectory to implement timely interventions. Appropriate interventions during the first 1000 days of life, which is the window of opportunity to prevent malnutrition, including undernutrition are of paramount importance. Optimal breastfeeding practices, introduction of nutritionally adequate

complementary food at the correct time and continuing improved feeding during illness are important components that need to be considered to prevent growth from faltering.

The causes leading to growth faltering are classified in literature as direct and indirect causes. As depicted in large population studies, feeding problems in otherwise healthy children lead to the onset of growth faltering between 4 to 8 months of age (Shrimpton et al., 2001). Some common practices observed in Sri Lanka in this regard are poor consistency of complementary feeds (CF), continuation of on-demand breastfeeding after commencement of CF, and continuation of night breast feeds (Sithamparapillai., et al 2022). Secondary analysis of the SLDHS 2016 data has identified some indirect modifiable factors that would prevent stunting including ownership of improved non-shared latrines, mother's exposure to radio television and newspaper, mother's education level of GCE (O/L) or above and having adequate money for daily expenses (WHO, 2019), which if addressed early could be used to prevent growth faltering hence, stunting. Further, district level analysis showed that lower standards of minimum acceptable diet in the 6-23 months old children, lower coverage of deworming, and unmet need of family planning as significant correlates of stunting in children less than 5 years of age. Women's participation in the labour force, and their engagement in the agriculture sector were predictive of higher stunting rates, while women's participation in the service sector was protective against stunting. The reason for this difference might be the inability to follow appropriate IYCF practices due to economic vulnerability and time constraints. These raise the need for context adjusted recommendations. It might be even more beneficial if interventions are individualised without assuming that 'one size fits all' (Kramer and Kakuma., 2012).

Therefore, it is important that we identify the timing of growth faltering in Sri Lankan children, especially at different settings/sectors and factors associated with that in the relevant age intervals. In this light, we need to look at the direct causes such as association of complementary feeding practices with the timing of growth faltering in detail. A study done in child welfare clinics in Sri Lanka found that although the quantity and consistency of the infants' diet are satisfactory, the quality is poor and increases the risk of growth faltering by 2.7 times (de Silva et al., 2015). Similarly, it is also important to link the indirect causes also with the timing of growth faltering in different sectors in view of possible interventions.

Growth monitoring has been an integral part of the maternal and child health programme of Sri Lanka. Up to 5 years of age, growth monitoring occurs at the Medical Officer of Health (MOH) clinics or field weighing posts. The practice is to measure the weight every month till the second birthday, and once in three months after 2 years till 5 years of

age, if there are no problems of growth. Otherwise, monthly weighing is recommended irrespective of age. Height measurements are to be done once in 6 months from two years of age, and during the first two years of life, it is recommended to measure length at 4, 9, 12 and 18 months, which coincide with the routine Child Welfare Clinic (CWC) visits. However, in case of children with malnutrition, length is to be measured every two months till two years of age and height every 3 months thereafter.

Understanding the patterns and contributory factors of growth faltering, needs to capture the variability in urban, rural and estate settings. This study aims at understanding the timing of growth faltering and changes of anthropometric indices over time in children during the first 1000 days of life and its association with feeding practices as well as other socioeconomic factors in Sri Lanka. Further, it would assess if the growth-faltered children reach their growth potential depicted by birth weight and length before 24 months to see how the existing programs can potentially address the observed growth deficits. It also creates a cohort with future potential of follow up to observe any long-term effects.

1.2 Scope and the Objectives of the study

General objective

To assess the timing and pattern of growth faltering during the first 1000 days of life in a Sri Lankan population using a cohort of children aged 12-24 months, and to determine maternal, child and social factors affecting growth faltering and how the existing program provisions relate to children's growth.

Specific objectives:

1. To determine the proportion of children with low birth weight, and growth faltering at each month by sector.

2. To assess the average age of deviation of weight for age, length for age and weight for length from the birth trajectory and describe the changes in the z scores of those indices (this assessment will be restricted to weight-for-age in this report since availability of length data in CHDR-B portion is limited).

3. To determine the association of major health (illness) or feeding related events with the growth faltering at different times.

4. To determine the effect of maternal nutritional status (BMI based) at booking visit and gestational weight gain on birth weight and subsequent growth of the child.

5. To determine the welfare programmes (governmental and non-governmental) that children were exposed to and their association with growth patterns.

6. To determine the association between other non-nutritional factors and growth (for growth faltering and current stunting, wasting and underweight).

7. To describe the prevalence of home risk factors to which children are exposed.

8. To assess the extent of use of growth charts and Child Health and Development Records (CHDR) by parents and healthcare workers as a tool for determining proper growth.

CHAPTER - 2

Review of Literature

Summary of literature

Nutrition failure especially during pregnancy and the first 24 months of life leads to loss of potential human capital. It translates into poor physical health, poor cognitive development, low educational attainment and increased health care costs (Shekar et al 2017). Practice of appropriateInfant and Young Child Feeding Practices (IYCF) is an important public health intervention in this regard which improves child survival, growth and development (Bhutta et al. 2008). The first 2 years of a child's life are particularly important, as optimal nutrition during this period lowers morbidity and mortality, reduces the risk of chronic disease and fosters better development overall.

The WHO/UNICEF global strategy for optimal IYCF recommends initiation of breastfeeding within one hour of birth; exclusive breastfeeding for the first six months; introducing nutritionally adequate and safe complementary foods after completion of 6 months; along with continuing breastfeeding up to two years and beyond (WHO and UNICEF, 2003). These recommendations have been adopted by the Government of Sri Lanka in 2007 and incorporated into the IYCF guidelines for Sri Lanka and the national strategy on IYCF in Sri Lanka (Family Health Bureau, 2014). However, despite these efforts, a high a percentage of growth faltering is still observed among Sri Lankan children (WHO, 2020; Sithamparapillai et al 2022; MRI, 2022).

2.1 What is growth faltering?

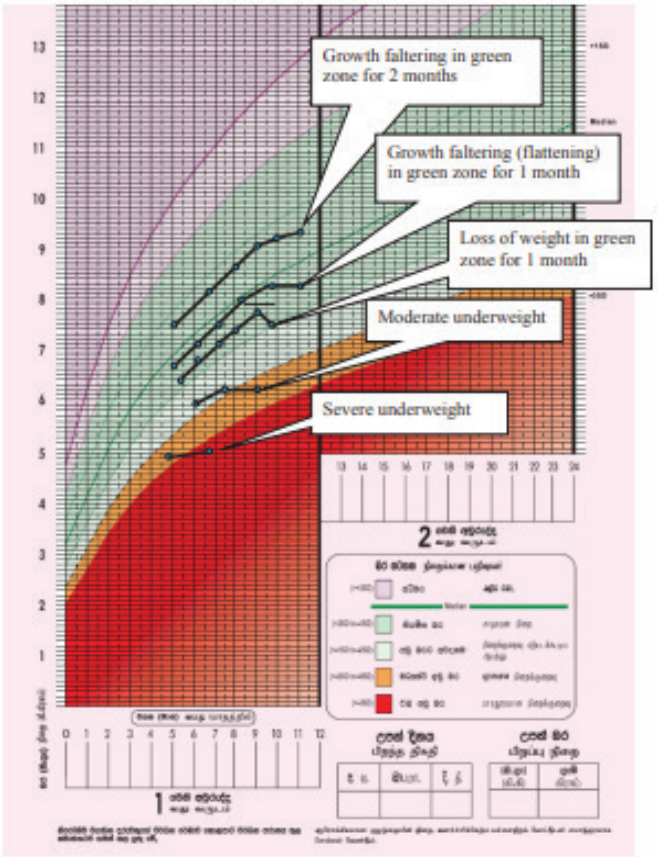
The term 'faltering growth' is widely used to refer to a slower rate of weight gain in childhood than expected for age and sex. The term faltering growth is preferred as periods of slow growth may represent temporary variation from the expected pattern and the word 'failure' may be seen as pejorative. Various definitions of faltering growth have been used in the past globally, meaning estimates of prevalence vary widely (NIG, 2017).

The definition used by FHB, Sri Lanka (FHB, 2008) to identify growth faltering at population level is stated in circular number 02-18-2008. It states that a child's growth curve should continue to rise parallel to reference lines based on the birth weight.

Therefore, any deviation of a child's growth curve compared to the reference curve such as inadequate weight gain, no weight gain or drop in weight between two consecutive weight measurements is defined as growth faltering.

According to Ministry of Health Manual for Health Care Workers on Management of Severe Acute Undernutrition and Moderate Acute Undernutrition of Children Under Five Years of Age, 3 categories of growth faltering have been described. Those are illustrated in Figure 1 (Ministry of Health, 2019).

Figure 1: Growth trends in weight for age chart of CHDR



2.2 Growth faltering in first two years of life:

Growth faltering patterns of children differ across the world and faltering patterns are different for weight and height. A study by Victoria et al (2010) analysed information available from the WHO Global Database on Child Growth and Malnutrition, comprising data from national anthropometric surveys from 54 countries. Anthropometric data comprise weight-for-age, length/height-for-age, and weight-for-length/height z scores.

The WHO regions were used to aggregate countries: Europe and Central Asia; Latin America and the Caribbean; North Africa and Middle East; South Asia; and sub-Saharan Africa. The study showed that weight for length/height starts slightly above the standard in children aged 1 to 2 months and falters slightly until 9 months of age, picking up after that age and remaining close to the standard thereafter. Weight for age starts close to the standard and falters moderately until reaching approximately −1z at 24 months and remaining reasonably stable after that. Length/height for age also starts close to the standard and falters dramatically until 24 months, showing noticeable bumps just after 24, 36, and 48 months but otherwise increasing slightly after 24 months. However, considering only the data from the South Asian region, weight for age SDS dropped steadily until 18 months and continued to decrease at a slower rate until 5 years. Drop in height-for-age SDS was more than weight-for-age SDS and it dropped until 24 months with no catch-up growth thereafter among children in the South Asian region. (Victoria et al, 2010)

A cross sectional descriptive study conducted in an immunisation clinic of a tertiary care hospital in Sri Lanka among 254 children by Sithamparapillai et al (2022) have revealed that high prevalence of growth faltering in this population until 18 months of age. In this study, drops in mean weight-for-age and length-for-age Z scores were noted at 4 months. a drop of more than 0.25 in weight-for-age Z score from birth was defined as weight faltering. Weight faltering, compared to birth weight, was noted in 50.4% (n = 128) of infants by 4 months of age. Of them majority (76.6%, n = 98) remained weight faltered (p = 0.497) at 12 months. However, there is no population-based study to confirm the above findings.

2.3 Factors associated with growth faltering:

The global literature reveals the potential of interaction of direct and indirect health factors as well as direct and indirect non-health factors leading to growth faltering. The direct factors been, breast feeding status, dietary diversity, supplementation, illness etc and indirect factors such as household wealth, maternal and paternal education, sanitation standards etc highlighted in literature in this regard (Keats et al, 2021, Li et al, 2020, Prado et al, 2018).

The study by Sithamparapillai, and co-workers (2022) revealed that onset of growth faltering is seen very early in life in a majority of infants in Sri Lanka, in spite of high exclusive breastfeeding rates. Further, many mothers persisted with exclusive

breastfeeding without starting CF, despite detecting growth faltering at an age earlier than 6 months. This was also confirmed at other local studies including Senarath (2022) as sub-optimal complementary feeding practices among infants and young children, together with reasons for such practices were elicited through a mixed method study. In conforming to Ministry of Health recommendations (Family Health Bureau, 2015), most caregivers had introduced solid foods to their children around 6 months of age.

The contribution of socio demographic factors should also not be underestimated. For example, Women's participation in the labour force and their engagement in the agriculture sector were predictive of higher stunting rates, while women's participation in the service sector was protective against stunting according to the findings of a review by WHO (2020).

The available evidence also points the need towards a sector-based approach, as many studies have revealed sector specific risk factors for growth faltering. Sub-optimal IYCF practices prevailing in the estate sector, despite improvement in socio-economic status (Weerasinghe and Bandara, 2015), warrant the necessity of specific strategies tailored to sub-populations. The positive deviance strategy is one such approach which has been investigated in the estate sector and found that positive deviant families had achieved high dietary diversity including adding foods of animal origin to their children's diet, in contrast to their counterparts (World Bank, 2018).

CHAPTER - 3

Methods and Approach

3.1 Study setting and sampling

3.1.1 Study design

This study was conducted as a community-based retrospective cohort study among 12- to 24-month-old term children. Longitudinal data were collected retrospectively for the period 12 to 24 months before the time of recruitment to the study depending on the current age.

3.1.2 Study setting

In selecting the setting the major residential sectors namely the urban, rural and estate sectors were covered. Districts with adequate number of MOH areas under urban, rural or estate population were shortlisted to ensure representation of these 3 sectors. Hence the following districts were included under the three sectors.

Urban

- Δ Colombo
- Δ Gampaha
- Δ Galle

Rural

- Δ Ampara
- Δ Polonnaruwa
- Δ Kilinochchi

Estate

- Δ Nuwara Eliya
- Δ Badulla

3.1.3 Study population and recruitment

The study population consisted of children between 12 to 24 months of age who have been registered by the Public Health Midwives (PHMs) for field health services provided through the MOH office. The children of the relevant age group were selected from Birth and Immunization (BI) Registers maintained by the PHMs. The B portion of the CHDR, which is maintained by the PHM, was scrutinized by the data collectors to check the adequacy of data points on growth monitoring prior to inclusion in the study. Selected mothers/caregivers were contacted via telephone.

When the eligible participants' parents or caregivers turned up on the pre-agreed day, they were further informed verbally about the study and provided with an information sheet and consent form. They were also provided with an opportunity to ask any questions and decide whether to participate in the study. Only the participants who received consent from their parents/caregivers were recruited. Inclusion and exclusion criteria used in the study are listed below:

3.1.4 Inclusion criteria

Children aged between 12 and 24 months (falling within the above window) registered with area PHM in the BI Register and attended CWC or field weighing posts to receive childcare services. The B portion of the child's CHDR should be available with the respective PHM, with at least 4 weight recordings being entered during the first 12 months of age.

3.1.5 Exclusion criteria

- Children born at a gestational age of less than 37 weeks
- Children with chronic conditions and feeding difficulties due to underlying medical reasons such as cerebral palsy or congenital deformities (e.g., cleft palate).
- Children with chromosomal disorders who have reduced growth potential (e.g., Downs syndrome)

- Children with increased nutrient requirements due to a chronic disease
- If the required data is missing in CHDR (anthropometric parameters measured) or the B portion is not available with the PHM

3.1.6 Sample size

The sample size was calculated to ensure optimum number of children in each stratum (urban, rural and estate). To estimate the main outcome the proportion of children with any growth failure was taken as 46% with its 95% CI to be within ±5%. The design effect for clustering was 1.5 and cluster size set at 40 with ICC of 0.013. The anticipated loss due any failure of obtaining complete information was taken as 5%. With these parameters, the estimated sample was approximately 600 for each sector, totalling to 1800 children. Since the cluster size was 40, the number of clusters required was 15 per stratum, making a total of 45 MOHs for the entire cohort.

3.1.7 Sampling method:

The children were recruited to the cohort using stratified cluster sampling method: Stratification was carried out by the residential sector (3 sectors, namely the urban, rural and estate, as defined by the Department of Census and Statistics – See Annex 1 for details). A cluster was a MOH area, which has usually a total population between 50,000 to 100,000.

3.1.8 Sample selection

Stage I - Selection of districts: As shown in Table below, 3 districts each from the urban and rural sectors, and 2 districts from the estate sector were purposely selected as the most appropriate districts to represent the respective sub-populations. The study districts were agreed upon through consensus during the meetings of the Technical Advisory Committee.

Stage II - Selection of MOH areas: A list comprising all MOH divisions with their population size by sector was prepared for the selected districts. Based on the percentage of the respective sub-population, MOH areas with the highest percentage of urban population were selected for the urban sample. Similarly, the MOH areas with the highest

percentage of rural and estate populations were selected for the rural and estate strata, respectively.

