

## PUBLIC HEALTH NUTRITION AND EPIDEMIOLOGY

# Current infant feeding practices and impact on growth in babies during the second half of infancy

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### Keywords

complementary feeding, exclusive breastfeeding, first food, infant growth, motor milestones.

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### Abstract

**Background:** Sri Lanka has made remarkable improvements in health, social and educational indices. However, child malnutrition exists as a significant health problem. Infant feeding indicators have not reached expected levels and improvements are partly constrained by a lack of data. The present study aimed to determine current infant feeding practices and their impact on growth among 6–12-month-old infants.

**Methods:** The study comprised a descriptive cross-sectional investigation conducted in randomly selected ( $n = 7$ ) Public Health Midwife areas in Galle, Sri Lanka. An interviewer-administered questionnaire was used to obtain data on sociodemographics and infant feeding. Mothers ( $n = 515$ ) attending well-baby clinics were recruited on voluntary and consecutive basis. Infants' body weights and lengths were measured using standard procedures.

**Results:** Exclusive breastfeeding rate for first 6 months was 49.0%. In total, 42.6% infants (219 out of 515) were given rice as first weaning food, followed by salt (58.6%) and sugar (42.3%). Oil had been introduced to 84.9% of infants by the end of 12 months. Most infants (over 71%) were given dairy products, whereas 62.3% were being fed various liquid foods using bottles. The introduction of commercial infant cereals, chocolates, plain tea, ice cream and deep fried snacks was noted. Age-specific body weight and length were not achieved by 30.5% and 29.5% of infants, respectively. Weight for length was not achieved by 25.5% of the infants. Delayed achievements of motor milestones were observed. Mothers' knowledge scores on basic nutrients were low.

**Conclusions:** Complementary feeding indices of the study group were not satisfactory. Maternal and child healthcare personnel need to identify causative factors for inappropriate feeding with a view to improve the complementary feeding patterns.

### Introduction

Child malnutrition remains a common health problem across the globe. It is the single biggest contributor to child mortality (Black *et al.*, 2010). In 2006, an estimated 9.5 million children aged under 5 years died and 35% of the deaths were directly related to under nutrition (World Health Organization, 2009; Black *et al.*, 2010). The situation in South Asia is reported to be critical in this respect. Over the past few decades, South Asia has remained as a

global hub for the burden of infant and child malnutrition and mortality (Michael *et al.*, 2010). It is evident that malnutrition causes irreversible damages when it occurs in the foetus and during the first 2 years of life, resulting in lower intelligence, reduced physical capacity and productivity (Martorell *et al.*, 1994). Furthermore, it leads to slow economic growth, perpetual poverty and increased healthcare costs. According to UNICEF's conceptual framework, the inadequate dietary intake and diseases are the immediate causes for child under-nutrition.

As a welfare state with a low middle income, Sri Lanka has made remarkable improvements in various health indicators over the past few decades. Maternal, infant and child mortalities in Sri Lanka have been reported to be lower among other Asian countries. On the other hand, the country has shown higher literacy and exclusively breastfeeding (EBF) rates, antenatal care and vaccination coverage. The Sri Lankan Health Service is an integrated system comprising a wide array of health institutions and community health services through Medical Officer of Health (MOH) divisions (Senarath *et al.*, 2010). In addition, Sri Lanka has a well established national programme for breastfeeding promotion, with the establishment of baby friendly hospital initiative in 1992. Furthermore, World Health Organization recommendations were adopted in 2005 such that the infants should be exclusively breastfed during first 6 months and thereafter be given nutritious complementary foods (CFs) at the same time as continuing breastfeeding up to 2 years or beyond [World Health Organization (WHO), 2002].

Despite the impressive health indicators, malnutrition remains a significant threat to Sri Lankan children. A UNICEF survey in 2003 reported that 36% of children were underweight, 17.3% were wasted and 18.6% were stunted. According to a UNICEF survey in 2008, low birth weight, being underweight, wasting and stunting rates were 16%, 16.3%, 15.7% and 12.6%, respectively. Even though there is a decline in the rates of malnutrition, these values are still unacceptably high. Therefore, the evaluation of infant feeding practices is of paramount importance for understanding the causative factors for malnutrition. The present study aimed to determine current feeding practices and their impact on growth indicators among 6–12-month-old infants.

