Original Article

Determinants of inappropriate complementary feeding practices in young children in Sri Lanka: secondary data analysis of Demographic and Health Survey 2006–2007

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Abstract

Inappropriate complementary feeding increases risk of undernutrition, illness and mortality in infants and children. This paper aimed to determine the factors associated with inappropriate complementary feeding practices in Sri Lanka. The Sri Lanka Demographic and Health Survey 2006–2007 used a stratified two-stage cluster sample of ever-married women 15–49 years, and included details about foods given to children aged 6–23 months during the last 24 h. The new World Health Organization indicators for infant and young child feeding (IYCF) – (introduction of solid/semi-solid or soft foods; minimum dietary diversity; minimum meal frequency; and minimum acceptable diet) were calculated for 2106 children aged 6–23 months. These indicators were examined against explanatory variables with multivariate analyses to identify factors associated with inappropriate practices.

Eighty-four per cent of infants aged 6–8 months were introduced to complementary food. The proportion of infants aged 6–8 months who consumed eggs (7.5%), fruits and vegetables other than those rich in vitamin A (29.6%) and flesh foods (35.2%) was low. Of children aged 6–23 months, minimum dietary diversity was 71%, minimum meal frequency 88% and minimum acceptable diet 68%. Children who lived in tea estate sector had a lower dietary diversity and minimum acceptable diet than children in urban and rural areas. Other determinants of not receiving a diverse or acceptable diet were lower maternal education, shorter maternal height, lower wealth index, lack of postnatal visits, unsatisfactory exposure to media and acute respiratory infections. In conclusion, complementary feeding indicators were adequate except in the 6–11 months age group. Subgroups with inappropriate feeding practices should be the focus of IYCF promotion programs.

Keywords: infant feeding, child feeding, infant feeding behaviour, complementary feeding, complementary foods, dietary patterns.

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Introduction

Suboptimal child feeding practices including inappropriate breastfeeding and complementary feeding practices were among the leading causes of undernutrition and mortality during the first 2 years of life (Black *et al.* 2008). Complementary feeding is defined

as the process of starting other foods and liquids along with breast milk, when breast milk alone is no longer sufficient to meet the nutritional requirements of infants (Pan American Health Organization & World Health Organization 2003). Based on scientific evidence, the World Health Organization (WHO) recommends that infants should receive nutritionally

adequate and safe complementary foods from 6 months while breastfeeding continues for up to 2 years of age or beyond (WHO 2002). Introducing complementary foods at 6 months of age (180 days), while continuing to breastfeed, is the global recommendation. In addition, the Pan American Health Organization (PAHO)/WHO guiding principles of complementary feeding for breastfed children emphasize other important aspects of feeding such as responsive feeding, safe preparation and storage of foods, giving adequate amounts of complementary food, appropriate food consistency, meal frequency and energy density, to ensure the required nutrient content of complementary foods (Pan American Health Organization & World Health Organization 2003).

A set of new indicators for assessing infant and young child feeding (IYCF) practices has been introduced by the WHO through a Working Group on Infant and Young Child Feeding Indicators in 2007 (WHO *et al.* 2008; Daelmans *et al.* 2009). These indicators have been validated to reflect dietary quality and quantity, using existing data sets of large-scale household surveys (Working group on Infant and Young Child Feeding Indicators 2006; WHO *et al.* 2008). The core indicators relevant to complementary feeding are: (1) introduction of solid, semi-solid or soft food; (2) minimum dietary diversity; (3) minimum meal frequency; (4) minimum acceptable diet which is the summary IYCF indicator; and (5) consumption of iron-rich or iron-fortified foods (WHO *et al.* 2008; Daelmans *et al.* 2009). Such indicators would be useful in the assessment of current situation, targeting vulnerable groups and evaluation of programs related to complementary feeding practices in children.

Trends in breastfeeding practices and timely complementary feeding rates in Sri Lanka indicate a substantial improvement over the past 2 decades (Department of Census and Statistics 1995, 2002; Senarath *et al.* 2010), with the country having the highest rates of breastfeeding indicators among South Asian countries (Dibley *et al.* 2010). However, details about the dietary diversity, frequency or an understanding about adequacy in terms of nutrients and energy are not available at national level because of lack of appropriate indicators for complementary feeding at the time of the above mentioned analyses. The Nutrition and Food Security Survey of Sri Lanka highlighted that the dietary diversity among young children was poor because feeding of certain food items such as food rich in animal proteins was markedly low (Jayatissa & Hossain 2010). The Sri Lanka complementary feeding study also emphasized the problem of inappropriate complementary feeding despite high rate of introduction of complementary feeding in infants 6–9 months of age (Ministry of Healthcare and Nutrition & UNICEF 2008).