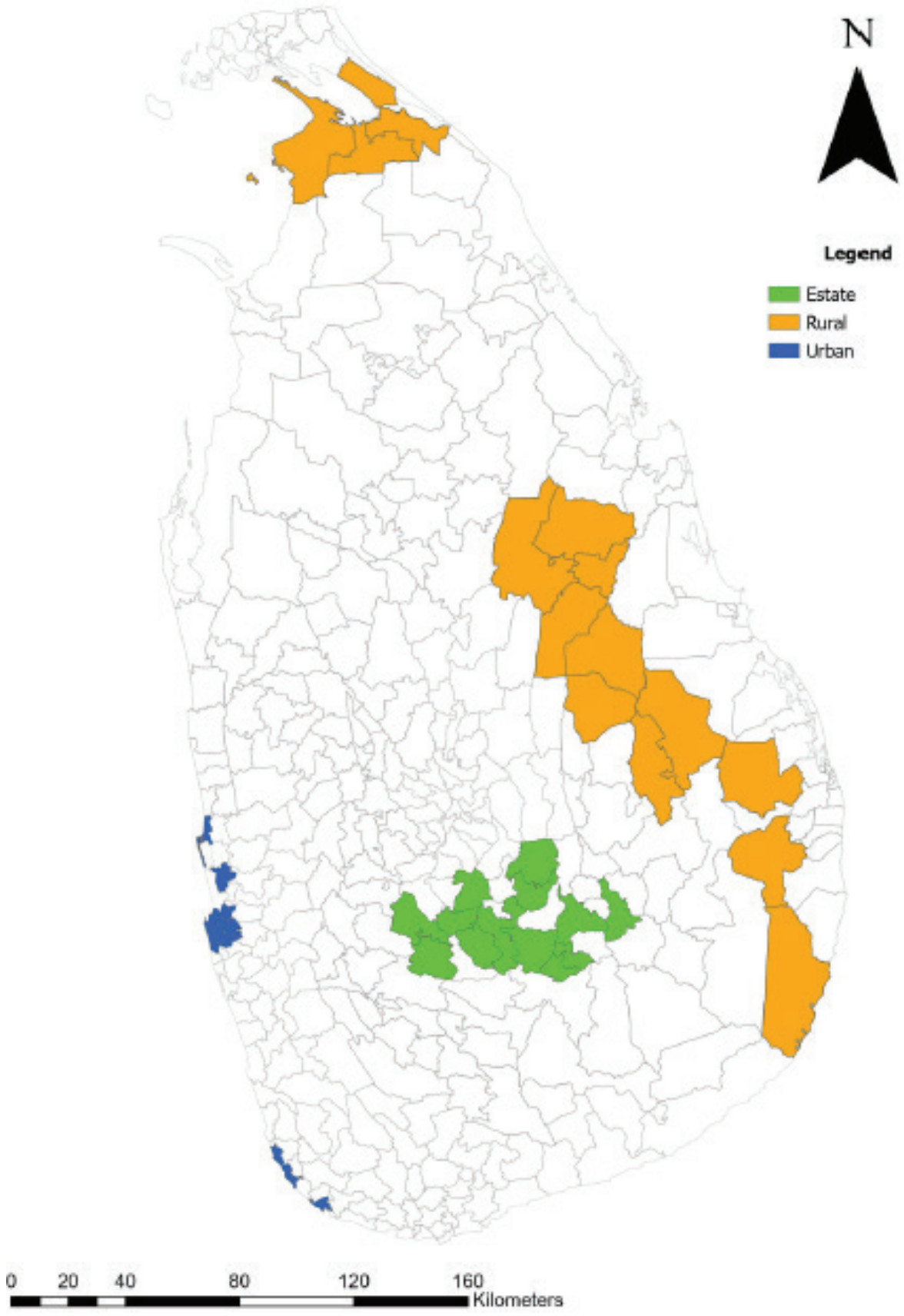
Table 1 summarises the number of MOH areas sampled for the study according to urban, rural and estate sectors and districts. The number of MOH areas (clusters) sampled for the selected districts are as follows: Colombo 10; Gampaha 3, Galle 2 (Urban sector 40 per cluster x 15 clusters); Ampara 6, Polonnaruwa 5 and Kilinochchi 4 (Rural sector 40 per cluster x 15 clusters); Nuwara Eliya 8 and Badulla 5 (Estate sector 40-50 per cluster x 13 clusters). The names of the selected MOH areas are given in Annex 2.

Table 1: Districts and number of MOH areas selected for the study according to urban, rural and estate sectors

Residential Sector	Districts	No. of MOH Areas
Urban	Colombo	10
	Gampaha	3
	Galle	2
Rural	Ampara	6
	Polonnaruwa	5
	Kilinochchi	4
Estate	Nuwara Eliya	8*
	Badulla	5
Total	**8 districts**	**43 MOH Areas**

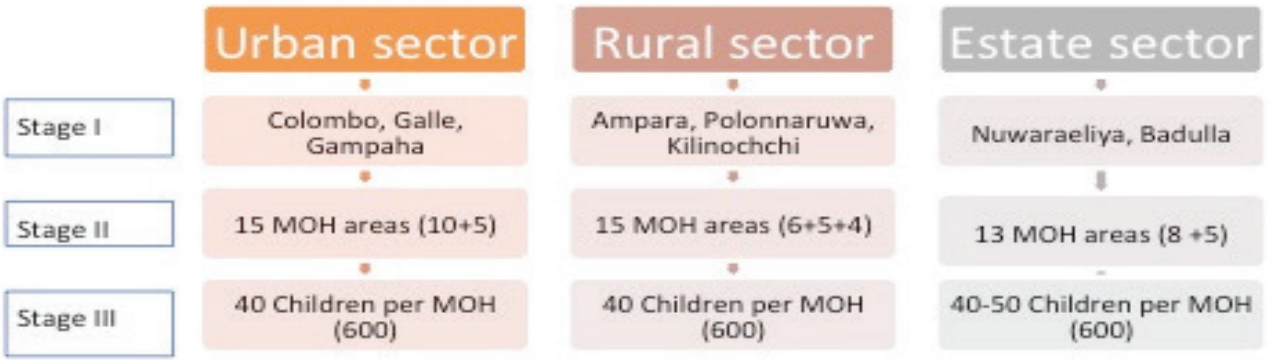
** In estate sector 2 clusters each were selected from 2 MOHs*

Figure 2: Map of the distribution of selected clusters



Stage III Selection of study participants: The required number of children (n=40) from the selected MOH areas were sampled systematically according to the BI registers of the PHMs. From a given MOH, 4 to 6 PHMs areas were included for this purpose. The PHM areas were selected at a planning session conducted with the MOH staff and research team, based on the MOHs information that best represents the relevant sector. e.g.: Battaramulla MOH area was selected for the study from Colombo district representing the Urban sector. Then there was a planning meeting with the research team and Battaramulla MOH staff to identify 5 PHM areas within the urban council area/ having the highest urban population. Then from the BI registers of selected PHM areas a list of eligible children was prepared based on age and other information provided by PHM. Forty (40) children were systematically selected from this and parents were contacted for screening of further eligibility and inviting for the study. If the parent did not respond for three different attempts at 3 different occasions, or when mother did not have a means of contact, a home visit was made for this purpose. If all attempts failed, the next eligible child was sampled. If 40 eligible children could not be sampled this way from the selected PHM areas the sampling frame was expanded to the next most eligible PHM area on the consensus of MOH.

Figure 3: Schematic diagram of the sampling process



3.2 Data collection tool

A structured data collection tool was developed to gather data from the mothers and relevant records including pregnancy record, CHDR A, and B potions. The questionnaire was developed by the core team of investigators considering the objectives of the study and possible variables. Consensus on the tool was obtained at the Technical Working Group. The tool included a series of questions to be asked from the mother, and several fields to enter data from different health records, and to enter the measurements made of the baby (current length and weight).

3.2.1 Pretesting

Pre-testing of the questionnaire was carried out in the Gothatuwa MOH area on the 9th of September 2023, by the research team (3 persons) after obtaining permission from the Ministry of Health. Sixteen children aged 12-24 months, and their mothers were interviewed after obtaining their consent. Seven fathers were also present for this session. The Child Health and Development Record (CHDR) A and B portions and Pregnancy Record from the mother was used to gather information. Interviews were conducted by the investigators using the questionnaire, and necessary data were extracted from the records. The team also obtained pictures of weight-for-age, length-for-age and weight-for-length charts from the CHDR. Thereafter, the B portion of the CHDR was obtained from the PHM and the date of weighing and taking the length measurement, the exact weights, and height were extracted. An interview took around 45 to 50 minutes. Following pretesting, the data collection tool was modified according to the feedback received.

The final tool consisted of the following sections:

Section A: Identification details- District, MOH area, PHM area, PHM Name & contact, Mothers name & contact, child's name, address, age, sex, Date of Birth

Section B: Baseline characteristics of the child: parity, singleton or multiple, mode of delivery, if delivered by Caesarean reasons, and measurements recorded at birth such as birth weight, length and OFC

Section C: Demographic and socioeconomic characteristics of family: education, employment, income, maternity leave and paternity leave.

Section D: Pregnancy related information: illness before and during pregnancy, micronutrient intake, haemoglobin and weight gain

Section E: Feeding and nutrition of the newborn: details of breastfeeding practices, complementary feeding, food diversity, decision making pattern on feeding, responsive feeding

Section F: Illness: changes in the diet

Section G: Growth faltering: detailed table by scrutinising weight-for-age chart of the CHDR

Section H: Micronutrient supplement use and food supplements by the baby

Section J: Welfare programmes and use of growth charts in relation to growth

Section K: Home risk factors

Section L: Wealth Index

Section M: Anthropometric measurements: weight and length of the child, and weight and height of the mother and father

Exclusive breastfeeding was defined as feeding/having been fed nothing other than breast milk for nutritional or fluid-providing purposes, excluding substances used for medicinal purposes. Episodes of Respiratory Tract Infection (RTI) was defined as an illness with upper respiratory symptoms and signs which lasted more than 48 hours with or without fever. An episode of diarrhoeal illness was defined as watery loose stools with more than 3 bouts per day lasting more than 48 hours. Frequent passage of formed or pasty stools seen in breastfed babies were not considered as diarrhoea. An episode of urinary tract infection and other illness was recorded if there were medical records, which indicated the diagnosis.

Antenatal data were extracted from the pregnancy record. Parents' current height and weight was measured whenever possible and if it is not possible to measure directly (especially of the father who may not be able to visit the centre) the declared anthropometric parameter was obtained. Other required data were obtained by directly interviewing the mother/father or caregiver

3.2.2 Data collection methods

Pre-tested questionnaire was administered by trained enumerators via direct (face to face) interview with the mother or principal caregiver. Paper-based data collection tools were used to gather data. Data from the pregnancy record, A and B portions of CHDR held with the PHM, and other health records were extracted to the form as required. Two enumerators were assigned to collect data from one mother/child dyad. The photographs of the relevant sections of the pregnancy record, and CHDR were obtained on permission.

Anthropometric measurements, which include weight and length were taken on the date of the interview by two trained enumerators following the standard protocols. Length was measured using SECA 417 - Portable & foldable measuring board (Infantometer) and weight via SALTER electronic digital scale - 9069. Instruments were calibrated prior to data collection and checked for accuracy regularly.

3.2.3 Limitations in data collection

Secondary data were extracted from the pregnancy record and CHDR. Certain weight measurements and higher number of length measurements were not available in the CHDR B portions. Anthropometric measurements extracted from the records had been taken for the purpose of service delivery, therefore may not be ideally suited for research purpose. Recall bias might be a problem when getting the details about breastfeeding and complementary feeding practices.

3.2.4 Taking photographs of certain sections of the CHDR and Pregnancy Record:

Photographs were taken of growth charts (weight for age chart, length for age chart, weight for length chart). Images of selected section of CHDR B portion and pregnancy records were also captured for future reference. All images of any single participant were stored as a single PDF file under serial number with password cover.

3.3 Approach to field work

3.3.1 Permission from institutions and health authorities

Ethics clearance was obtained from the Ethics Review Committee of the Sri Lanka College of Paediatricians (ERC Ref No: SLCP/ERC/2023/08). Permission for the proposed study were obtained from the Ministry of Health (DGHS), PDHS of the relevant provinces, Director General of the Plantation Human Development Trust, and the Chief MOH of the Colombo Municipal Council. FHB and SLCP facilitated this process. RDHS of the selected districts and the MOHs of selected MOH areas were informed prior to field visits.

3.3.2 Appointment and responsibilities of the field teams

Three field teams were appointed for the 3 sectors (urban, rural and estate), with each team having a Sector Data Manager, a District Coordinator and 10 to 12 enumerators. The field team members (Annex 3) were selected based on educational and field work related experience. Individuals with a medical degree awaiting internship or a degree in other health/science related fields from a recognized University from Sri Lanka or overseas were selected through a face-to-face interview process.

Table 2: Summary of the study team members

Category	**No. of persons by sector/district**								**Total**
Field Team Leader	1								**1**
Overall Data Manager	1								**1**
Co-Consultant	1								**1**
Sector	**Urban**			**Rural**			**Estate**		
Sector Data Managers	1			1			1		**3**
District	**Colombo**	**Gampaha**	**Galle**	**Ampara**	**Polonnaruwa**	**Kilinochchi**	**Nuwara Eliya**	**Badulla**	
District Coordinators	1	1	1	1	1	1	1	1	**8**
Enumerators	12			12			12		**36**

The primary responsibility of the Sector Data Manager was entering the collected data into the central system, cross checking the entered data with the questionnaire along with enumerators, maintaining the data backup mechanism and safety measures of data and coordinating the data entering with the Overall Data Manager and team leader. The district level logistic management was handled by District Coordinators which include the permissions, planning visits to selected MOH areas, designing sampling frames and selection of the sample. They also arranged the data collection setting logistics with the help of regional health staff and study enumerators. Enumerators conducted the face-to-face interviews with participants, measured the anthropometric measurements of the child and handed over the completed questionnaire to Sector Data Manager.

3.3.3 Training of field team

Training of the field team was critical to ensure the quality and reliability of data. Therefore, after the finalization of questionnaires, all team members were given an in house two-day classroom and a field-based training. The field training was conducted at Battaramulla MOH area in the Colombo district. A field manual was developed for enumerators to gather data in a uniform manner.

The experts from College of Paediatricians in Sri Lanka, FHB of the Ministry of Health, UNICEF and university academia conducted the training session for team members. During this training program, the major aspects covered were purpose and objectives of study, detailed discussion of the questionnaire (questions by question), anthropometric measurements, how to maintain quality and reliability of the data, etc. All team members were trained to measure the anthropometric measurement of the child without any errors by an experienced anthropometrist. After classroom training, all study team members visited a selected CWC from Battaramulla MOH area for field practices..

3.3.4 Execution of data collection by field team

District Field Coordinators met the RDHS and MOH to obtain the permission for field work (SLCP requesting permission letter and approval from DGHS to carry out the research project were forwarded to RDHS formally via fax/email) and visited the selected PHM's clinics for the field arrangement as described under sample selection section 3.1.8. In the estate sector, the required sample size was covered from 29 estates in 13 MOH areas even though the initial plan was to approach 15 MOHs. In the urban and rural sectors, sample sizes were achieved from 15 MOHs each as planned.

The field team leader, co-consultant, overall data manager and the sector data managers supervised the data collection process with on-site visits. The collected data were reviewed at regular intervals throughout the process for quality appraisal including completeness. Further, the anthropometric instruments used were periodically calibrated to ensure accuracy. Inter-rater variability was monitored to ensure consistency.

3.3.5 Data management

All the questionnaires and record sheets were serially numbered to ensure identification. The sector data managers, and district coordinators on a daily basis corrected missing data and incompatible data in the field itself. Data cleaning was carried out prior to analysis. Supervision of the data collection and entry was by the sector data managers and overall data manager.

3.4 Data Analysis and Interpretation

Data entry was conducted using a specific data entry application. The front-end interphase of the application was done with built-in checks in the questionnaire itself to avoid any data entry errors. Apart from the pre-coded answers in the questionnaire, rest of the responses were also coded for data entry. Sector data managers coded open-ended questions and code lists were provided to the overall data manager to compile the data.