## Materials and methods

### Population and community setting

This was a community-based, descriptive, cross-sectional study. Sri Lanka is divided into 25 administrative districts. The study was conducted in Galle district, which has a total population of more than one million (11.1% in urban sectors, 87.2% in rural sectors and 1.7% in estate sectors, respectively) (Department of Census and Statistics, 2011). There are 19 primary healthcare divisions (i.e. MOH divisions) in Galle district with several public health midwife (PHM) areas in each. The study was conducted in seven randomly selected MOH divisions. Furthermore, eight to 10 PHM areas were also randomly selected from each MOH division and data were collected during May 2012 to December 2013 at the well baby clinics conducted in the respective areas.

### Subject recruitment

A total of 515 mother–infant (aged 6–12 months) pairs were randomly recruited based on the sample size calculation previously reported by Lwanga & Lemeshow (1991). Subject recruitment was carried out on an entirely voluntary and consecutive basis. Inclusion criteria included: (i) an infant aged  $\geq 6$  months but  $< 1$  year and (ii) consuming both breast milk and complementary foods (solids and liquids). Exclusion criteria included: (i) continued exclusive breastfeeding; (ii) completely weaned infants (i.e. those who have stopped breastfeeding completely); (iii) serious congenital anomalies or chronic diseases; and (iv) a failure to understand the local language (Sinhala). We identified only two babies who had weaned completely. They had consumed breast milk only for approximately 7 days and were adopted children (they had separated from their mothers within 1 week of their birth). Because their feeding pattern is markedly different from the remainder of the infants, we excluded them from the study.

Ethical approval was obtained from the Ethical Review Committee, Faculty of Medicine, University of Ruhuna. Institutional approvals were obtained from the local authorities of the Ministry of Health. Informed written consent was obtained from the mothers prior to the interview.

### Data collection

A comprehensive interviewer-administered, pretested questionnaire was used to gather data on sociodemographics, breastfeeding practices, CF patterns, maternal knowledge and attitudes on infant feeding, nutrition and growth, and hygienic aspect of CFs. The questionnaire comprised questions assessing mothers' knowledge of basic nutrients, rich dietary sources for main nutrients, their role in growth and health, effects of cooking and processing on the nutritional value of food, etc. Questions such as 'what are the basic nutrients that should be in your infant's diet?', 'what nutrients are required for the proper growth of the bones and teeth of your baby?' and 'what is required for the proper formation and growth of healthy blood, for proper vision and for healthy skin and hair?' were included in the questionnaire. They were requested to recall three foods each that are rich in starch, protein, fat, iron, calcium, folic acid, vitamin A and vitamin D, etc. Mothers' attitudes on infant feeding were assessed by asking questions such as 'how long do you think that your baby should exclusively breastfeed?', 'how long you wish to continue breastfeeding your baby?', 'when you should start giving CFs to your baby?', 'how do you improve the palatability of CFs for

your baby?', 'what are the features that you expect to be in your infant's CFs?', 'what do you do if your baby is refusing CFs?', 'what is your idea on forceful feeding' and 'how do you encourage your baby to feed with CFs'. Multiple educational programmes and demonstrations on CF are conducted in every post-natal clinic in Sri Lanka. The above questions were asked to assess the impact of them upon maternal knowledge and attitudes to CFs. All interviews were conducted in local (Sinhala) language. Infant's body weights (up to 100 g) and lengths (for last completed 1 mm) were measured in accordance with standard procedures using calibrated spring scales (model 235 6S; Unicef Salter, UK), infantometers and measuring boards. Infants' ages at which the motor milestones were achieved were obtained by direct questioning.

### Statistical analysis

Data were tabulated using an EXCEL spreadsheet (Microsoft Corp., Redmond, WA, USA) and descriptive statistics were calculated where appropriate. Infant growth was expressed in the form of Z-scores relative to the WHO Child Growth Standards (WHO Multicentre Growth Reference Study Group, 2006a,b). SPSS, version 20.0 (Chicago, IL, USA) was used to analyse any correlation between study parameters and ANOVA on group variables. Any association of feeding practices and sociodemographic characteristics with infants' growth were further determined.  $P < 0.05$  was considered statistically significant.