Detailed information on complementary feeding practices in Sri Lanka would guide policies and programs as well as new research to explore the current situation, trends and reasons for failure. Information on risk factors for inadequate complementary feeding will help target high-risk groups or the formulation of actions to minimize the risk factors through health programs. The aim of this paper was to assess the complementary feeding practices among children 6–23 months of age according to the new WHO indicators and to determine the factors associated with inappropriate complementary feeding practices

Key messages

- Introduction of complementary food within 6–8 months of age was satisfactory, and the dietary diversity, meal frequency and minimum acceptable diet were relatively good in Sri Lanka except in the 6–11 months age group.
- Poor complementary feeding practices were associated with children living in the tea estate sector; lower maternal education, lower wealth index, shorter maternal height, lack of post-natal visits, unsatisfactory exposure to media and children with acute respiratory infections.
- There was a consistent relationship between dietary diversity and minimum acceptable diet across various characteristics examined.
- Subgroups with inappropriate feeding practices should be the focus of IYCF promotion programs.

using Sri Lanka Demographic and Health Survey (SLDHS) 2006–2007 data.

Methods

Data source

The SLDHS 2006–2007 covered 20 districts from eight provinces (excluding the Northern province because of prevailing conflict situation) using a stratified two-stage cluster sample design (Department of Census and Statistics (DCS) & Ministry of Healthcare and Nutrition (MOH) 2009). A cluster was defined as a *Grama Niladhari* area – the smallest administration unit at village level. The first stage involved selection of 2106 clusters from three strata: 430 from urban, 1479 from rural and 197 from the tea estate sector. The second stage of selection involved systematic sampling of 10 housing units from each cluster. All ever-married women 15–49 years living in these households ($n = 14\,692$) were interviewed using a questionnaire, with a response rate of 97.5%. Respondents were asked detailed questions about the feeding status for their lastborn child under 24 months, who was living with the mother. In the sample, there were 2181 firstborn children aged 6–23 months. Seventy-five children were excluded because of incomplete data for the variables that were considered, thus our analysis was restricted to a total of 2106 children aged 6–23 months.

Special permission was obtained from the Department of Census and Statistics, Sri Lanka to analyse and present the Demographic and Health Survey (DHS) data. In the DHS survey, the primary data were collected according to ethical standards. Our analysis was conducted conforming to ethical principles and standards. The data used in these analyses were de-identified, and thus no ethical clearance for these secondary data analyses was required.

Complementary feeding indicators and explanatory factors

We applied the new and updated IYCF indicators of the WHO (Daelmans *et al.* 2009) which were based on mother's recall of foods given to the child in the 24 h

before the survey. The following four outcome measures were estimated:

1. Introduction of solid, semi-solid or soft foods: Proportion of infants 6–8 months of age who receive solid, semi-solid or soft foods.
2. Minimum dietary diversity: Proportion of children 6–23 months of age who receive foods from four or more food groups of the seven food groups. The seven food groups used for tabulation of this indicator were: grains, roots and tubers; legumes and nuts; dairy products (milk, yogurt, cheese); flesh foods (meat, fish, poultry and liver/organ meats); eggs; vitamin A-rich fruits and vegetables; and fruits and vegetables other than those rich in vitamin A. Consumption of any amount of food from each food group is sufficient to 'count', i.e. there is no minimum quantity, except if an item is only used as a condiment.
3. Minimum meal frequency: Proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more. Minimum was defined as: two times for breastfed infants 6–8 months, three times for breastfed children 9–23 months and four times for non-breastfed children 6–23 months.
4. Minimum acceptable diet: Proportion of children 6–23 months of age who receive a minimum acceptable diet (apart from breast milk). This composite indicator is calculated from the following two fractions: breastfed children 6–23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day, and non-breastfed children 6–23 months of age who received at least two milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency during the previous day. However, in the present analysis, this indicator was confined to only breastfed children because the minimum number of non-breast milk feeds as in the definition was not available in the DHS survey data.