The enumerator teams carried data entry closely supervised by the sector data managers. Enumerators had the access to the front-end interphase of the application only and they could go back and forth in the entry sheet for corrections and verifications prior to submission. The photographs were also uploaded through the same application with the same serial numbers embedded. Access to the database is protected via a secure password. With the first arrived filled questionnaires the data analysis program was tested, and the overall data manager did minor adjustments to the program. Following completion of data entry, the database was sorted and cleaned by the data managers in a three-step data cleaning and at each level, whenever there was a query, the original data sheet was traced, and necessary verifications and corrections were done.

3.4.1 Measures to Ensure Data Quality

In order to ensure the reliability and validity of collected information, consultants followed the best practices given below:

- High standards were maintained in recruiting suitable persons with experience as field workers/officers. Adequate training was provided on interviewing techniques and the subject matter of the survey.

- Data collection was conducted in a language conversant to the respondents. Data collection tools were available in all three languages.

- Interviews were conducted at a time most convenient to the respondents through an appointment system.

- Interviewing etiquettes were strictly followed by the enumerators and survey supervisors closely monitored the process.

- The interviewer assured the respondents of the confidentiality of information, indicated the time required for completing the interview and sought his/her approval to continue with the survey

- The interviewer responded adequately to any queries of the respondent.

- Repeating a question to help the respondent when she/he does not understand the question correctly, misses the emphasis, or seems unable to make up the correct response. Repetition gave the respondent more time to reflect on the question.

- The interviewer recorded responses during the interview without waiting until the interview was completed.

- Responses were noted down in the language of respondents, keeping the same phrases, grammatical usages, and peculiarities of speech.

3.4.2 Best Practices Followed to Ensure Quality of Data Collection

1. The survey consultant /sector data managers undertook random field visits to ensure surveys are conducted appropriately and acceptably. Further field supervision teams from College of Paediatricians and UNICEF country office also observed the data collection process.

2. Completed questionnaires were scrutinised first by the survey supervisor to ensure completeness and accuracy of the filled responses and incomplete questionnaires were returned to the field enumerator to complete the same.

3. The field consultants conducted, further quality checking before entering the data into the data entry software system.

4. Entered data were randomly checked to ensure accuracy.

5. Dummy output tables were developed in consultation with SLCP before generating actual survey results.

3.4.3 Statistical Analysis

The first round of data analysis was carried out by the data managers and consultants and presented in this report. The statistical packages SPSS, Stata and WHO Anthro software were used for data analysis. Quantitative data processing methods were used to arrive at more accurate conclusions and recommendations.

Basic characteristics of the sample: Sociodemographic characteristics of the children and the parents, antenatal parameters, birth and neonatal events, feeding behaviours, illness related information, welfare benefits and home risk factors were summarized as frequency distribution tables, percentages, mean (SD), and median (IQR) with 95% confidence intervals as appropriate.

Low birth weight:

Low birth weight was interpreted as <2500g of birth weight.

Growth faltering:

Percentage of children who had growth faltering were analysed at each month using CHDR-B portion weight recordings.

- Growth faltering was defined as >0.25 downward deviation of weight for age Z score (WAZ) from that of birth WAZ. Mean WAZ and proportion of growth faltering was then reported for each month.

- First incidence of downward deviation of WAZ >0.25 from that of birth WAZ according to CHDR-B portion recordings was considered the age of onset of growth faltering.

The weight for age charts, which is used by the PHM for identification of growth faltering, was also captured as photographs. Visual inspection of these charts can be carried out to screen for growth faltering based on the guidelines published by FHB.

Factors associated with low birth weight and growth faltering: Chi Square testing was used to assess the factors significantly associated with low birth weight and growth faltering at different time points.

3.4.4 Ethical Considerations

The study was conducted according to the protocol for which approval was taken from the Ethics Review Committee of the Sri Lanka College of Paediatricians.

The study procedure was explained in detail using the information sheet and consent form. Informed written consent was taken from parents or caregivers. Privacy and the confidentiality of all information and identities of participants were strictly maintained and will not be disclosed when publishing the study results. Name, address and contact number have been included in the questionnaire, if need to provide any feedback to parents on their child's growth. However, no personal disclosures will be made, and the anonymity of participants will be maintained in disseminating results.

Questionnaires, information sheets and consent forms were translated into Sinhala and Tamil and administered to ensure that all participants understand properly. The participation was without compulsion, and the subject had the right to withdraw participation at any time without providing a reason. All the measurements were non-invasive.

If any unacceptable feeding practices were found, appropriate referral was done to the PHM.

The consent form and data sheets were securely stored in a separate cupboard and kept under lock and key. Study computers were password protected. The individual data of the study population were available only to the researchers and supervisors. Editing provision was available only during the data entry process, and there was no access to the database.

CHAPTER - 4

Results

This survey was conducted to assess the timing and pattern of growth faltering in the first 1000 days of life, retrospectively studying a total sample of 1875 term born children, currently aged 12–24-months representing the three residential sectors, namely urban, rural and estate.

4.1 Age and sex distribution of the sample of children

The following table shows the age and sex distribution according to the residential sector of the study participants.

Table 3: Age sex distribution of the study sample according to sector

Age and Sex	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Age category (in months)								
12-14	185	28.6	157	26.5	121	19.0	463	24.7
15-17	147	22.8	134	22.6	157	24.7	438	23.4
18-20	128	19.8	137	23.1	157	24.7	422	22.5
21-24	186	28.8	165	27.8	201	31.6	552	29.4
Sex								
Female	320	49.5	295	49.7	307	48.3	922	49.2
Male	326	50.5	298	50.3	329	51.7	953	50.8

There is almost an equal percentage of children in different age categories with a slightly higher proportion in the 21-24-month age category in the sample (29.4%). The male: female distribution in the sample was almost equal in total as well as in all residential sectors.

4.2 Socio- demographic characteristics of the parents and family

4.2.1 Age distribution of parents

Table 4: Age distribution of the parents of the referenced child according to sector

Age (in years)	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Mother								
<20	3	0.5	2	0.3	5	0.8	10	0.5
20-29	284	44.0	275	46.4	304	47.8	863	46.0
30-39	324	50.2	283	47.7	297	46.7	904	48.2
40 or above	35	5.4	33	5.6	30	4.7	98	5.2
Father								
20-29	161	24.9	138	23.3	156	24.5	455	24.3
30-39	363	56.2	356	60.0	391	61.5	1110	59.2
40 or above	121	18.7	98	16.5	87	13.7	306	16.3
NA	1	0.2	1	0.2	2	0.3	4	0.2

NA – not available

Most of the mothers belonged to the 30–39-year age group (48.2%) followed by the 20-29 age group (46.0%). There were only 10 mothers in the sample who were less than 20 years of age. Similarly, the majority (59.2%) of the fathers belonged to the 30-39 age category.

4.2.2 Education level of the parents

Table 5: Education of the parents of the referenced child according to sector

Highest Education Level	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Mother								
Passed Grade 5 or less	14	2.2	4	0.7	46	7.2	64	3.4
Passed Grade 6-9	151	23.4	123	20.7	242	38.1	516	27.5
Passed O/L	280	43.3	285	48.1	231	36.3	796	42.5
Passed A/L	141	21.8	150	25.3	102	16.0	393	21.0
Degree and above	60	9.3	29	4.9	14	2.2	103	5.5
NA	0	0.0	2	0.3	1	0.2	3	0.2
Father								
Passed Grade 5 or less	6	0.9	7	1.2	40	6.3	53	2.8
Passed Grade 6-9	154	23.8	154	26.0	306	48.1	614	32.7
Passed O/L	313	48.5	304	51.3	204	32.1	821	43.8
Passed A/L	128	19.8	106	17.9	66	10.4	300	16.0
Degree and above	44	6.8	19	3.2	11	1.7	74	3.9
NA	1	0.2	3	0.5	9	1.4	13	0.7

NA – not available

In the urban sector, 31.1% of the mothers have either passed Advanced Level or had higher-level education, while in the rural and the estate sector it was 30.5% and 18.4% respectively. Among the fathers also, the highest proportion who passed A/L and above was seen in the urban sector (26.8%), followed by the rural (21.6%) and estate sector (13.5%).

4.2.3 Employment status of the parents

Table 6: Employment status of the parents of the referenced child according to sector

Employment status	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Mother								
Employed Government sector	29	4.5	18	3.0	34	5.3	81	4.3
Employed Private sector	46	7.1	10	1.7	51	8.0	107	5.7
Self-employed / Own business	33	5.1	18	3.0	10	1.6	61	3.3
Casual Worker	9	1.4	4	0.7	143	22.5	156	8.3
Take care of house work	522	80.8	522	88.0	396	62.3	1440	76.8
NA	7	1.1	21	3.5	2	0.3	30	1.6
Father								
Employed Government sector	54	8.4	148	25.0	31	4.9	233	12.4
Employed-Private sector	323	50.0	96	16.2	199	31.3	618	33.0
Self-employed / Own business	161	24.9	110	18.5	105	16.5	376	20.1
Casual Worker	102	15.8	165	27.8	277	43.6	544	29.0
Take care of house work	1	0.2	67	11.3	16	2.5	84	4.5
NA	5	0.8	7	1.2	8	1.3	20	1.1

NA – not available

The above table shows that most mothers are not employed (76.8%) and take care of housework in the total sample. However, in the estate sector it was seen that this percentage is only 62.3%. Though the working percentage was high in the estate sector, 22.5% of the mothers worked as casual workers. Most fathers were employed in the private sector (33.0%), followed by being employed as a casual worker (29.0%) and being self-employed (20.1%) in the total sample.

4.2.4 Family Income

Table 7: Status of having a regular monthly family income according to sector

Family income	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Having a regular income								
Yes	417	64.6	440	74.2	321	50.5	1178	62.8
No	229	35.4	153	25.8	315	49.5	697	37.2
Monthly family income in Rupees								
Less than 30,000	170	26.3	289	48.7	441	69.3	900	48.0
30,000 - less than 50,000	268	41.5	218	36.8	163	25.6	649	34.6
50,000- less than 100,000	154	23.8	74	12.5	27	4.2	255	13.6
100,000- less than 150,000	36	5.6	8	1.3	3	0.5	47	2.5
More than 150,000	17	2.6	1	0.2	0	0.0	18	1.0

This table shows that 49.5% of the families in the estate sector, 35.4% families in the urban sector and 25.8% families in the rural sector reported that they do not have a regular monthly family income. It also shows that 69.3% of the families in the estate sector, 48.7% families in the rural sector and 26.3% families in the urban sector reported that their family income was less than 30,000 Rupees a month. The proportion of families earning less than 100,000 a month was 99.5% in the estate sector followed by 98.5% in the rural sector and 91.8% in the urban sector.

4.2.5 Status of family support

Table 8: Availability of extended family support according to sector

Availability of extended family support	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Always	301	46.6	262	44.2	307	48.3	870	46.4
Sometimes	123	19.0	160	27.0	100	15.7	383	20.4
No	222	34.4	171	28.8	229	36.0	622	33.2

As indicated in the table above, 46.4% of the total sample indicated that they always have extended family support in child rearing. Interestingly, all three sectors had fairly similar percentages of the same response. However, 36% of the estate mothers indicated that there is absolutely no extended family support, while this was 34.4% and 28.8% in urban and rural sectors respectively.

4.3 Pre- pregnancy and maternal characteristics

4.3.1 Maternal morbidities

The following table describes the maternal illnesses reported before and during the pregnancy for the index child.

Table 9: Illness before and during pregnancy

Illness	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Prior to pregnancy								
Diabetes	14	2.2	15	2.5	3	0.5	32	1.7
Hypertension	13	2.0	14	2.4	8	1.3	35	1.9
Heart Disease	6	0.9	3	0.5	3	0.5	12	0.6
Epilepsy	4	0.6	5	0.8	6	0.9	15	0.8
Other	125	19.3	117	19.7	48	7.5	290	15.5
During pregnancy								
Gestational Diabetes Mellitus	87	13.5	56	9.4	37	5.8	180	9.6
Hypertension	65	10.1	44	7.4	33	5.2	142	7.6
Infection with fever	9	1.4	15	2.5	6	0.9	30	1.6
Other disease-causing hospitalisation	8	1.2	13	2.2	5	0.8	26	1.4
Other	134	20.7	85	14.3	30	4.7	249	13.3

The proportion of the mothers who have had GDM during pregnancy was 9.6%, while those who had hypertension during pregnancy was 7.6% as seen in the table above. However, the proportion of those having diabetes and hypertension before pregnancy was 1.7% and 1.9% respectively.

4.3.2 Micronutrient and food supplementation at pre-pregnancy and pregnancy

Table 10: Use of supplementation during pre-pregnancy and pregnancy period

Supplementation during pre-pregnancy and pregnancy period	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Pre- pregnancy Folic acid	325	50.3	427	72.0	348	54.7	1100	58.7
Supplementation during pregnancy (at least 4-6 times a week)								
Iron	599	92.7	565	95.3	613	96.4	1777	94.8
Folic acid	598	92.6	569	96.0	614	96.5	1781	95.0
Calcium	607	94.0	568	95.8	613	96.4	1788	95.4
Vitamin C	600	92.9	563	94.9	613	96.4	1776	94.7
Multivitamin	73	11.3	38	6.4	19	3.0	130	6.9
Food Supplementation (Thriposha)	256	39.6	171	28.8	136	21.4	563	30.0

Overall use of folic acid during the pre-pregnancy period was 58.7%, with the highest proportion observed in the rural (72.0%) sector followed by the estate sector (54.7%) and urban sector (50.3%).

The use of iron, folic acid, calcium and vitamin C during pregnancy at least 4-6 times a week was around 95% and the use of multivitamins was 6.9%. Food supplementation with Thriposha and use of it at least 4-6 times a week was 30.0% overall, with the highest proportion reported from the urban sector (39.6%) and the lowest from the estate sector (21.4%).

4.3.3 Maternal pre-pregnancy nutritional status

The maternal BMI at booking visit was approximated as the pre pregnancy BMI of mothers, which is described in the following table.

Table 11: Pre-pregnancy BMI of the mothers

Pre pregnancy BMI Category Kg/m^2	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
<18.5(underweight)	74	13.3	90	16.0	120	21.9	284	17.0
18.5-24.9 (normal)	225	40.5	271	48.0	333	60.7	829	49.7
25.0-29.9(overweight)	182	32.7	149	26.4	75	13.7	406	24.3
30 & higher (obese)	75	13.5	54	9.6	21	3.8	150	9.0
Total	**556**	**100.0**	**564**	**100.0**	**549**	**100.0**	**1669**	**100.0**

The results showed that in the estate sector, 60.7% of the mothers were of normal weight, while in the rural sector it was 48.0%, and in the urban sector it was 40.5%. Nearly 22% of the mothers were underweight in the estate sector, while underweight in the rural and urban sector was 16.0% and 13.3% respectively. In the urban sector, 13.5% of the mothers were obese, while another 32.7% were overweight prior to pregnancy. Overall, while 17% was underweight while 33.3% was either overweight or obese.

4.3.4. Gestational weight gain

The gestational weight gain was calculated by subtracting the weight at booking visit by the weight record closest to the delivery, as of the weight chart of pregnancy record for the singleton pregnancies.

Adequacy in weight gain during pregnancy was calculated according to the requirement for each pre-pregnancy weight category (FHB) according to the BMI. For underweight, the adequate weight gain was considered as 12.5kg to 18kg, in the normal BMI category the adequate weight gain was 11.5kg to 16kg, while for overweight category it was 7 kg to 11.5 kg and for those in the obese category the adequate weight gain was 5 kg to 9kg. The results are described below.

Table 12: Weight gain adequacy according to pre-pregnancy BMI categories and sector (n=1601 mothers of singleton babies, and BMI)

Adequacy of weight gain			Residential sector				
			Urban	Rural	Estate	Total	
			%	%	%	%	No.
Pre-pregnancy BMI category (kg/m^2)	Less than 18.5	Inadequate	60.3	67.8	82.6	72.2	195
		Adequate	36.8	28.7	13.9	24.4	66
		Excess	2.9	3.4	3.5	3.3	9
	18.5-24.9	Inadequate	70.6	69.0	70.9	70.2	560
		Adequate	20.6	23.1	25.6	23.4	187
		Excess	8.9	7.8	3.5	6.4	51
	25.0-29.9	Inadequate	45.5	45.9	56.0	47.6	191
		Adequate	35.4	36.5	34.7	35.7	143
		Excess	19.1	17.6	9.3	16.7	67
	>30 and higher	Inadequate	44.8	38.3	33.3	40.9	54
		Adequate	26.9	44.7	50.0	36.4	48
		Excess	28.4	17.0	16.7	22.7	30

According to the above table inadequate weight gain was highest (72.2%) in those with a pre-pregnancy BMI less than 18.5kg/m2. The inadequate weight gain was highest among mothers with BMI less than 18.5 5kg/m2 in the estate sector (82.6%).