## Results

### Demography and infants' characteristics

Out of 515 mothers, 147 (28.5%) were from urban areas, 317 (61.5%) from rural areas and the remainder were from estate areas of Galle District. Mother's age ranged from 17.0 to 45.0 years with a mean (SD) of 29.0 (5.8) years. More than 29.0% of mothers had an advanced level and or higher levels of education. The highest educational qualifications of the majority ( $n = 236$ ; 45.9%) were between grades 5–10. There were 460 (89.5%) housewives. 35 (6.8%) mothers were professionals and the remainder were either skilled/unskilled workers. Parity ranged from 1 to 9. However, 240 mothers (46.7%) were with their first baby at the time of interview. The mean monthly income of a family was Rs 26 500. Only 35 (6.8%) families had a monthly income of less than Rs 10 000. Most (47.0%) received an income of more than Rs 20 000. There were 269 (52.3%) male and 245 (47.6%) female infants in the study group. Most (310; 60.3%) were between 9 and 12 months and the remainder were between 6 and 8 months. Mean (SD) birth weight was 2.9 kg (0.4).

### Infant feeding pattern

The mean (SD) duration for EBF was 5.2 (1.1) months. Seven (1.4%) mothers had continued EBF for more than 7 months. Forty-nine percent ( $n = 252$ ) of infants had been exclusively breastfed for first 6 months. However, 28.2% had undergone EBF only for 5 months and 12.1% had introduced CFs at 4 months for various reasons. Forty-eight (9.3%) infants had undergone EBF for <3 months. The reasons for introducing additional food before 6 months ( $n = 262$ ; 51%) were medical advice and poor weight gain of the baby ( $n = 49$ ; 9.5%); the aim of resuming employment ( $n = 19$ ; 3.7%); and no valid reason ( $n = 194$ ; 37.8%). However, 498 (96.9%) of the mothers were aware that the optimum duration of EBF is for 6 months. Only four (0.8%) mothers considered that EBF for 4 months is adequate and 10 (1.9) mothers did not have any idea on the correct duration for EBF. In total, 211 (41.2%) mothers had a clear intention of continuing breastfeeding up to 2 years or more. Another 108 (21%) mothers mentioned that they would be continuing breastfeeding until baby demands.

A significant portion of the infants ( $n = 208$ ; 40.5%) had been given water before 6 months of age. However, the mean (SD) age for water introduction was 5.6 (1.3) months. Formula feeding rate was 18.3%. The mean (SD) age for introduction of formula was 5.8 (2.7) months. Only 25 (27.5%) mothers commenced formula feeding on the advice of healthcare personnel. The remainder had started formula feeding on their own or on parent's advice without any indication.

Almost half of the infants (49%;  $n = 252$ ) were given complementary foods at 6 months. Most (219; 42.6%) had been given mashed rice as the first complementary food, either as boiled rice or mixed with breast milk or dhal and vegetables. A significant portion (154, 30.0%) had received *canjee water* (liquid gruel) and another 58 infants (11.3%) had received fruit juices as the first food. Twenty-one (4.1%) infants were fed with fruit pulps (papaw, banana or butter fruit) and 15 (2.9%) were fed with commercial infant cereals as the first food. In total, 463 (90.0%) infants had been fed with rice by the time of the interview. Table 1 presents the rate of introduction of foods.

Mean (SD) age was 6.8 (1.1) months for the introduction of oil (rate of 84.9%) and 7.6 (1.7) months for both salt and sugar (rate of 58.6% for salt and 42.3% for sugar). The most common type of oil used for the preparation of CFs was coconut oil. Margarine and butter introduction rates were 34.8% and 31.7%, respectively. It was evident that considerable numbers of infants were fed with different types of inappropriate commercial food items (i.e. deep fried snacks, ice cream, sugary biscuits,

**Table 1** Introduction rates of the selected food items\*

Food item	Urban (n = 147)	Rural (n = 316)	Estate (n = 51)	Total (%) (n = 514)
Rice	126 (85.7)	296 (93.7)	44 (86.3)	466 (90.0)
Sprats	98 (66.7)	278 (88.0)	46 (90.2)	422 (81.9)
Fish	110 (74.8)	239 (75.6)	35 (68.6)	384 (74.6)
Meat	56 (38.1)	138 (43.7)	18 (35.3)	212 (41.2)
Egg	93 (63.3)	205 (64.9)	28 (54.9)	326 (63.3)
Yoghurt	98 (66.7)	239 (75.6)	30 (58.8)	367 (71.3)
Cheese	78 (53.1)	154 (48.7)	18 (35.3)	250 (48.5)
Oils	112 (76.2)	283 (89.6)	42 (82.4)	437 (84.9)
Salt	95 (64.6)	178 (56.3)	29 (56.9)	302 (58.6)
Sugar	69 (46.9)	129 (40.8)	20 (39.2)	218 (42.4)
Coconut oil	56 (38.1)	203 (64.2)	32 (62.7)	291 (56.6)
Margarine	40 (27.2)	121 (38.3)	19 (37.3)	180 (35.0)
Butter	54 (36.7)	96 (30.4)	13 (25.5)	163 (31.7)
Vegetable oil	7 (4.8)	5 (1.6)	0 (0.0)	12 (2.3)
Commercial infant cereal products	85 (57.8)	105 (33.2)	14 (27.5)	204 (39.7)
Chocolates	61 (41.5)	120 (38.0)	15 (29.4)	196 (38.1)
Plain tea	45 (30.6)	105 (33.2)	11 (21.6)	161 (31.3)
Ice cream	36 (24.5)	66 (20.9)	09 (17.6)	111 (21.6)
Sausages	15 (10.2)	24 (7.6)	04 (7.8)	43 (8.4)
Soft drinks (commercially available)	18 (12.2)	35 (11.1)	06 (11.8)	59 (11.5)
Deep fried snacks	19 (12.9)	14 (4.4)	04 (7.8)	37 (7.2)

\*Data are given as *n* (%).

chocolates and artificial fruit drinks, etc.). These foods were not recommended for infants in Sri Lanka by health authorities as a result of the presence of sugar, salt, artificial flavors, food additives, artificial colours, preservatives, etc. Iron/vitamin supplementation rate was 16.1%.

Mother's normal feeding behaviour was discussed during the interview to determine whether they placed any emphasis on responsive feeding. Almost all the mothers in the study group fed their babies themselves unless they were compelled to leave the baby under special circumstances. Most (446; 87%) mothers said that they keep talking and paying with the baby when feeding. In total, 247 (48%) said that they let the baby eat with older children or family members and 316 (62%) mothers said that they let the baby play or engage in own activities when eating. Approximately half the mothers in the study group 253 (49%) encouraged self-feeding. However, only 135 (26%) mothers said that they could complete feeding within approximately 20 min. Another 54 (10%) were finishing feeding after approximately 10 min. Another 116 (23%) were taking approximately 1 h to complete feeding and the remainder were taking more than 1 h for feeding. Most (431; 84%) were of the view that force feeding should not be carried out. Others reported that force feeding is helpful for introducing new food

items to the baby, to feed more and to complete the meal within a short duration.

When evaluating the current CF practices in the study group, 88% mothers knew that the best time for commencement of CF is after first 6 months, although only half the participants (49%) were found to initiate CF at the correct age. Over 40% of the infants were given water before 6 months of age. Hiccup, constipation, and dryness of skin, mouth and throat were among the reasons given for the early introduction of water. Some mothers gave water to their infants to promote hunger in accordance with the elder's advice. Few mothers (0.4%) had given water from birth itself for no reason. More than 42% of the infants were fed with mashed rice as the first complementary food. Approximately 4% were fed with fruit pulps in semi-solid consistency. The remaining 54% of infants were fed with highly watery CFs with low-energy density, including cunjee water, fruit juices, vegetable soups, plain tea and infant formula. By contrast, it was found that the usage of bottles for CF was considerably higher (62%) in this study group. Thin and highly watery CFs were used on bottle feeding. The refusal of solid and semi-solid foods was also found at a later stage (after approximately 9 months). More than 24% of the mothers had a view that CF should be mashed or ground thoroughly until the infant is at least 1 year of age. The food item that is mostly refused by infants (34%) was rice, which is the staple food in Sri Lanka.