4.3.5 Birth order, type and mode of delivery

The birth order of the index child, type of birth (singleton or twin), mode of delivery and reasons for caesarean sections performed are presented in the table below.

Table 13: Birth characteristic including the birth order, type, mode of delivery and the reason for caesarean delivery

Birth characteristics		Residential sector							
		Urban		Rural		Estate		Total	
		No.	%	No.	%	No.	%	No.	%
Birth order of this child (N=1875)	1st	317	49.1	225	37.9	254	39.9	796	42.5
	2nd	199	30.8	223	37.6	218	34.3	640	34.1
	3rd	99	15.3	121	20.4	122	19.2	342	18.2
	4th	23	3.6	24	4.0	36	5.7	83	4.4
	5th	5	0.8	0	0.0	4	0.6	9	0.5
	6th	3	0.5	0	0.0	2	0.3	5	0.3
Birth type (N=1868)	Singleton	639	98.9	590	99.5	632	99.4	1861	99.3
	Twins	4	0.6	1	0.2	2	0.3	7	0.4
Mode of delivery (N=1875)	Caesarean	254	39.3	189	31.9	199	31.3	642	34.2
	Vaginal	392	60.7	404	68.1	437	68.7	1233	65.8
Reason for caesarean delivery (N=642) *(*Multiple responses)*	Short mother	1	0.4	3	1.6	7	3.5	11	1.7
	Past Section	63	24.8	72	38.1	74	37.2	209	32.6
	Subfertility	7	2.8	7	3.7	0	0.0	14	2.2
	Maternal illness	24	9.4	11	5.8	24	12.1	59	9.2
	Failed	32	12	34	18.0	19	9.5	85	13.2
	Obstructed labour	31	12.2	23	12.2	18	9.0	72	11.2
	Multiple babies	1	0.4	1	0.5	1	0.5	3	0.5
	Baby's illness	5	2.0	9	4.8	26	13.1	40	6.2
	Requested by family	10	3.9	1	0.5	0	0.0	11	1.7
	Others	100	39.4	43	22.8	22	11.1	165	25.7
	No clear reason	2	0.8	2	1.1	14	7.0	18	2.8

The above table shows that 42.5% of the total sample was first born children. Of the total sample 34.2% of the mothers have had a caesarean delivery. The percentage is highest in the urban sector with 39.3% of the mother's delivery through a caesarean section. The reasons were inquired from the mother. The commonest reason was past caesarean section (32.6%).

4.4 Illness pattern of children since birth

The following tables (table 14 to 19) describe the illnesses of the index children at different age points reported by the mothers.

Table 14: Illness reported during ages 1-3 months according to sector

Illness during ages 1-3 months	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Cough, phlegm with or without fever	218	33.7	214	36.1	313	49.2	745	39.7
Fever only	50	7.7	55	9.3	75	11.8	180	9.6
Diarrhoea	22	3.4	12	2.0	39	6.1	73	3.9
Urinary tract infection	3	0.5	3	0.5	2	0.3	8	0.4
Any other illness	47	7.3	34	5.7	27	4.2	108	5.8

The commonest illness reported at the age of 1-3 months was respiratory symptoms (39.7%), followed by fever (9.6%). The estate sector reported the highest percentage of respiratory illness (49.2%), fever (11.8%), diarrhoea (6.1%) compared to other two sectors.

Table 15: illness reported during ages 4-6 months according to sector

Illness during ages 4-6 months	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Cough, phlegm with or without fever	300	46.4	301	50.8	376	59.1	977	52.1
Fever only	69	10.7	87	14.7	126	19.8	282	15.0
Diarrhoea	46	7.1	20	3.4	91	14.3	157	8.4
Urinary tract infection	3	0.5	7	1.2	2	0.3	12	0.6
Any other illness	22	3.4	17	2.9	18	2.8	57	3.0

The commonest illness reported at the age of 4-6 months also was respiratory symptoms (52.1%), followed by fever (15.0%) and diarrhoea (8.4%). The estate sector reported the highest percentage of respiratory illness (59.1%), fever (19.8%), diarrhoea (14.3%) compared to other two sectors. This same pattern seems to be continuing for all age groups as described in the tables below.

Table 16: Illness reported during ages 7-9 months according to sector

Illness during ages 7-9 months	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Cough, phlegm with or without fever	361	55.9	310	52.3	390	61.3	1061	56.6
Fever only	85	13.2	84	14.2	120	18.9	289	15.4
Diarrhoea	67	10.4	29	4.9	150	23.6	246	13.1
Urinary tract infection	2	0.3	5	0.8	3	0.5	10	0.5
Any other illness	37	5.7	30	5.1	18	2.8	85	4.5

Table 17: Illness reported during ages 10-12 months according to sector

Illness during ages 10-12 months	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Cough, phlegm with or without fever	340	52.6	292	49.2	412	64.8	1044	55.7
Fever only	100	15.5	85	14.3	122	19.2	307	16.4
Diarrhoea	62	9.6	24	4.0	106	16.7	192	10.2
Urinary tract infection	2	0.3	5	0.8	3	0.5	10	0.5
Any other illness	32	5.0	33	5.6	14	2.2	79	4.2

Table 18: Illness of children reported during ages 13-18 months according to sector

Illness during ages 13-18 months	Residential sector							
	Urban (N=569)		Rural (N=537)		Estate (N=625)		Total (N=1731)	
	No.	%	No.	%	No.	%	No.	%
Cough, phlegm with or without fever	268	47.1	229	42.6	366	58.6	863	49.9
Fever only	78	13.7	73	13.6	92	14.7	243	14.0
Diarrhoea	73	12.8	20	3.7	109	17.4	202	11.7
Urinary tract infection	3	0.5	2	0.4	1	0.2	6	0.3
Any other illness	48	8.4	25	4.7	21	3.4	94	5.4

Table 19: Illness of children reported during ages 19-24 months according to sector

Illness during ages 19-24 months	Residential sector							
	Urban (N=272)		Rural (N=255)		Estate (N=344)		Total (N=871)	
	No.	%	No.	%	No.	%	No.	%
Cough, phlegm with or without fever	91	33.5	71	27.8	114	33.1	276	31.7
Fever only	27	9.9	19	7.5	18	5.2	64	7.3
Diarrhoea	14	5.1	6	2.4	23	6.7	43	4.9
Urinary tract infection	2	0.7	1	0.4	1	0.3	4	0.5
Any other illness	13	4.8	7	2.7	4	1.2	24	2.8

Overall, highest percentage of children with respiratory symptoms was reported at the age of 7-9 months (56.6%), followed by 10-12 months (55.7%). Similarly the highest percentage of children with diarrhoea was reported at the age of 7-9 months (13.1%).

4.5 Birth weight and associated factors

Table 20: Prevalence of low birth weight and average birth weight among the study participants according to sector

Birth weight	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Less than 2500g	56	8.7	56	9.5	132	20.8	244	13.0
2500g or 3499g	521	80.7	481	81.1	484	76.1	1486	79.3
3500g or above	69	10.7	56	9.4	20	3.1	145	7.7
Average birth weight (in grams)								
Mean	2995		2988		2771		2917	
SD	392		408		378		406	
Standard Error	15		17		15		9	

* *The sample comprised of babies born at a POA of 37 weeks or later*

The above table indicates that prevalence of low birth weight was highest in the estate sector (20.8%) followed by the rural sector (9.5%) and urban Sector (8.7%). The overall prevalence of LBW was 13.0%. The mean birth weight was lowest in the estate sector,

which is 2771 grams, while the respective values for urban and rural sectors are 2995g and 2988g respectively. Proportion of new-borns with birth weight of 3500g or above was higher in urban (10.7%) and rural (9.4%) sectors than in the estate (3.1%).

4.5.1 Factors associated with low birth weight

Table 21: Association between pre-pregnancy BMI category and birth weight

Pre-pregnancy BMI category kg/m²	Birth Weight category			Total	Statistical significance
	Less than 2500g	2500g to 3499g	3500g or more		
<18.5 (underweight)	54 (19.3)	216 (77.1)	10 (3.6)	280	**Chi Square = 42.042[a] Df =6 P<0.001**
18.5-24.9 (normal)	107 (12.7)	679 (80.7)	55 (6.5)	841	
25-29.9 (overweight)	31 (7.5)	337 (81.6)	45 (10.9)	413	
>=30 (obese)	18 (12.7)	103 (72.5)	21 (14.8)	142	
Total	**210 (12.5)**	**1335 (79.7)**	**131 (7.8)**	**1676**	

The above table shows that the highest proportion of low birth weight was seen among those who were underweight (19.3%), and the proportion of babies with birth weight of 3500g or more is highest among those who were obese (14.8%). This difference was statistically significant at P<0.001.

Table 22: Association between adequacy of weight gain during pregnancy and birth weight

Adequacy of Weight gain	Birth Weight category			Total	Statistical significance
	Less than 2500g	2500g to 3499g	3500g or more		
Inadequate	160 (16.0)	787 (78.5)	55 (5.5%)	1002	**Chi square =50.755[a] Df= 4 P<0.001**
Adequate	38 (8.5)	365 (81.8)	43 (9.6)	446	
Excess	5 (3.2)	126 (80.3)	26 (16.6)	157	
Total	**203** (12.6)	**1278 (79.6)**	**124 (7.7)**	**1605**	

The above table shows that the highest proportion of low birth weight was seen among those who had inadequate weight gain (16.0%), and the proportion of babies with birth weight of 3500g or more is highest among those who had excess weight gain (16.6%). This association was statistically significant at p<0.001. The proportion of low birth weight reduced with increase in the gestational age at delivery and this association was statistically significant.

4.6 Feeding practices

4.6.1 Breastfeeding indicators

Table 23: Breastfeeding status of children less than 24 months of age according to sector

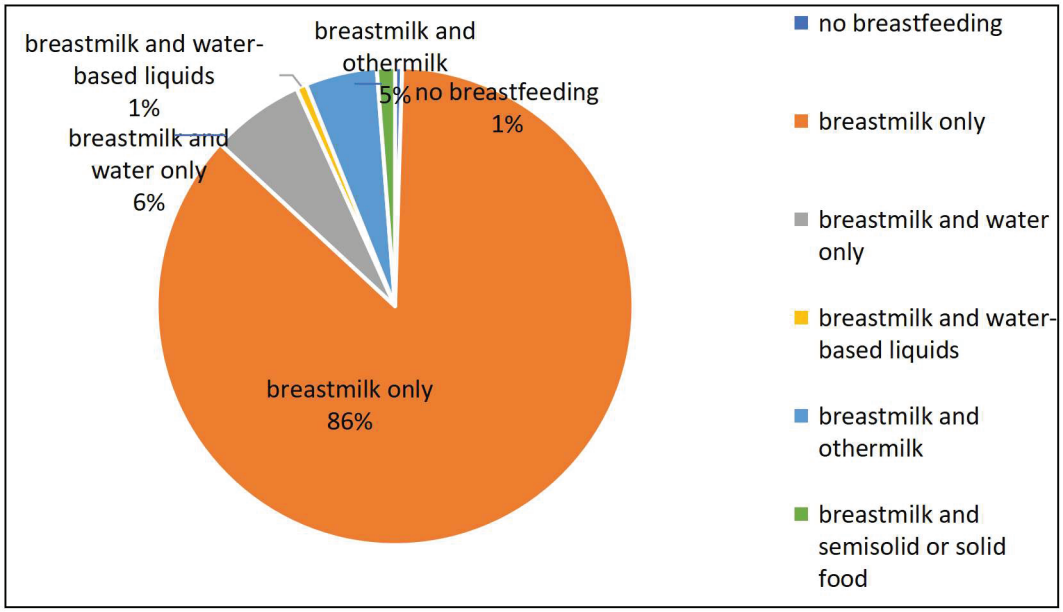
Breast feeding status	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Ever breastfed	645	99.8	592	99.8	634	99.7	1871	99.8
Early Initiation of Breastfeeding	641	99.4	592	100.0	632	99.7	1865	99.7
Exclusively breastfed for the first 2 days	588	91.0	536	90.4	551	86.6	1675	89.3
Exclusively breastfed during 4th month	569	88.1	529	89.2	522	82.1	1620	86.4
Exclusively breastfed during 6th month	379	58.7	372	62.7	361	56.8	1112	59.3
Mix milk feeding rate during 4th month	41	6.3	26	4.4	27	4.2	94	5.0
Mix milk feeding rate during 6th month	62	9.6	34	5.7	48	7.5	144	7.7
Continued breastfeeding 12-23 months	543	90.5	486	90.5	506	90.7	1535	90.6

4th month = 3.0-3.9 months; 6th month = 5.0-5.9 months

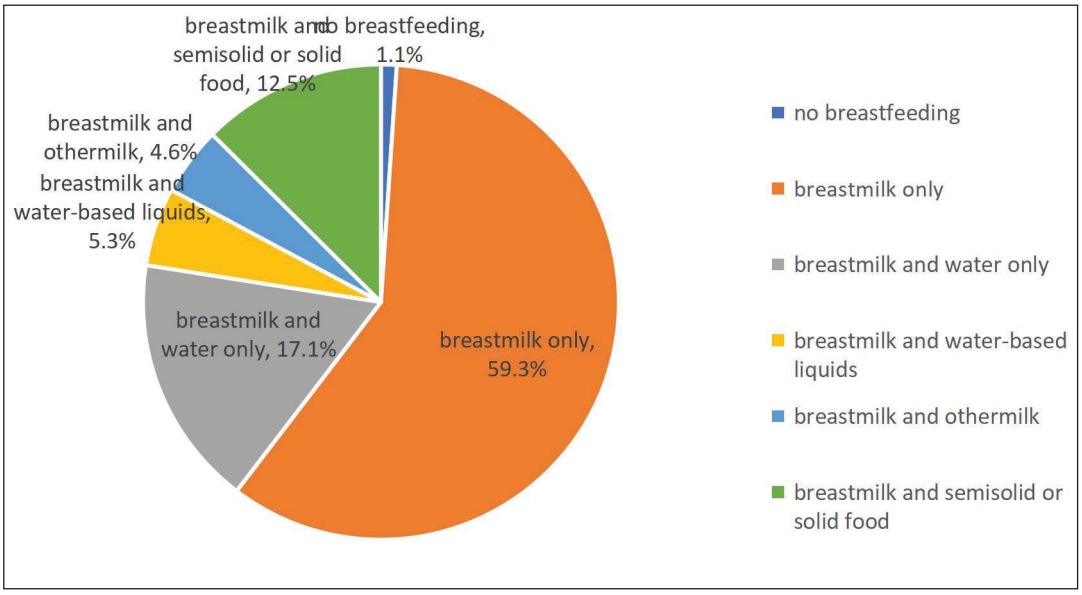
The proportion ever breast-fed was 99.8% as seen in the Table. Further, 99.7% of the infants have had early initiation of breastfeeding within 1 hour of birth. Exclusive breastfeeding during the first 2 days after birth was 89.3%. Nearly 60% of the children were exclusively breastfed during the 6th month of life and continuation of breast-feeding in the second year was seen among 90.6% of the children.

Figure 4: Feeding pattern of children during the 4th and 6th months of life

Feeding pattern during the 4th month



Feeding pattern during the 6th month



4th month = 3.0-3.9 months; 6th month = 5.0-5.9 months

The figure above shows the feeding pattern at 4 and 6 months respectively

4.6.2 Type of liquids given at different age points

Table 24: Liquids given at 3 months of age according to sector

Type of liquid	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Water	41	6.3	39	6.6	92	14.5	172	9.2
Powdered milk	45	7.0	28	4.7	30	4.7	103	5.5
Fresh milk	0	0.0	1	0.2	0	0.0	1	0.1
Kanji	2	0.3	0	0.0	11	1.7	13	0.7
Fruit juice	9	1.4	4	0.7	7	1.1	20	1.1
Malted milk	0	0.0	0	0.0	1	0.2	1	0.1
Sodas, colas etc.	0	0.0	0	0.0	0	0.0	0	0.0

3rd month=2.0-2.9 months of age

The table shows that, at 3 months, 9.2% of the infants have received water and 5.5% have received milk powder (infant formulae).