In the present study group, the age appropriate vaccination coverage (98.4%) was highly satisfactory. However, 52 (10.1%) infants had suffered from diarrhoea and 50 (9.7%) suffered with skin rashes during a period of 1 month prior to the interviews. Prevalence rates for vomiting, allergies and mouth rashes were 6.2% (*n* = 32), 4.7% (*n* = 24) and 3.1% (*n* = 16), respectively. Hygienic aspects of CFs appeared to be satisfactory. Most (260; 50%) were using well water for the preparation of CFs, whereas 248 (48%) were using tap water and seven (1%) were using tube well water. Most (449; 87%) of the mothers said that they properly washed and boiled the utensils used for the preparation, storage and feeding of CFs. In total, 261 (51%) of mothers were giving fresh CFs (just after preparation) to their infants. Others were reusing CF once prepared. However, only 23 (4%) were refrigerating and heating CFs before the subsequent feeding.

The mean (SD) knowledge score was 46.8 (21.4). When analysing the knowledge scores, it was found that approximately one-third of mothers (32.3%) possessed a very poor knowledge on nutrients. Only 21 mothers (4.1%) exhibited a sound knowledge on this aspect. Illnesses reported in infants during a period of 1 month prior to the interview and the maternal knowledge on basic nutrients is presented in Table 2.

**Table 2** Illnesses\* reported among infants and mothers' knowledge score† on nutrients

	Urban (n = 147)	Rural (n = 316)	Estate (n = 51)	Total (n = 514)
Illness				
Diarrhoea	19 (12.9)	31 (9.8)	2 (3.9)	52 (10.1)
Vomiting	12 (8.2)	18 (5.7)	2 (3.9)	32 (6.2)
Allergies	4 (2.7)	17 (5.4)	3 (5.9)	24 (4.7)
Skin rashes	11 (7.5)	35 (11.1)	4 (7.8)	50 (9.7)
Mouth rashes	3 (2.0)	10 (3.2)	3 (5.9)	16 (3.1)
Knowledge score				
<40	70 (48.6)	76 (24.3)	22 (43.1)	168 (32.3)
40–60	39 (27.1)	142 (45.4)	17 (33.3)	198 (39.1)
61–80	26 (18.1)	84 (26.8)	10 (19.6)	120 (23.9)
>80	09 (6.3)	11 (3.5)	1 (2.0)	21 (4.1)

\*Illnesses were reported 1 month prior to the interview. Data are given as n (%).

†One hundred and forty-four mothers from urban and 313 from rural areas participated.

### Direct assessment of the nutritional status of infants

Z-scores for infant's weight-for-age, length-for-age and body mass index (BMI)-for-age were calculated. Percentages for the achievement of age-specific weight, length and weight for length are presented in Table 3. The weights of 153 (30.5%) infants were below the 'road to health' region of the child health development record. Furthermore, age appropriate length was not achieved by 148 (29.5%) and weight for length was not achieved by 128 (25.5%) infants. The median ages for achievement of six gross motor milestones were calculated and compared with the respective WHO medians (Table 4). The median age for sitting without support, for standing with

**Table 3** Achievement of age-specific weight, age-specific length and weight for length (n = 501)

Age (n)	Number of infants (%) whose weight is below (–1 SD) the roads to health region of CHDR	Number of infants (%) whose length is below (–1 SD) the roads to health region of CHDR	Number of infants (%) whose weights were not satisfactory for length (–1 SD)
6 months (42)	13 (31.0)	12 (28.6)	9 (21.4)
7 months (88)	20 (22.7)	23 (26.1)	22 (25.0)
8 months (68)	18 (26.5)	23 (33.8)	15 (22.1)
9 months (98)	31 (31.6)	24 (24.5)	34 (34.7)
10 months (66)	24 (36.4)	22 (33.3)	18 (27.3)
11 months (99)	36 (36.4)	28 (28.3)	22 (22.2)
12 months (40)	11 (27.5)	16 (40.0)	8 (20.0)
Total (501)	153 (30.5)	148 (29.5)	128 (25.5)

CHDR, child health development record.