Table 25: Liquids given at 4 months of age according to sector

Type of liquid	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Water	115	17.8	109	18.4	180	28.3	404	21.5
Powdered milk	63	9.8	37	6.2	46	7.2	146	7.8
Fresh milk	4	0.6	3	0.5	1	0.2	8	0.4
Kanji	22	3.4	9	1.5	11	1.7	42	2.2
Fruit juice	43	6.7	22	3.7	23	3.6	88	4.7
Malted milk	0	0.0	2	0.3	1	0.2	3	0.2
Sodas, colas etc.	0	0.0	0	0.0	1	0.2	1	0.1

4th month=3.0-3.9 months of age

During the 4th month of life, 21.5% of the infants have received water and 7.8% have received powdered milk (infant formulae). Fruit juice was given to 4.7% of the infants.

Table 26: Liquids given at 5 months of age according to sector

Type of liquid	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Water	231	35.8	193	32.5	231	36.3	655	34.9
Powdered milk	74	11.5	41	6.9	53	8.3	168	9.0
Fresh milk	4	0.6	1	0.2	2	0.3	7	0.4
Kanji.	53	8.2	14	2.4	19	3.0	86	4.6
Fruit juice.	107	16.6	66	11.1	44	6.9	217	11.6
Malted milk	0	0.0	2	0.3	2	0.3	4	0.2
Sodas, colas etc	0	0.0	0	0.0	1	0.2	1	0.1

5th month=4.0-4.9 months of age

During the 5th month of life, 34.9% of the infants have received water and 9.0% have received powdered milk (infant formulae). Fruit juice was given to 11.6% of the infants.

Table 27: Liquids given at 6 months of age according to sector

Type of liquid	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Water	604	93.5	522	88.0	566	89.0	1692	90.2
Powdered milk	101	15.6	60	10.1	123	19.3	284	15.1
Fresh milk	43	6.7	29	4.9	39	6.1	111	5.9
Kanji.	149	23.1	63	10.6	66	10.4	278	14.8
Fruit juice.	468	72.4	356	60.0	254	39.9	1078	57.5
Malted milk	4	0.6	7	1.2	15	2.4	26	1.4
Sodas, colas etc	1	0.2	2	0.3	6	0.9	9	0.5

6th month=5.0-5.9 months of age

During the 6th month of life, 90.2% of the infants have received water and 15.1% have received powdered milk (infant formulae). Fruit juice was given to 57.5% of the infants. Kanji was given to 14.8% of the children.

4.6.3 Type of semi-solid and solid food given at different age points

Semisolid and solid food items that were given to the children are described below. The consumption of the broad group of food items was marked as consumed if it was ever given during the time period through a recall.

Table 28: Semisolid or solid food given during 4th month of life according to sector

Type of semi-solid and solid food	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Grains, roots, tubers	16	2.5	8	1.3	20	3.1	44	2.3
Yellow vegetables[a]	14	2.2	7	1.2	12	1.9	33	1.8
Other vegetables[b]	11	1.7	6	1.0	6	0.9	23	1.2
Dark Green Leafy vegetables[a]	7	1.1	7	1.2	6	0.9	20	1.1
Yellow fruits[a]	17	2.6	8	1.3	11	1.7	36	1.9
Other fruits[b]	11	1.7	6	1.0	7	1.1	24	1.3
Pulses, nuts and seeds	7	1.1	6	1.0	7	1.1	20	1.1
Dairy products (yogurt, cheese, curd etc.)	8	1.2	4	0.7	8	1.3	20	1.1
Flesh foods (meat, fish, poultry, organ meats)	4	0.6	3	0.5	1	0.2	8	0.4
Eggs	0	0.0	5	0.8	2	0.3	7	0.4

4th month=3.0-3.9 months of age

[a] Vitamin A rich fruits and vegetables

[b] other fruits and vegetables

The above table shows the diverse food items given to the child at 4 months. Starch-based items were given to 2.3% of the infants and 1.8% have received yellow vegetables. Around 1.1% to 1.9% of the infants have received yellow fruits, other fruits, other vegetables, dark green vegetables and legumes. Meat and fish have been given to 0.4% of the infants and milk and its products given to 1.1%. Eggs have been given 0.4% of the infants.

Table 29: Semisolid or solid food given during 5th month of life according to sector

Type of semi-solid and solid food	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Grains, roots, tubers	47	7.3	31	5.2	45	7.1	123	6.6
Yellow vegetables[a]	45	7.0	27	4.6	28	4.4	100	5.3
Other vegetables[b]	31	4.8	20	3.4	11	1.7	62	3.3
Dark green leafy vegetables[a]	29	4.5	21	3.5	12	1.9	62	3.3
Yellow fruits[a]	58	9.0	31	5.2	22	3.5	111	5.9
Other fruits[b]	45	7.0	24	4.0	15	2.4	84	4.5
Pulses, nuts and seeds	29	4.5	20	3.4	16	2.5	65	3.5
Dairy products (yogurt, cheese, curd etc)	15	2.3	14	2.4	15	2.4	44	2.3
Flesh foods (meat, fish, poultry, organ meats)	16	2.5	10	1.7	4	0.6	30	1.6
Eggs	7	1.1	10	1.7	8	1.3	25	1.3

5th month=4.0-4.9 months of age

[a] Vitamin A rich fruits and vegetables

[b] other fruits and vegetables

The above table shows the diverse food items given to the child at 5 months. Starch-based items was given to 6.6% of the infants and 5.3% have received yellow vegetables. Around 3-6% of the infants have received yellow fruits, other fruits, other vegetables, dark green vegetables and legumes. Meat and fish have been given to 1.6% of the infants and milk and its products given to 2.3%. Eggs have been given 1.3% of the infants.

Table 30: Semisolid or solid food given during 6th month of life according to sector

Type of semi-solid and solid food	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Grains, roots, tubers	414	64.1	424	71.5	493	77.5	1331	71.0
Yellow vegetables[a]	408	63.2	380	64.1	405	63.7	1193	63.6
Other vegetables[b]	317	49.1	279	47.0	231	36.3	827	44.1
Dark green leafy vegetables[a]	292	45.2	318	53.6	258	40.6	868	46.3
Yellow fruits[a]	350	54.2	269	45.4	229	36.0	848	45.2
Other fruits[b]	314	48.6	248	41.8	193	30.3	755	40.3
Pulses, nuts and seeds	325	50.3	243	41.0	259	40.7	827	44.1
Dairy products (yogurt, cheese, curd etc)	182	28.2	167	28.2	142	22.3	491	26.2
flesh foods (meat, fish, poultry, organ meats)	242	37.5	186	31.4	138	21.7	566	30.2
Eggs	130	20.1	160	27.0	156	24.5	446	23.8

6th month=5.0-5.9 months of age

\a Vitamin A rich fruits and vegetables

b other fruits and vegetables

Table 31: Semisolid or solid food given during 7th month of life according to sector

Type of semi-solid and solid food	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Grains, roots, tubers	445	80.2	501	88.5	499	90.7	1445	86.5
Yellow vegetables[a]	460	82.9	472	83.4	447	81.3	1379	82.5
Other vegetables[b]	367	66.1	365	64.5	280	50.9	1012	60.6
Dark green leafy vegetables[a]	341	61.4	412	72.8	305	55.5	1058	63.3
Yellow fruits[a]	412	74.2	361	63.8	307	55.8	1080	64.6
Other fruits[b]	394	71.0	337	59.5	263	47.8	994	59.5
Pulses, nuts and seeds	388	69.9	346	61.1	313	56.9	1047	62.7
Dairy products (yogurt, cheese, curd etc)	256	46.1	267	47.2	187	34.0	710	42.5
flesh foods (meat, fish, poultry, organ meats)	304	54.8	307	54.2	207	37.6	818	49.0
Eggs	217	39.1	279	49.3	223	40.5	719	43.0

7th month=6.0-6.9 months of age

[a] Vitamin A rich fruits and vegetables

b other fruits and vegetables

Table 32: Semisolid or solid food given during 8th month of life according to sector

Type of semi-solid and solid food	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Grains, roots, tubers	508	91.5	525	92.8	524	95.3	1557	93.2
Yellow vegetables[a]	521	93.9	525	92.8	503	91.5	1549	92.7
Other vegetables[b]	448	80.7	421	74.4	365	66.4	1234	73.8
Dark green leafy vegetables[a]	428	77.1	454	80.2	376	68.4	1258	75.3
Yellow fruits[a]	480	86.5	429	75.8	378	68.7	1287	77.0
Other fruits[b]	469	84.5	400	70.7	348	63.3	1217	72.8
Pulses, nuts and seeds	455	82.0	416	73.5	366	66.5	1237	74.0
Dairy products (yogurt, cheese, curd etc)	383	69.0	371	65.5	252	45.8	1006	60.2
flesh foods (meat, fish, poultry, organ meats)	391	70.5	394	69.6	270	49.1	1055	63.1
Eggs	354	63.8	368	65.0	303	55.1	1025	61.3

8th month=7.0-7.9 months of age

[a] Vitamin A rich fruits and vegetables

[b] other fruits and vegetables

Tables 30, 31 and 32 shows the semisolid or solid food given during 6th, 7th and 8th month of life according to sector. There has been a gradual increase in the consumption of individual food items. At 8 months around 93% of the children have received starch-based food and yellow vegetables. Around 73-77% of the infants have received yellow fruits, other fruits, other vegetables, dark green vegetables and legumes. Meat and fish have been given to 63.1% of the infants and milk and its products given to 60.2%. Eggs have been given 61.3% of the infants.

4.6.4 Minimum Dietary Diversity

Table 33: Minimum dietary diversity, from 6,7,8,9,12 and 15 months, by sector (5 out of 8 food groups)

Minimum dietary diversity in different months	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
At 6 months (N=1875)	327	50.6	271	45.7	274	43.1	872	46.5
At 7 months (N=1875)	488	75.5	450	75.9	418	65.7	1356	72.3
At 8 months (N=1875)	580	89.8	521	87.9	505	79.4	1606	85.7
At 9 months (N=1854)	603	94.8	555	94.5	552	87.5	1710	92.2
At 12 months (N=1827)	621	100.0	573	99.7	623	98.7	1817	99.5
At 15 months (N=1262)	424	100.0	383	99.7	452	99.6	1259	99.8

The minimum dietary diversity is defined as receiving at least 5 food items out of the 8 food groups (WHO & UNICEF 2021). These groups are;

1. Breast milk
2. Grains, roots, tubers and plantains
3. Pulses (beans, peas, lentils), nuts and seeds
4. Dairy products (milk, infant formula, yogurt, cheese)
5. Flesh foods (meat, fish, poultry, organ meats)
6. eEggs
7. Vitamin-A rich fruits and vegetables
8. Other fruits and vegetables

The results showed that at 6 months the diversity was 46.5% and gradually increased to 99.5% at 12 months of age.

4.6.4 Minimum Meal Frequency

Table 34: Minimum meal frequency at 7, 9, and 12 months by sector

Minimum Meal Frequency	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
At 7 months (N=1867)	621	97.0	579	97.8	602	94.8	1802	96.5
At 9 months (N=1874)	583	90.4	552	93.1	563	88.5	1698	90.6
At 12 months (N=1871)	616	95.5	571	96.8	613	96.4	1800	96.2

**7 months = at least 2 meals per day*

** 9-23 months = at least 3 main meals per day for the breastfed; 4 main meals a day for the non-breastfed*

The minimum meal frequency was calculated considering at least 2 main meals a day until 8 months and minimum of 3 main meals per day for breastfed children and minimum of 4 main meals a day for non-breast-fed children. At 12 months of age 96.2% had a minimum meal frequency.

4.6.5 Consumption of sweets and biscuits

Sweets (chocolates, candies, toffees, lollipops, pebbles, ice cream, popsicles, and cakes) and biscuits that were given to the children are described below. The consumption of the broad group of food items was marked as consumed if it was ever given during the time period through a recall.

Table 35: Consumption of sweets from 4 months to 24 months according to sector

Ages in month in which sweets was given	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
At 4 month (N=1875)	0	0.0	0	0.0	3	0.5	3	0.2
At 5 month (N=1875)	1	0.2	0	0.0	9	1.4	10	0.5
At 6 month (N=1875)	13	2.0	15	2.5	54	8.5	82	4.4
At 7 month (N=1875)	33	5.1	30	5.1	75	11.8	138	7.4
At 8 month (N=1875)	82	12.7	68	11.5	115	18.1	265	14.1
At 9 month (N=1875)	119	18.4	111	18.7	154	24.2	384	20.5
At 10 month (N=1875)	162	25.1	141	23.8	173	27.2	476	25.4
At 11 month	182	28.2	154	26.0	176	27.7	512	27.3
At 12 month	433	68.6	372	64.1	418	65.7	1223	66.2
At 13 month *	435	76.4	413	76.9	448	71.7	1296	74.9
At 14 month *	391	77.7	380	78.5	416	71.5	1187	75.7
At 15 month *	368	80.9	341	79.9	395	74.2	1104	78.1
At 16 month *	335	81.9	312	80.0	363	73.9	1010	78.3
At 17 month *	308	83.5	276	79.8	317	72.7	901	78.3
At 18 month *	296	94.3	258	86.9	317	83.2	871	87.8
At 19 month *	258	94.9	227	89.0	291	84.6	776	89.1
At 20 month *	212	96.4	184	88.5	239	84.2	635	89.2
At 21 month *	177	96.2	143	89.4	200	86.6	520	90.4
At 22 month *	133	95.0	124	91.2	157	85.3	414	90.0
At 23 month *	76	91.6	89	91.8	113	86.9	278	89.7
At 24 month *	31	100.0	41	95.3	71	91.0	143	94.1

**The values for the sections above the age of 12 months are calculated for the number of children available within that age group in the cohort*

The above table shows that at 6 months, 12 months and 18 months, the consumption of sweets was 4.4%, 66.2% and 87.8% respectively.

Table 36: Consumption of biscuits from 4 months to 24 months according to sector

Ages in month in which biscuits was given	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
At 4 month (N=1875)	4	0.6	4	0.7	16	2.5	24	1.3
At 5 month (N=1875)	13	2.0	6	1.0	28	4.4	47	2.5
At 6 month (N=1875)	124	19.2	84	14.2	161	25.3	369	19.7
At 7 month (N=1875)	190	29.4	130	21.9	221	34.7	541	28.9
At 8 month (N=1875)	261	40.4	181	30.5	283	44.5	725	38.7
At 9 month (N=1875)	309	47.8	226	38.1	332	52.2	867	46.2
At 10 month (N=1875)	347	53.7	264	44.5	356	56.0	967	51.6
At 11 month *	369	57.1	278	46.9	364	57.2	1011	53.9
At 12 month *	521	82.6	431	74.3	515	81.0	1467	79.4
At 13 month *	496	87.2	446	83.1	532	85.1	1474	85.2
At 14 month *	437	86.9	408	84.3	496	85.2	1341	85.5
At 15 month *	401	88.1	365	85.5	459	86.3	1225	86.6
At 16 month *	362	88.5	335	85.9	428	87.2	1125	87.2
At 17 month *	325	88.1	296	85.5	378	86.7	999	86.8
At 18 month *	295	93.9	270	90.9	346	90.8	911	91.8
At 19 month *	257	94.5	233	91.4	313	91.0	803	92.2
At 20 month *	209	95.0	190	91.3	254	89.4	653	91.7
At 21 month *	176	95.7	145	90.6	207	89.6	528	91.8
At 22 month *	134	95.7	123	90.4	165	89.7	422	91.7
At 23 month *	81	97.6	91	93.8	118	90.8	290	93.5
At 24 month *	31	100.0	42	97.7	71	91.0	144	94.7

** The values for the sections above the age of 12 months are calculated for the numbers within that age group*

The above table shows that at 6 months, 12 months and 18 months, the consumption of biscuits was 19.7%, 79.4% and 91.8% respectively.