**Table 4** Comparison of age (months) of medians of motor milestone achievements\*

Motor milestone	Median age in months		
	WHO Multicentre Growth Reference Study Group (2006a,b)	Present study	Achievement rate (%)
Sitting without support	5.9	9.6	70.4
Hands and knees crawling	8.3	9.2	90.8
Standing with assistance	7.4	9.7	82.9
Walking with assistance	9.0	10.0	73.8
Standing alone	10.8	11.0	65.0
Walking alone	12.0	11.0	42.5

\*Calculation was performed in accordance with the number of infants at the respective age.

assistance, for hands and knees crawling and walking with assistance appeared to be higher than the WHO median. By contrast, the median age for walking alone was lower than the WHO median age. Approximately 13.5% of the infants aged >9 months were unable to sit without support and 4.9% of the infants ages >11.5 months were unable to stand with assistance. It was noted that over 88.1% of the infants who showed delays in achieving the above two motor milestones had not achieved age-specific weight.

Correlation analysis of infants' BMI with birth weight, EBF duration, mothers' knowledge scores, level of education and monthly income indicated that infants' BMI has a significant correlation ( $P = 0.001$ ,  $r = 0.145$ ) with the birth weight and that the mothers' knowledge score has a significant correlation ( $P < 0.01$ ,  $r = 0.502$ ) with their educational level. Table 5 indicates the Pearson correlations of infant BMI, birth weight, mother's education, maternal knowledge score and duration of EBF.

When multiple comparisons were made using ANOVA to investigate differences of birth weights, present weight, length, BMI and weight gain of infants in urban, rural and estate sectors, it was observed that the lengths of the urban infants were significantly higher ( $P < 0.05$ ) than those of rural infants. Knowledge scores of rural mothers were significantly higher than those of the urban mothers ( $P < 0.001$ ) and the mothers of the estate sector ( $P = 0.021$ ).

### Discussion

Appropriate feeding practices play a pivotal role in ensuring optimum growth, development and health during

**Table 5** Pearson correlations (*r*) on some parameters of the study<sup>†</sup>

	Body mass index	Birth weight	Mother's education	Maternal knowledge score	Duration of EBF
Body mass index		0.15*(0.00)	-0.03 (0.51)	-0.02 (0.64)	-0.01 (0.79)
Birth weight	0.15* (0.00)		0.05 (0.28)	0.07 (0.10)	0.15* (0.00)
Mother's education	-0.03 (0.51)	0.05 (0.28)		0.50* (0.00)	-0.00 (0.93)
Maternal knowledge score	-0.02 (0.64)	0.07 (0.10)	0.50* (0.00)		0.03 (0.55)
Duration of EBF	-0.01 (0.79)	0.15* (0.00)	-0.00 (0.93)	0.03 (0.55)	

\*Correlation is significant at the 0.01 level (two-tailed).

<sup>†</sup>Results presented as *r* (*P* value).

EBF, exclusively breastfeeding.

infancy. WHO recommends EBF (feeding of infant solely with human milk without any additional food or beverages including water) for the first 6 months, followed by the introduction of appropriate CFs at the same time as breastfeeding continues until 2 years of age or beyond (WHO, 2002). Even though breastfeeding is widespread in many countries, EBF practice is reported to be limited (IAEA, 2010). From 2005, Sri Lanka adopted the WHO recommendation on EBF and the available literature indicates higher rates for EBF in the country. According to a Demographic and Health Survey (DHS) 2006/07, 75.8% Sri Lankan infants aged between 0 and 5 months were exclusively breastfed, which was the highest rate for the South East Asian region (Department of Census & Statistics & Ministry of Healthcare & Nutrition, 2009). The survey conducted in an MOH area close to the capital of Sri Lanka reported that 62.2% children were exclusively breastfed until the completion of the first 6 months (Perera *et al.*, 2011). According to International Baby Food Action Network of Asia, the rate for EBF varies from 10% to 68% in South Asian countries. In Maldives, it was 10%; Bangladesh and India have reported the rate to be 46% and 47%, respectively. Pakistan (50%), Sri Lanka (58%) and Nepal (68%) are categorised as Asian countries with a good status of EBF rates (International Baby Food Action Network, Asia, 2007). However, according to the Sri Lanka CF Study – 2008, only 9.9% of the infants had been exclusively breastfed during the first 6 months (Ministry of Health, 2008). Godakandage (2006) reported that only 48.8% of infants are exclusively breastfed until the end of the fourth month, based on his study conducted in four MOH areas in Colombo, Sri Lanka. In the present study, 49.0% of infants are exclusively breast fed until 6 months of age. In 1993, the mean duration for EBF was 1.2 months in Sri Lanka and, in 2000, it was reported to be 3.7 months (Department of Census & Statistics & Ministry of Healthcare & Nutrition, 2009). The mean duration for EBF in the present study was 5.2 months. The improvement of EBF can be attributed to the effectiveness of the prenatal and post-natal