4.6.6 Feeding behaviour after commencement of complementary feeding

Table 37: Changes in breastfeeding after establishment of complementary feeding

Change in breastfeeding pattern or practice	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Breastfeeding in relation to main meals after introducing semi solids and solid food								
Breast feeds are usually given just before meals	87	13.5	62	10.5	50	7.9	199	10.6
Breast feeds are usually given soon after meals	434	67.2	356	60.0	201	31.6	991	52.9
Breastfeeds are given in-between meals	105	16.3	163	27.5	363	57.1	631	33.7
No Breast feeding	31	4.8	22	3.8	34	5.3	87	4.6
Pattern of breastfeeding after introduction of semisolid and solid food								
Reduced the number of times of breastfeeding	465	72.0	481	81.1	555	87.3	1501	80.1
Breastfed as a soothing method of baby	417	64.6	370	62.4	307	48.3	1094	58.3
Breastfed to make baby sleep	504	78.0	468	78.9	501	78.8	1473	78.6
Breastfed during free times of mother (eg after return from work)	96	14.9	90	15.2	180	28.3	366	19.5
Breastfeeding limited to night time	74	11.5	55	9.3	72	11.3	201	10.7
Continued on breastfeeding every time baby demanded	463	71.7	381	64.2	440	69.2	1284	68.5
Breastfed when baby didn't take a adequate meal	370	57.3	301	50.8	375	59.0	1046	55.8

After establishing feeding of semi solid or solid food, majority has breastfed the child soon after meals (52.9%), while 10.6% reported to have breastfed before the main meal. After introducing semisolid or solid food items 80.1% reported having reduced the number of times of breastfeeding. Further, 78.6 % reported that they breastfed to put the baby to sleep and 58.9% had breastfed as a soothing method for the baby.

4.6.7. Responsive feeding and feeding habits

Table 38: Responsive feeding and other feeding behaviour according to sector

Positive feeding practices		Residential sector							
		Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
		No.	%	No.	%	No.	%	No.	%
Maintain a regular meal time to feed your child	Never, rarely or sometimes	186	28.8	195	32.9	127	20.0	508	27.1
	Often or always	460	71.2	398	67.1	509	80.0	1367	72.9
Feed your child after recognizing that she/he is hungry	Never, rarely or sometimes	237	36.7	252	42.5	281	44.2	770	41.1
	Often or always	409	63.3	341	57.5	355	55.8	1105	58.9
Allow or assist your child to eat by herself/himself	Never, rarely or sometimes	327	50.6	310	52.3	289	45.4	926	49.4
	Often or always	319	49.4	283	47.7	347	54.6	949	50.6
Talk to the child lovingly to encourage feeding	Never, rarely or sometimes	100	15.5	95	16.0	47	7.4	242	12.9
	Often or always	546	84.5	498	84.0	589	92.6	1633	87.1
Keep a fixed place for eating	Never, rarely or sometimes	341	52.8	412	69.5	451	70.9	1204	64.2
	Often or always	305	47.2	181	30.5	185	29.1	671	35.8

The results show that 72.9% of parents maintain a regular mealtime to feed, 58.9% feed child after recognizing that the child is hungry, 50.6% allow or assist the child to eat by herself/himself, 87.1% talks to the child lovingly (saying good baby etc.) to encourage feeding, and 35.8% keep a fixed place for eating.

Table 39: Negative feeding and other feeding behaviour according to sector

Negative Feeding practices		Residential sector							
		Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
		No.	%	No.	%	No.	%	No.	%
Feed your child against his/her will when she/he refuses to eat	Never, rarely or sometimes	531	82.2	477	80.4	505	79.4	1513	80.7
	Often or always	115	17.8	116	19.6	131	20.6	362	19.3
Talk to your child harshly (scaring, blaming) to encourage feeding	Never, rarely or sometimes	608	94.1	567	95.6	604	95.0	1779	94.9
	Often or always	38	5.9	26	4.4	32	5.0	96	5.1
Feed your child by showing objects such as television, mobile phones	Never, rarely or sometimes	561	86.8	563	94.9	573	90.1	1697	90.5
	Often or always	85	13.2	30	5.1	63	9.9	178	9.5
Feed your child by showing animals or surrounding environment	Never, rarely or sometimes	287	44.4	222	37.4	179	28.1	688	36.7
	Often or always	359	55.6	371	62.6	457	71.9	1187	63.3
Feed your child while running behind him/her	Never, rarely or sometimes	419	64.9	362	61.0	317	49.8	1098	58.6
	Often or always	227	35.1	231	39.0	319	50.2	777	41.4

It was seen that 19.3% of the parent feed the child against the wishes of the child, and 5.1% talks to the child harshly (scaring or blaming) during feeding. Feeding the child by showing objects such as mobile phones and television was reported by 9.5% of the families and 63.3% would feed the child by showing the surrounding environment or animals. Forty-one-point one percent of the families reported that the caregivers would feed the child by running behind the child.

4.7. Growth faltering

4.7.1 Proportion of children with growth faltering

Growth faltering was assessed at each month from the weight measurements recorded in the B portion of the CHDR. A drop of WAZ of more than 0.25 from birth Z score was considered as growth faltering as described in section 3.4.3 in methodology.

Table 40: Proportion of children with growth faltering based on WAZ deviation from birth trajectory

Growth faltering at different time periods	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
Growth faltering at 1 month	223	45.0	164	36.1	206	46.0	593	42.4
Growth faltering at 2 months	238	47.0	206	40.6	233	49.4	677	45.6
Growth faltering at 3 month	191	46.2	205	39.4	219	46.3	615	43.7
Growth faltering at 4 month	242	45.6	194	36.8	203	42.1	639	41.5
Growth faltering at 5 month	220	48.2	189	34.9	198	41.0	607	41.0
Growth faltering at 6 month	229	44.4	183	33.8	186	39.5	598	39.1
Growth faltering at 7 month	208	46.1	193	35.5	176	36.1	577	39.0
Growth faltering at 8 month	175	40.0	197	36.1%	185	36.9	557	37.5
Growth faltering at 9 month	207	41.2	195	35.9	190	37.5	592	38.1
Growth faltering at 10 month	188	41.4	211	38.6	196	39.2	595	39.7
Growth faltering at 11 month	196	45.1	231	42.3	209	42.3	636	43.1
Growth faltering at 12 month	197	44.7	236	44.0	232	46.0	665	44.9
Growth faltering at 13 month	164	43.7	215	44.1	199	41.9	578	43.2
Growth faltering at 14 month	149	50.2	205	46.5	184	41.3	538	45.4
Growth faltering at 15 month	124	47.1	184	47.3	180	44.4	488	46.2
Growth faltering at present	346	53.6	298	50.7	300	47.2	944	50.5

The above table shows that the proportion of growth faltering at first month based on the drop in WAZ, was 42.4%. In the 2nd month the total proportion of children with growth faltering was 45.6%. Within the first 6 months the highest proportion of growth faltering was observed in the 2nd month.

Between 6 months to one year the highest proportion was seen at 12 months (44.9%), and the highest contribution to this is from the estate sector, where 46.0% of children show growth faltering followed by urban (44.7%) and rural (44.0%) sectors. Out of all children aged 12-24 months, half (50.5%) has growth faltering currently when compared with their birth WAZ.

4.7.2 Age of onset of growth faltering

Age of onset of growth faltering according to WAZ deviation from the birth is presented below.

Table 41: Age of onset of growth faltering (in months) by sector

Residential sector	Parameter (in months)							
	Mean	Minimum	Median	Maximum	Percentile 25	Percentile 75	Standard Deviation	Total N
Urban	2.93	1.00	2.00	15.00	1.00	3.00	3.06	646
Rural	3.48	1.00	2.00	15.00	1.00	4.00	3.60	593
Estate	3.15	1.00	2.00	15.00	1.00	4.00	3.16	636
Total	3.18	1.00	2.00	15.00	1.00	4.00	3.28	1875

Based on the first time point of WAZ deviation of >0.25, average age was calculated in months and summarized according to the sector. On average, onset of growth faltering was detected around 3 months, with some variation across sectors. It occurs earlier in urban children (2.93 months) in contrast to estates (3.15 months) and rural sectors (3.48 months).

4.8 Current nutritional status of the child

The study team measured the current weight and length of the children and the following analysis is based on this primary data.

Table 42: Anthropometric status (Wasting, Stunting and Underweight) of children by Sector

Anthropometric status		Residential sector							
		Urban		Rural		Estate		Total	
		No.	%	No.	%	No.	%	No.	%
Weight for age	Severe underweight	16	2.5	13	2.2	16	2.5	45	2.4
	Moderate underweight	77	11.9	74	12.5	138	21.7	289	15.4
	Underweight	**93**	**14.4**	**87**	**14.7**	**154**	**24.2**	**334**	**17.8**
	Normal	551	85.3	499	84.6	482	75.8	1532	81.8
	Overweight	2	0.3	4	0.7	0	0.0	6	0.3
	Total	646	100.0	590	100.0	636	100.0	1872	100.0
Height for age	Severe stunting	11	1.7	9	1.5	26	4.1	46	2.5
	Moderate stunting	52	8.1	43	7.3	155	24.4	250	13.4
	Stunting	**63**	**9.8**	**52**	**8.8**	**181**	**28.5**	**296**	**15.8**
	Normal	582	90.2	541	91.2	453	71.5	1576	84.2
	Total	645	100.0	593	100.0	634	100.0	1872	100.0
Weight for height	SAM	18	2.8	10	1.7	9	1.4	37	2.0
	MAM	74	11.5	75	12.7	69	10.9	218	11.7
	Wasting	**92**	**14.3**	**85**	**14.4**	**78**	**12.3**	**255**	**13.7**
	Normal	547	84.9	501	84.9	553	87.2	1601	85.7
	Overweight	5	0.8	4	0.7	3	0.5	12	0.6
	Total	644	100.0	590	100.0	634	100.0	1868	100.0

The above shows that the overall prevalence of underweight was 17.8% with the highest proportion observed in the estate sector (24.2%). The overall prevalence of stunting was 15.8% with the highest observed from the estate sector which is 28.5%. The overall prevalence of wasting was 13.7%, the highest proportion observed in the urban sector (14.3%). The determinants of these anthropometric indicators are presented in Section 4.11 of this report.

4.9 Supplementation to Child

Table 43: Vitamin A and Multiple Micro Nutrient (MMN) supplementation according to sector

Supplementation to the child		Residential sector							
		Urban		Rural		Estate		Total	
		No.	%	No.	%	No.	%	No.	%
Vitamin A	6 months (N=1875)	566	87.6	552	93.1	623	98.0	1741	92.9
	12 months (N=1875)	501	77.6	527	88.9	609	95.8	1637	87.3
	18 months (N=974)	226	72.0	244	80.8	307	85.8	777	79.8
MMN	6 months (N=1875)	305	47.2	300	50.6	200	31.4	805	42.9
	12 months (N=1875)	330	51.1	341	57.5	219	34.4	890	47.5
	18 months (N=974)	162	51.6	140	46.4	103	28.8	405	41.6

The overall proportion of children who received vitamin A supplementation at 6 months, 12 months and 18 months showed a reducing trend with proportions being 92.9%, 87.3% and 79.8 % respectively. The children who received MMN were comparatively low. The proportion of children who received MMN at 6, 12, and 18 months was 42.9%, 47.5% and 41.6% respectively.

Table 44: Food supplementation given to the child by sector

Other supplementation to the reference child		Residential sector							
		Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
		No.	%	No.	%	No.	%	No.	%
Thriposha during the past one year (N=1875)	Ever received	177	27.40	203	34.20	274	43.10	654	34.90
	Not received	469	72.60	390	65.80	362	56.90	1221	65.10
Other cereal based food supplements (N=1875)	No	160	24.80	132	22.30	236	37.10	528	28.20
	Yes	486	75.20	461	77.70	400	62.90	1347	71.80

* Correct denominator for Thriposha recipients has not been considered in this table due to complexity of data

Thriposha was ever received at least in some months by 34.9% of the children. This proportion was highest in the estate sector (43.1%) followed by the rural sector (34.2%) and the urban sector (27.4%). The analysis was carried out as ever received or not because the supply of Thriposha was not regular during the past 2 years and the guidelines for issuing Thriposha changed during this period. These results are for children born during September 2021 to October 2022.

4.10 Welfare programs (governmental and non-governmental) that children were exposed to

Table 45: Welfare programs children were exposed by sector

Welfare Programmes *(*Multiple responses)*	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Samurdhi / Aswesuma	74	11.5	149	25.1	97	15.3	320	17.1
Food basket / voucher during pregnancy	476	73.7	439	74.0	425	66.8	1340	71.5
Food aids (other than Thriposha) during pregnancy/lactating period	61	9.4	47	7.9	24	3.8	132	7.0
Vouchers and cash donations to purchase food items (Eg: UNICEF / WFP)	121	18.7	150	25.3	323	50.8	594	31.7
State funded Rs 5000 during the crisis period	212	32.8	133	22.4	96	15.1	441	23.5
Any other cash donations for food from charity organizations	16	2.5	17	2.9	6	0.9	39	2.1
Any other in-kind donations from charity organizations	42	6.5	34	5.7	4	0.6	80	4.3

It is observed that 17.1% of the families are beneficiaries of Samurdhi or Aswesuma programme. Food basket during pregnancy was received by 71.5% of the mothers and 7.0% of the mothers have received food aid during pregnancy /lactating period.

4.11 Use of CHDR by parents and healthcare staff as mentioned by the parents

4.11.1 Weight and height recoding in the CHDR B portion

Table 46: Frequency of weight and length recording in the CHDR B portion during the first to 6th months of age of the child, by sector (n=1875)

Number of times weight and length were recorded in B Portion of CHDR	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
Weight recordings 1-6 months								
None	5	0.8	6	1.0	26	4.1	37	2.0
Once	9	1.4	3	0.5	22	3.5	34	1.8
2 times	32	5.0	12	2.0	35	5.5	79	4.2
3 times	72	11.1	30	5.1	76	11.9	178	9.5
4 times	130	20.1	46	7.8	102	16.0	278	14.8
5 times	172	26.6	117	19.7	117	18.4	406	21.7
6 times	226	35.0	379	63.9	258	40.6	863	46.0
Length recordings 1-6 months								
None	159	24.6	110	18.5	312	49.1	581	31.0
Once	305	47.2	260	43.8	261	41.0	826	44.1
2 times	137	21.2	163	27.5	55	8.6	355	18.9
3 times	31	4.8	36	6.1	6	0.9	73	3.9
4 times	11	1.7	11	1.9	1	0.2	23	1.2
5 times	2	0.3	7	1.2	1	0.2	10	0.5
6 times	1	0.2	6	1.0	0	0.0	7	0.4

Table 47: Frequency of weight and length recording in the CHDR B portion during the 7th to 12th months of age of the child, by sector (n=1847)

Number of times weight and length was recorded in B Portion of CHDR	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
Weight recordings 7-12 months								
Once	26	4.1	2	0.3	8	1.3	36	1.9
2 times	44	7.0	7	1.2	25	3.9	76	4.1
3 times	79	12.5	10	1.7	44	6.9	133	7.2
4 times	101	16.0	31	5.3	103	16.2	235	12.7
5 times	156	24.7	78	13.4	156	24.5	390	21.1
6 times	225	35.7	452	77.9	300	47.2	977	52.9
Length recordings 7-12 months								
None	98	15.5	73	12.6	160	25.2	331	17.9
Once	287	45.5	240	41.4	367	57.7	894	48.4
2 times	195	30.9	197	34.0	94	14.8	486	26.3
3 times	41	6.5	38	6.6	14	2.2	93	5.0
4 times	9	1.4	14	2.4	1	0.2	24	1.3
5 times	0	0.0	8	1.4	0	0.0	8	0.4
6 times	1	0.2	10	1.7	0	0.0	11	0.6

Table 48: Frequency of weight and length recording in the CHDR B portion during the 13th to 18th months of age of the child, by sector (n=992)

Number of times weight and length was recorded in B Portion of CHDR	Residential sector							
	Urban		Rural		Estate		Total	
	No.	%	No.	%	No.	%	No.	%
Weight recordings 13-18 months								
None	13	4.1	3	1.0	9	2.4	25	2.5
Once	24	7.6	1	0.3	15	3.9	40	4.0
2 times	29	9.2	4	1.3	18	4.7	51	5.1
3 times	43	13.7	9	3.0	43	11.3	95	9.6
4 times	60	19.1	24	8.1	57	15.0	141	14.2
5 times	62	19.7	57	19.2	95	24.9	214	21.6
6 times	83	26.4	199	67.0	144	37.8	426	42.9
Length recordings 13-18 months								
None	86	27.4	54	18.2	116	30.4	256	25.8
Once	169	53.8	136	45.8	218	57.2	523	52.7
2 times	48	15.3	78	26.3	40	10.5	166	16.7
3 times	6	1.9	14	4.7	6	1.6	26	2.6
4 times	2	0.6	6	2.0	1	0.3	9	0.9
5 times	2	0.6	3	1.0	0	0.0	5	0.5
6 times	1	0.3	6	2.0	0	0.0	7	0.7

Table 46, 47 and 48 shows the number of weight and height recordings at different age categories. During the first 6 months 46% of the children have had weight recorded monthly. During the 7-12 months and 13-18 months the rates were 52.9% and 42.9% respectively. Height was recorded at least twice in 24.9% of the children during the first 6 months.