awareness and educational programmes, breastfeeding counselling, home visits, lactation management programmes and baby friendly hospital initiatives in Sri Lanka.

Approximately 40.5% of infants in the study group had given water before 6 months of age. This is not advisable because too much of water can interfere with the baby's ability to absorb nutrients in breast milk and also cause infant's stomach to feel full, which curbs the desire to feed. Water supplements fill the baby up without adding energy and therefore can result in weight loss. Introduction rates of many nutritionally important food items, including sprats, fish, meat and egg, appear satisfactory. According to the Sri Lanka CF survey, animal product intake was very low (7%). Fish and eggs were consumed by 25% and 18% of infants. In the present study, introduction rates of fish and egg were 75% and 63%, respectively. Approximately 97% of the infants were consuming dhal very frequently and 65% were consuming boiled whole gram. Pro-vitamin A rich food consumption rates were also high (carrot 97%, pumpkin 90%). Approximately 58% of the infants were fed with spinach and 80% were fed with Centella. An improvement in the mean age for oil introduction (6.8 months) is seen in comparison to Sri Lanka CF study (8–9 months). The addition of oil is important because it increases the energy value of CF. Furthermore, it improves the palatability of the infant for CFs. The type of oil frequently used by 35% of the mothers was margarine. This practice should be discouraged in that hydrogenated fat consumption is not recommended for children <3 years of age as a result of the presence of trans-fatty acids and harmful antioxidants. Even a court order and a circular by Ministry of Health have been issued in Sri Lanka regarding the ban of margarine for children. Salt and sugar are not recommended to be included in CFs in the first year of life in Sri Lanka. This is a result of developing kidneys with limited functional capacity that are unable to handle high solute loads. However, the introduction rates of sugar and salt in the study were high, at 42% and 59%, respectively. The mean

age for both salt and sugar introduction was too early (7.6 months). On the other hand, the early introduction of sugar sensitises the taste buds, promotes tooth decay and leads to weight gain and obesity later in life (Bowen *et al.*, 1997; Douglass *et al.*, 2004 and Nainar & Mohummed, 2004). Perera *et al.* (2011) reported that 44% of infants in a MOH area near the capital of Sri Lanka had been given sugar before 1 year of age. Higher consumption rates of chocolates, ice cream, soft drinks, sausages, deep fried snacks and instant noodles were also observed. Addiction to such commercial foods that are sweet in taste, flavoured and salty may blunt the appetite and inhibit the consumption of more nutrient-dense foods. Although tea is a popular drink throughout the European region, it is not recommended for infants and young children. In the present study sample, over 31% of the infants were consuming tea daily. Tannins and other compounds found in tea bind with iron and other minerals, thereby reducing bioavailability (Allen & Ahluwalia, 1997). Most of the mothers mentioned that they included sugar in tea and orange juice. This practice should also be discouraged.

The age appropriate vaccination coverage was highly satisfactory in the study group. However, some infants had suffered from diarrhoea (10%), vomiting (6.2%) and rashes (10%) during the 1 month preceding the interviews. However, they had recovered completely at the time of interview.

The knowledge scores of the mothers on basic nutrients were not satisfactory. Approximately one-third of the mothers (32.3%) of the study sample had scores below 40. Many of them were unable to recall few basic nutrients, their functions in the human body and some of the rich dietary sources for them, etc. Knowledge scores of rural mothers were significantly higher than that of urban and estate mothers. Based on the midwives' observations, this may be attributed to the higher participation of the rural mothers in various education programmes conducted at their clinics.