4.11.2 Growth faltering detected by the weight for age chart

Age of onset of growth faltering as assessed visually using the weight-for-age chart of the CHDR is presented below. This is the method that is used by the PHM in the field to detect growth faltering. The age at which the growth faltering (slowing, flattening and dropping) was first observed are as follows.

Table 49: Age of onset of growth faltering (based on the visual interpretation of weight for age charts in CHDR) according to sector

Descriptive statistics (months)	Residential Sector			
	Urban	Rural	Estate	Total
Mean	5.3	6.6	5.2	5.7
SD	3.5	3.7	3.4	3.6
Median	5.0	6.0	5.0	5.0

* *Growth faltering was determined by visually screening the weight for age chart of the CHDR by the enumerators, subject to verification by investigators (n=1752)*

As per the results shown in table above, the median age of growth faltering was 5 months, and the mean was 5.7 months in the total sample. There is a slight delay in the onset of growth faltering in rural children (mean=6.6 months) compared to urban (mean= 5.3 months) and estate (mean=5.2 months) children.

4.11.3 Use of the CHDR by the caregivers and health care staff

Table 50: Use of the CHDR by the caregivers and health care staff

Use of CHDR		Residential sector							
		Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
		No.	%	No.	%	No.	%	No.	%
Use by the caregivers									
To assess the growth of the child	Always	463	71.7	304	51.3	266	41.8	1033	55.1
	Sometimes	159	24.6	269	45.4	314	49.4	742	39.6
	Never	23	3.6	12	2.0	55	8.6	90	4.8
	Not reported	1	0.2	8	1.3	1	0.2	10	0.5
To assess the development milestones of the child	Always	440	68.1	274	46.2	221	34.7	935	49.9
	Sometimes	148	22.9	265	44.7	273	42.9	686	36.6
	Never	42	6.5	24	4.0	82	12.9	148	7.9
	Not reported	16	2.5	30	5.1	60	9.4	106	5.7
To obtain information regarding proper feeding	Always	402	62.2	222	37.4	226	35.5	850	45.3
	Sometimes	185	28.6	321	54.1	272	42.8	778	41.5
	Never	38	5.9	24	4.0	81	12.7	143	7.6
	Not reported	21	3.3	26	4.4	57	9.0	104	5.5
To obtain information regarding micro-nutrient supplementation	Always	265	41.0	154	26.0	110	17.3	529	28.2
	Sometimes	140	21.7	199	33.6	190	29.9	529	28.2
	Never	141	21.8	105	17.7	222	34.9	468	25.0
	Not reported	100	15.5	135	22.8	114	17.9	349	18.6
Mothers' perception of the use of CHDR by health care staff									
The health staff used the CHDR to discuss about the child's growth with you	Always	564	87.3	441	74.4	489	76.9	1494	79.7
	Sometimes	69	10.7	138	23.3	121	19.0	328	17.5
	Never	12	1.9	12	2.0	26	4.1	50	2.7
	Not reported	1	0.2	2	0.3	0	0.0	3	0.2
When the child was referred to another facility the referral was written in the CHDR**	Always	114	17.6	78	13.2	115	18.1	307	16.4
	Sometimes	65	10.1	127	21.4	129	20.3	321	17.1
	Never	280	43.3	276	46.5	297	46.7	853	45.5
	Not reported	187	28.9	112	18.9	95	14.9	394	21.0
Health staff requested the CHDR when you visited a doctor or health facility (other than the MOH)	Always	236	36.5	213	35.9	254	39.9	703	37.5
	Sometimes	114	17.6	168	28.3	201	31.6	483	25.8
	Never	286	44.3	181	30.5	163	25.6	630	33.6
	Not reported	10	1.5	31	5.2	18	2.8	59	3.1

The CHDR has been used by more than 85% of the mother always or sometimes to assess the growth of the child (94.7%), to assess the development milestones of the child (86.5%), and to obtain information regarding proper feeding (86.8%), although only 56.4% of the mothers had used it to obtain information regarding micro-nutrient supplementation as seen in the table above.

It was seen that 79.7% of the health staff always used the CHDR to discuss about the child's growth with the caregivers and 33.5% of the mothers stated that when the child was referred to another facility the referral was written in the CHDR always or at least sometimes. While 37.5% of the health staff had requested for the CHDR when the baby was taken to a medical officer/ health facility (other than the MOH) another 33.6% had never requested for it.

4.12 Type of home risk factors

Table 51: Home risk factors according to sector

Home risk factors *(*Multiple responses)*	Residential sector							
	Urban (N=646)		Rural (N=593)		Estate (N=636)		Total (N=1875)	
	No.	%	No.	%	No.	%	No.	%
Physical unavailability of mother/father to care for the child	23	3.6	18	3.0	44	6.9	85	4.5
Psychological/physical incompetency of the principal caregiver	34	5.3	15	2.5	21	3.3	70	3.7
Unavailability of a permanent caregiver	6	0.9	12	2.0	70	11.0	88	4.7
Increased care burden of the principal caregiver compromising attention to the child	64	9.9	24	4.0	64	10.1	152	8.1
Substance abuse by mother/ father/ caregiver /index family member	22	3.4	57	9.6	64	10.1	143	7.6
Violence/disputes at home, abuse of the child including neglect	21	3.3	21	3.5	35	5.5	77	4.1
Not having a permanent place of residence	146	22.6	58	9.8	184	28.9	388	20.7
Poverty and food insecurity	91	14.1	119	20.1	235	36.9	445	23.7
Un-kept dirty house	18	2.8	10	1.7	31	4.9	59	3.1
Household involved in anti-social activities	0	0.0	1	0.2	3	0.5	4	0.2

Table 51 shows the home risk factors of the families that was gathered from interviewing the caregiver. Poverty and food insecurity was reported by 23.7% of the families with the highest being in the estate sector (36.9%) followed by rural sector (20.1%). Not having a permanent place of residence was reported by 20.7% of the families. Substance abuse by mother, father or the principal caregiver was seen among 7.6% of the families, while violence was reported by 4.1% of the families.

4.13 Determinants of Growth faltering

Table 52: Determinants of growth faltering between 12 to 24 months among children born with birth weight of 2500g or more (n=1601)

Characteristic		Current growth Faltering				P value
		Yes		No		
		No.	%	No.	%	
Sex	Female	415	54.2	350	45.8	P=0.096
	Male	488	58.4	348	41.6	
Age category of child (months)	12-14	172	46.1	201	53.9	**P<0.001**
	15-17	186	52.4	169	47.6	
	18-20	205	57.1	154	42.9	
	21-24	340	66.1	174	33.9	
Maternal age category (yrs.)	<35 years	691	55.5	554	44.5	P=0.174
	35 and higher	212	59.6	144	40.4	
Mother's education level	Below O/L	343	58.4	244	41.6	P=0.327
	O/L passed	324	56.3	251	43.7	
	AL Passed & above	236	53.8	203	46.2	
Mothers occupation	Housewife	708	56.7	540	43.3	P=0.744
	Casual worker	75	57.3	56	42.7	
	Employed	120	54.1	102	45.9	
Maternal anaemia during pregnancy	Anaemia	270	57.4	200	42.6	P=0.599
	No Anaemia	624	56.0	490	44.0	
Exclusively breastfed at 6 month	No	356	56.2	278	43.8	P=0.870
	Yes	547	56.6	420	43.4	
Continued breastfeeding 12-23	No	78	58.6	55	41.4	P=0.432
	Yes	735	55.1	599	44.9	
Receiving solid food at 7 months	No	26	55.3	21	44.7	P=0.879
	Yes	877	56.4	677	43.6	
Meeting minimal dietary diversity at 8 months	No	122	56.0	96	44.0	P=0.888
	Yes	781	56.5	602	43.5	
Respiratory illness in the past	No	320	58.3	229	41.7	P=0.272
	Yes	583	55.4	469	44.6	
Growth faltering at 3 months	Yes	429	76.1	135	23.9	**P<0.001**
	No	252	39.9	379	60.1	
Growth faltering at 6 months	Yes	479	84.2	90	15.8	**P<0.001**
	No	256	34.6	483	65.4	
Residential sector	Urban	334	57.9	243	42.1	P=0.662
	Rural	290	55.8	230	44.2	
	Estate	279	55.4	225	44.6	
Poverty as a home risk factor	No	681	55.3	550	44.7	P=0.111
	Yes	222	60.0	148	40.0	
Wealth Index Quintile	Lowest	183	59.2	126	40.8	P=0.156
	Second	153	50.2	152	49.8	
	Middle	189	57.6	139	42.4	
	Fourth	188	58.6	133	41.4	
	Highest	190	56.2	148	43.8	
	Total	**903**	**56.4**	**698**	**43.6**	

* Children with missing data were excluded

For this analysis, growth faltering was defined as deviation of the current WAZ (based on the direct measurements taken during the survey) from the birth WAZ using the same difference as before (WAZ more than -0.25). The analysis was carried out for those with normal birth weight excluding those with birth weight <2500 g. Out of the factors analysed, age category of the child, early growth faltering, i.e, at 3 months and at 6 months were strong predictors for the current growth faltering ($p<0.05$).

Table 53: Determinants of growth faltering at the age of 12 months in children born with birth weight of 2500g or more (n=1276)

Characteristic		Growth faltering at 12 months				P value
		Yes		No		
		No	%	No	%	
Sex	Female	289	46.8	329	53.2	P=0.071
	Male	341	51.8	317	48.2	
Maternal age category	<35 years	482	48.2	517	51.8	P=0.127
	35 and higher	148	53.4	129	46.6	
Mother's education level	Below O/L	246	50.9	237	49.1	P=0.529
	O/L passed	221	49.6	225	50.4	
	AL Passed & above	163	47.0	184	53.0	
Mothers occupation	Housewife	501	50.0	501	50.0	P=0.364
	Casual Worker	54	51.4	51	48.6	
	Employed	75	44.4	94	55.6	
Maternal anaemia during pregnancy	Anaemia	207	53.2	182	46.8	P=0.077
	No anaemia	418	47.8	456	52.2	
Exclusively breastfed at 6 month	No	244	48.8	256	51.2	P=0.742
	Yes	386	49.7	390	50.3	
Breast feeding at 12 months	No	63	61.8	39	38.2	**P=0.006**
	Yes	507	47.7	557	52.3	
Given solid food at 7 month	No	17	45.9	20	54.1	P=0.672
	Yes	613	49.5	626	50.5	
Meeting minimum dietary diversity at 8th month	No	88	49.4	90	50.6	P=0.985
	Yes	542	49.4	556	50.6	
Diarrhoea in the past	No	552	49.7	558	50.3	P=0.510
	Yes	78	47.0	88	53.0	
Respiratory illness in the past	No	221	49.0	230	51.0	P=0.845
	Yes	409	49.6	416	50.4	
Growth faltering at 3 months	Yes	344	74.0	121	26.0	**P<0.001**
	No	149	28.4	375	71.6	
Growth faltering at 6 months	Yes	377	82.3	81	17.7	**P<0.001**
	No	155	24.7	472	75.3	
Residential sector	Urban	188	47.7	206	52.3	P=0.347
	Rural	230	48.2	247	51.8	
	Estate	212	52.3	193	47.7	
Poverty as a home risk factor	No	461	47.0	520	53.0	**P=0.002**
	Yes	169	57.3	126	42.7	
	Lowest	139	54.5	116	45.5	P=0.154

* Children with missing data were excluded

For this analysis, growth faltering was defined as deviation of the WAZ at 12 months of age from the birth WAZ using the same difference as before (WAZ more than -0.25). Significant predictors of growth faltering are household poverty, having early growth faltering at 3 or 6 months, and discontinuation breastfeeding after one year.

4.14 Factors associated with wasting, stunting and underweight.

The following tables show the results of analysis of factors associated with wasting, stunting and underweight.

Table 54: Factors associated with underweight in children aged 12-24 months

Factor		Weight for age				P Value
		Underweight		Not underweight		
		No.	%	No.	%	
Sex	Female	145	15.8	775	84.2	**P=0.021***
	Male	189	19.9	763	80.1	
Age category of child	12-14	49	10.7	410	89.3	**P<0.001**
	15-17	72	17.1	349	82.9	
	18-20	86	20.6	331	79.4	
	21-24	127	22.1	448	77.9	
Maternal age category	<35 years	256	17.5	1204	82.5	P=0.513
	35 and higher	78	18.9	334	81.1	
Mother's education level	Below O/L	149	21.0	562	79.0	**P=0.005**
	O/L passed	117	17.6	549	82.4	
	AL Passed & above	68	13.7	427	86.3	
Mothers' occupation	Housewife	262	17.9	1205	82.1	**P<0.001**
	Casual worker	44	28.2	112	71.8	
	Employed	28	11.2	221	88.8	
Anaemia	Anaemia	103	18.4	457	81.6	P=0.657
	No anaemia	226	17.5	1063	82.5	
Pre-pregnancy BMI category	Data not available	39	19.7	159	80.3	**P=0.002**
	Less than 18.5	68	24.3	212	75.7	
	18.5-24.9	155	18.4	686	81.6	
	25.0-29.9	53	12.9	358	87.1	
	>30 and higher	19	13.4	123	86.6	
Weight gain according to BMI	Inadequate	204	20.4	797	79.6	**P=0.001**
	Adequate	65	14.6	381	85.4	
	Excess	16	10.3	140	89.7	
Birth Weight	Low	94	38.5	150	61.5	**P<0.001**
	Normal	240	14.7	1388	85.3	
Exclusively breastfed at 6 month	No	136	17.8	626	82.2	P=0.996
	Yes	198	17.8	912	82.2	
Continued breastfeeding from 12-23 months	No	30	18.8	130	81.3	P=0.660
	Yes	266	17.4	1266	82.6	
Semi solid, Solid	No	11	19.0	47	81.0	P=0.820

Semi solid, Solid food given at 7 months	Yes	323	17.8	1491	82.2	
Minimum Dietary Diversity at 8 months	No	57	21.2	212	78.8	P=0.121
	Yes	277	17.3	1326	82.7	
Respiratory illness	No	94	15.0	533	85.0	**P=0.022**
	Yes	240	19.3	1005	80.7	
Growth faltering at 6m	Normal	152	16.1	790	83.9	P=0.052
	Growth faltering	182	19.6	748	80.4	
Residential sector	Urban	93	14.4	553	85.6	**P<0.001**
	Rural	87	14.7	503	85.3	
	Estate	154	24.2	482	75.8	
Poverty as a home risk factor	No	235	16.5	1192	83.5	**P=0.005**
	Yes	99	22.2	346	77.8	
Wealth Index Quintile	Lowest	95	25.5	278	74.5	**P<0.001**
	Second	65	17.4	309	82.6	
	Middle	68	18.0	310	82.0	
	Fourth	53	14.2	319	85.8	
	Highest	53	14.1	322	85.9	
	Total	**334**	**17.8**	**1538**	**82.2**	

The above table shows that underweight was higher among the male children (19.9%) compared to the girl child (15.8%). The proportion of underweight increased with the age categories with the highest reported among 21-24 months old children (22.1%). Estate sector showed a very high proportion of underweight children compared to other residential sectors (24.2%). Mothers educated below O/Ls had the highest proportion of underweight children compared to higher educational levels (21.0%). Further, those mothers who are employed as casual workers had a very high percentage of underweight children (28.2%) compared to other types of work and to housewives. Those children in the poorest wealth quintile (25.5%) and those identified as having poverty through the risk assessment (22.2%) showed higher proportion of underweight.