Infants with severe infective diseases, congenital anomalies, chronic diseases and preterm babies were excluded from the study to avoid confounders. However, the prevalence of low birth weight (LBW) in the study group was 13.3%. This was reported to be 16.3% in the Sri Lanka CF survey (Ministry of Health, 2008). It was reported that the prevalence of LBW had fluctuated between 16.9% and 17.6% from 2003 to 2008 in Sri Lanka (UNICEF, 2011). Our finding shows a declining trend for LBW, indicating the relevance of the present emphasis on antenatal care. However, when looking at the direct assessment of the nutritional status of the infants, it was found that the mean BMI in all age groups ranged from 16.54 to 16.73. Approximately 30.5% of infants had not achieved the age

appropriate weight, 29.5% had not achieved the age appropriate length and 25.5% were not achieved weight for length. According to the DHS survey of 2006–07, the prevalence of being underweight, stunting and wasting among children aged <5 years in Galle district was 23%, 16% and 14%, respectively (Department of Census and Statistics, 2009). The island wide values were 16% (underweight), 16% (stunting) and 13% (wasting) according to Sri Lanka CF survey 2008.

When analysing the achievements on WHO gross motor milestones, remarkable deviations were found between the median age for motor milestone achievements in the study group and the respective WHO median age (WHO Multicentre Growth Reference Study Group, 2006a,b). Numerous studies have documented the positive impact of high energy intake and micronutrient supplementation on motor development (Kuklina *et al.*, 2004; Siegel *et al.*, 2005). Hence, it is possible that delays in motor milestone achievement might be a result of the poor nutritional status of the infants, as reflected by 88% of infants who had delayed sitting without support and standing with assistance not achieving the age appropriate weight.

According to the Departments of Census and Statistics (2001) the total fertility rate in Galle is 2.1 and female literacy rate is 91.5. The level of education of the mothers of the sample was high and none of them exhibited any difficulty in recalling information about feeding practices retrospectively. Interviews were conducted by a single interviewer with the aim of minimising interviewer bias. However, it is acknowledged that the recall bias would not have been totally eliminated. Furthermore, the participants in the present study were the mothers who attended the well-baby clinics. Therefore, it can be a reflective of a population of mothers who are more concerned with infant nutrition and healthcare. Hence, it is assumed that the situation in the remainder of the infants is either similar or worse than this.

In conclusion, these findings show the effectiveness of breastfeeding promotion programmes conducted in Sri Lanka over the past few years. Approximately 94.6% of the mothers mentioned that they received knowledge and skills on infant feeding from the midwives. This clearly reflects the strengths of the community health service in Sri Lanka. Furthermore, it provides evidence indicating that the rate of LBW is going down in Sri Lanka. At present, the mothers are well aware of the new WHO recommendation on EBF. Mothers' attitudes have improved on EBF and on the continuation of breast feeding for 2 years or more. However, only half of the mothers are still practicing EBF. Even though the inclusion of animal products, pulses, dairy products, green leafy vegetable and oils in CFs has increased, most infants curiously display a poor

growth. This could be attributed mainly to the malpractices of CF, as indicated by the higher rates for the introduction of watery CFs and sugary foods, feeding of various commercial food items and poor skills on infant feeding. Being underweight, stunting and wasting have increased remarkably, reflecting the impact of improper feeding practices. At present, infants show delays in achieving motor milestones. The next indication would be poor cognitive development. The present study implies that further emphasis is required to promote EBF and improve infant feeding practices in Sri Lanka. Maternal and healthcare personnel need to investigate the drawbacks of the existing programmes. Identification of the causative factors for malpractice in CF with a view to improving CF practice is important. Educational interventions including comprehensive evaluation programmes, nutrition supplementation and further research represent other feasible options.

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### Conflict of interests, source of funding and authorship

The authors declare that they have no conflicts of interest.

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TB contributed to the study design and methods, collected and analysed data, interpreted the results and prepared the draft of the manuscript. MH, CL and SA developed the original concept, contributed to the study design and methods, analysed and interpreted the results, and reviewed and edited the manuscript. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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