Proportion of underweight was high when the mothers were having a pre pregnancy BMI of <18.5 kg/m2 (24.3%) and inadequate weight gain (20.4%). The underweight proportion was higher in children among those whose birth weight was less than 2.5Kg (38.5%). All these associations were statistically significant at $p<0.05$.

Table 55: Factors associated with stunting in children aged 12-24 months

Factor		Length for age				
		Stunting		No stunting		
		No.	%	No.	%	
Sex	Female	122	13.3	798	86.7	**P=0.003**
	Male	174	18.3	778	81.7	
Age category of child (Months)	12-14	38	8.2	423	91.8	**P<0.001**
	15-17	70	16.7	350	83.3	
	18-20	69	16.6	347	83.4	
	21-24	119	20.7	456	79.3	
Maternal age category (Years)	<35	221	15.1	1239	84.9	P=0.132
	35 and higher	75	18.2	337	81.8	
Mother's education level	Below O/L	143	20.1	567	79.9	**P<0.001**
	O/L passed	102	15.3	564	84.7	
	AL Passed & above	51	10.3	445	89.7	
Mothers occupation	Housewife	210	14.3	1257	85.7	**P<0.001**
	Casual worker	52	33.3	104	66.7	
	Employed	34	13.7	215	86.3	
Anaemia	Anaemia	85	15.2	474	84.8	P=0.710
	No anaemia	205	15.9	1085	84.1	
Pre-pregnancy BMI category	Data not available	40	20.1	159	79.9	**P=0.017**
	Less than 18.5	46	16.5	233	83.5	
	18.5-24.9	146	17.4	694	82.6	
	25.0-29.9	49	11.9	364	88.1	
	>30 and higher	15	10.6	126	89.4	
Weight gain according to BMI	Inadequate	164	16.4	836	83.6	P=0.092
	Adequate	57	12.8	388	87.2	
	Excess	18	11.5	139	88.5	
Birth Weight	Low	86	35.4	157	64.6	**P<0.001**
	Normal	210	12.9	1419	87.1	
Exclusively breastfed at 6 month	No	127	16.7	635	83.3	P=0.401
	Yes	169	15.2	941	84.8	
Continued breastfeeding from 12-23 months	No	30	18.8	130	81.3	P=0.195
	Yes	228	14.9	1304	85.1	
Semi solid, Solid food given at 7 months	No	7	12.3	50	87.7	P=0.458
	Yes	289	15.9	1526	84.1	
Minimum Dietary Diversity at 8 months	No	55	20.6	212	79.4	**P=0.021**
	Yes	241	15.0	1364	85.0	
Respiratory illness	No	93	14.8	535	85.2	P=0.398

	Yes	203	16.3	1041	83.7	
Growth faltering at 6m	Normal	144	15.3	798	84.7	P=0.531
	Growth faltering	152	16.3	778	83.7	
Residential sector	Urban	63	9.8	582	90.2	**P<0.001**
	Rural	52	8.8	541	91.2	
	Estate	181	28.5	453	71.5	
Poverty as a home risk factor	No	207	14.5	1222	85.5	**P=0.005**
	Yes	89	20.1	354	79.9	
Wealth Index Quintile	Lowest	104	27.8	270	72.2	**P<0.001**
	Second	65	17.4	309	82.6	
	Middle	57	15.1	321	84.9	
	Fourth	37	10.0	334	90.0	
	Highest	33	8.8	342	91.2	
	Total	296	15.8	1576	84.2	

The above table shows that stunting was higher among the male children (18.3%) compared to the girl child (13.3%). The proportion of stunting increased with the age categories with the highest reported among 21-24 months old children (20.7%). Estate sector showed a very high proportion of stunting compared to other sectors (28.5%). Mothers educated below O/Ls had the highest proportion of stunted children (20.1%) compared to higher educational levels. Further, those mothers who are employed as casual workers had a very high percentage of stunted children (33.3%) compared to other types of work and to housewives. Those children in the poorest wealth quintile (27.8%) and those identified as having poverty through the risk assessment (20.1%) showed higher proportion of stunting.

The stunting proportion was higher in children among those whose birth weight was less than 2.5kg (35.4%) and those children not achieving a minimum dietary diversity at 8 months (20.6%). All these associations were statistically significant at $p<0.05$

Table 56: Factors associated with wasting in children aged 12-24 months

Factor		Weight for length				
		Wasting		No wasting		
		No.	%	No.	%	
Sex	Female	106	11.5	812	88.5	**P=0.009**
	Male	149	15.7	801	84.3	
Age category of child	12-14	50	10.9	409	89.1	P=0.184
	15-17	62	14.8	356	85.2	
	18-20	65	15.6	351	84.4	
	21-24	78	13.6	497	86.4	
Maternal age category	<35 years	196	13.4	1263	86.6	P=0.606
	35 and higher	59	14.4	350	85.6	
Mother's education level	Below O/L	99	14.0	609	86.0	P=0.403
	O/L passed	97	14.6	568	85.4	
	AL Passed & above	59	11.9	436	88.1	
Mothers' occupation	Housewife	206	14.1	1257	85.9	P=0.062
	Casual worker	26	16.7	130	83.3	
	Employed	23	9.2	226	90.8	
Anaemia	Anaemia	70	12.5	488	87.5	P=0.359
	No anaemia	182	14.1	1105	85.9	
Pre-pregnancy BMI category	Data not available	25	12.6	173	87.4	P=0.161
	Less than 18.5	48	17.3	230	82.7	
	18.5-24.9	120	14.3	720	85.7	
	25.0-29.9	48	11.7	363	88.3	
	>30 and higher	14	9.9	127	90.1	
Weight gain according to BMI	Inadequate	154	15.4	844	84.6	**P=0.032**
	Adequate	55	12.4	390	87.6	
	Excess	13	8.3	143	91.7	
Birth Weight	Low	62	25.5	181	74.5	**P<0.001**
	Normal	193	11.9	1432	88.1	
Exclusively breastfed at 6 months	No	108	14.2	652	85.8	P=0.560
	Yes	147	13.3	961	86.7	
Continued breastfeeding from 12-23 months	No	27	16.9	133	83.1	P=0.199
	Yes	202	13.2	1326	86.8	
Semi solid, Solid food given at 7 months	No	11	19.3	46	80.7	P=0.207
	Yes	244	13.5	1567	86.5	
Minimum Dietary	No	32	12.0	235	88.0	P=0.392

Minimum Dietary Diversity at 8 months	Yes	223	13.9	1378	86.1	
Respiratory illness	No	75	12.0	550	88.0	P=0.141
	Yes	180	14.5	1063	85.5	
Growth faltering at 6m	Normal	114	12.1	827	87.9	P=0.051
	Growth faltering	141	15.2	786	84.8	
Residential sector	Urban	92	14.3	552	85.7	P=0.476
	Rural	85	14.4	505	85.6	
	Estate	78	12.3	556	87.7	
Poverty as a home risk factor	No	193	13.5	1232	86.5	P=0.809
	Yes	62	14.0	381	86.0	
Wealth Index Quintile	Lowest	52	14.0	320	86.0	P=0.959
	Second	47	12.6	325	87.4	
	Middle	50	13.2	328	86.8	
	Fourth	52	14.0	319	86.0	
	Highest	54	14.4	321	85.6	
	Total	255	13.7	1613	86.3	

The above table shows that wasting was higher among the male children (15.7%) compared to the girl child (11.5%) and this difference was significant. The proportion of wasting increased with the age categories with the highest reported among 18-20 months old children (15.6%). Wasting was higher among those children whose mother had inadequate weight gain during pregnancy (15.4%). The wasting proportion was also higher when the birth weight was less than 2.5kg (25.5%) All these associations were statistically significant at $p<0.05$.

CHAPTER - 5

Conclusions and Recommendations

- This study serves as the first cohort study with a countrywide representation in Sri Lanka, covering the 3 main residential sectors namely the urban, rural and estate sectors. It captures data on a wide spectrum of individual, household, and societal determinants of child growth commencing from the pre pregnancy period up to the current time point.

- A substantial proportion of mothers had either diabetes or hypertension during pregnancy, requiring close monitoring and appropriate management beyond routine antenatal care, in order to minimize effects of these conditions on maternal and fetal well-being, and pregnancy outcome.

- Intake of folic acid before pregnancy (58.7% at present) should be further promoted during pre-pregnancy sessions, especially in the urban and estate sectors.

- Study found that the majority of women enter pregnancy with suboptimal BMI, either underweight or overweight. Overall, only 50% of pregnant mothers had a normal BMI at the booking visit of pregnancy, while 17% were thin and 34% were overweight or obese. The urban sector reported higher prevalence of overweight/obesity and lesser prevalence of thinness. In contrast, the estate sector reported higher prevalence of thinness and lesser prevalence of overweight/obesity. Interventions to achieve optimum BMI should be carried out during pre-pregnancy/interpregnancy care, targeting both underweight and overweight/obese women.

- Study revealed that a very high percentage of mothers with low or normal BMI had inadequate weight gain (72%). The study also confirmed that the prevalence of low birth weight was significantly higher in those with inadequate weight gain (15.9%) than those with adequate (8.6%) or excess weight gain (4.2%). Findings suggest the importance of targeting low BMI mothers and promote dietary and other interventions to ensure optimum weight gain during pregnancy.

- Weight gain during pregnancy was inadequate especially among mothers who are thin (72%) or have a normal BMI (70%). Adequate weight gain during pregnancy is associated with a lower prevalence of stunting, wasting and underweight ($p<0.05$). Weight gain according to BMI categories should be ensured and monitored during antenatal care services.

- Considering that LBW was significantly associated with undernutrition, it is important to strengthening LBW preventive strategies as well through pre-conception care/ adolescent health care in addition to care during pregnancy.

- Increased dietary diversity has an effect on reducing stunting. Despite an adequate level of dietary diversity, feeding dairy products, flesh food (meet, fish, etc.), and eggs was somewhat lower during early months of complementary feeding. This deficiency was prominent in the estate sector. We recommend that active promotion of food emphasizing the importance of including animal sources of food such as chicken, meat, fish, eggs, milk foods, etc. should be given priority in IYCF / nutrition promotion sessions. Availability and affordability of such food to all families should be assured through poverty alleviation or social safety nets.

- During the latter half of infancy, there was a rapid increase in the practice of giving sweets (4.4% at 6 months to 66.2% at 12 months) and biscuits (19.7% at 6 months to 79.4% at 12 months). Since these practices have a negative effect in correct complementary feeding, action to discourage such unhealthy practices should be taken using behaviour change communication strategies.

- The study found that there is a high frequency of inappropriate breastfeeding practices (demand feeding, feeding as a soothing mechanism, feeding just before meals) after initiating complementary feeding. Structuring of breastfeeding after initiation of complementary feeding is recommended.

- With respect to responsive feeding, there are several substandard practices: absence of a regular place for feeding, inability in recognizing hunger cues, forceful feeding, not allowing child to feed herself/himself, distract feeding while showing animals or surrounding environment and feeding while running around with the child. Measures should be taken to discourage these practices after understanding the underlying reasons for such behavior.

- Incidence of respiratory illness was high in young children and the frequent respiratory illness was found to be a determinant of underweight. Feeding is severely compromised during illness; therefore, it would be useful to explore preventive measures, and alternative feeding measures in illness.

- In consistent with previous studies, low birth weight was found to be a strong determinant of underweight, stunting, and wasting. Improving undernutrition

would not be possible unless measures are taken to increase the birth weight. Furthermore, the results indicate that the longer the period of gestation, higher the birth weight, and thereby a subsequent reduction in the rate of stunting, wasting and underweight. Therefore, findings suggest avoiding early inducing or delivery unless there is a strong indication.

- Growth faltering identified as a drop of WAZ of more than 0.25 from birth weight Z score was observed among nearly 40-45% of children from the first month to 6 months and from 10th to 15th month. Currently, nearly half of the children aged 12-24 months have growth faltering. Early growth faltering predisposes a child for underweight and wasting, while longstanding growth faltering leads to stunting. Therefore, early detection of growth faltering and timely intervening would prevent a child leading to undernutrition. In case of prolonged growth faltering, investigation of causes, and implementation of health and non-health interventions should be carried out without delay.

- The age of onset of growth faltering detected through WAZ deviation method was 2 to 3 months earlier than by the visual inspection of weight for age chart in the CHDR. Early growth faltering identified though the WAZ deviation method is an important predictor of subsequent growth faltering and can be seen as a sensitive method to identify the children who would subsequently have growth faltering.

- The best method in identifying growth faltering should be explored further though a more intense analysis of the data, with cut offs specific to different birth weight categories.

- The estate sector children had a higher prevalence of underweight and stunting in contrast to the urban and rural sectors. Acute undernutrition is not reflected by the indicator wasting, since there was a high number of children with short stature in the estate sector, whose weight was adequate to their height. More context-specific interventions should be designed and implemented in different subpopulations taking into consideration their biological, social, economic, and environmental situation.

- Socio-economic deprivation is a strong reason for child undernutrition. In this study, both perceived poverty and objectively assessed household wealth index were found as strong predictors of underweight and stunting ($p<0.01$). Poor maternal education and maternal occupation as casual worker are also associated with increased

underweight and stunting ($p<0.01$). While health services will be promoting IYCF strategies and disease prevention strategies, the government should address the non-health interventions such as education, employment, and economy in order to achieve a sustainable improvement in child.

- Growth monitoring through PHMs in the preventive health sector varies across regions. Length recording in the CHDR-B portion was inadequate, while recording of weight with correct date of measurement was poor in some areas. We recommend that weight, and length should be assessed as per the growth monitoring guidelines and recorded in the CHDR-B portion, and this should be closely supervised by the supervisory health staff.

- This cohort study has a wealth of longitudinal data from preconception period to the age of 2 years of the child. It would be useful to do further analysis such as multiple regression analysis, predictive models, etc. in order to understand the interplay between factors associated with growth faltering and anthropometric status.

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Annex 1 – Definition of urban, rural and estate sectors

There are no universally accepted definitions for urban, rural and estate sectors and each and every country defines it independently according to their administrative, economic and population-related criteria.

Since 2001, Department of census and statistics is using the following definitions for all 3 sectors in their surveys;

Urban sector/area: all areas administered by Municipal and Urban councils. Currently are 41 UCs and 24 MCs constitutes the urban sector; Estate sector/areas: all plantations which are 20 acres or more in extent and with ten or more resident labourers; Rural sector/areas: all areas other than urban and estate areas. 271 Pradeshiya Sabhas make up the rural and estate sectors (Weeraratne., 2016; ILO)

Annex 2: List of MOH areas selected for the study, by sector and district

Urban			Rural			Estate	
Colombo	Galle	Gampaha	Polonnaruwa	Amapara	Kilinochchi	Nuwara Eliya	Badulla
• Dehiwala • Nugegoda • Battaramulla • Kolonnawa • Pitakotte • CMC / District 01 • CMC / District 02 A/B • CMC / District 03 • CMC / District 04 • CMC / District 05	• Hikkaduwa • Galle MC	• Ja-ela • Kelaniya • Negombo	• Aralaganwila • Hingurakgoda • Lankapura • Medirigiriya • Thamankaduwa	• Damana • Dehiattakandiya • Lahugala • Mahaoya • Padiyathalawa • Uhana	• Kandawalai • Kilinochchi • Pallai • Poonakary	• Ambagamuwa • Kotagala • Kothmale • Lindula • Maskeliya • Nuwara Eliya • Ragala • Walapane	• Bandarawela • Passara • Haliela • Haputale • Welimada

CMC = Colombo Municipal Council; MC = Municipal Council

Annex 3: List of field team members

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ISBN 978-955-52048-4-2