Consumption of iron-rich or iron-fortified foods was not estimated because the survey did not collect information about iron-fortified food. The explana-

tory variables were classified into five levels: individual (child), parent, household, health care and community level characteristics. Child's age was categorized as 6–8, 9–11, 12–17 and 18–23 months considering the practical importance to have narrower age intervals in the younger age than older within the sample. Birthweights were obtained from the Child Health Development Records that had been provided to every mother at childbirth. Acute respiratory infections (ARIs) was defined as having symptoms of cough accompanied by short, rapid breathing which was chest related during 2 weeks preceding the survey. Any child with watery or blood and mucus stool in the last 2 weeks was considered as having diarrhoea. A simple index was created to define satisfactory exposure to media – if a woman reads a newspaper at least once a week, or watches television daily, or listens to radio daily. Standard definition for improved source of drinking water used in the Multiple Indicator Cluster survey was applied (UNICEF 2010). With respect to household decision making, the mothers were asked who in their family usually has the final say on making decisions on four specified areas: their own health care; major household purchases; purchases for daily household needs; and visiting her family or relatives. It was defined as 'mother involved' if she had participated in the decision making either alone or jointly with husband or someone else regarding any of the four decision making areas.

Wealth index was constructed using principal components analysis to determine the weights for the index based on information collected about several household assets and facilities (Filmer & Pritchett 1998). This index was divided into five categories (quintiles), and each household was assigned to one of these categories.

Statistical analysis

Four complementary feeding indicator variables, namely, introduction of solid, semi-solid or soft foods, minimum dietary diversity, minimum meal frequency and minimum acceptable diet rates, were expressed as dichotomous variables. The four complementary feeding indicators were examined against a set of

independent variables to determine the prevalence and factors associated with inappropriate practices. Statistical analyses were performed using Stata version 10.0 (StataCorp, College Station, TX, USA). 'Svy' commands were used to allow for adjustments for the cluster sampling design, sampling weights and the calculation of standard errors. These commands used Taylor series linearization method to estimate confidence intervals around prevalence estimates. Chi-squared test was used to test the significance of associations in the cross-tabulations.

Multiple logistic regression using a stepwise backwards approach to model construction was employed to determine the factors significantly associated with inappropriate feeding practices. The factors that were not significant ($P \geq 0.05$) were eliminated in a stepwise manner, and those factors, when any level of the factor was significant ($P < 0.05$), were retained in the final model. The odds ratios (ORs) with 95% confidence intervals were calculated in order to assess the adjusted risk of independent variables.

Results

Characteristics of the sample

Table 1 presents the distribution of the sample according to attributes of the child, parent, household, health care provision and community. The prevalence of low birth weight (LBW) was 14%, prevalence of diarrhoea was 7% and ARI was 5%. The majority of mothers in the sample was in the age bracket of 20–34 years (78.4%) while only 3% was in the age group of 15–19 years. The percentage of mothers with no schooling or with primary education only was 11%, secondary education was 53% and higher education was 36%. Nearly 56% of partners have had secondary education with 13% having only primary education or no schooling.

With regard to health care service provision to pregnant mothers, nearly 66% has received at least seven antenatal clinic (ANC) visits and 79% received antenatal home visits by public health midwife (PHM). However, only 24% of post-natal mothers had received the recommended three or more home visits by the PHM. The majority of the sample was

Table 1. Individual, parental, household, health care and community level characteristics of children aged 6–23 months, Sri Lanka 2006–2007 (*n* = 2106)

Characteristic	<i>n</i>	%	Characteristic	<i>n</i>	%
<i>Child characteristics</i>			Decision making at household		
Gender of child			Mother involved	1670	79.3
Male	1074	51.0	Mother not involved	436	20.7
Female	1032	49.0	Household wealth index		
Age of child (months)			Poorest	368	17.5
6–8	321	15.3	Poorer	437	20.8
9–11	401	19.0	Middle	422	20.0
12–17	703	33.4	Richer	454	21.6
18–23	681	32.3	Richest	425	20.2
Birth order			Source of drinking water		
Firstborn	834	39.6	Improved	1865	88.6
Second	786	37.3	Not improved	241	11.4
Third or higher	487	23.1	Exposure to media		
Birthweight (g)			Satisfactory†	1761	83.6
Low (<2500)	296	14.1	Limited	345	16.4
Normal (≥2500)	1810	85.9	<i>Health care characteristics</i>		
Diarrhoea in the past 2 weeks			No. of antenatal clinic visits*		
No	1966	93.4	1–3	239	11.4
Yes	140	6.6	4–6	452	21.4
Acute respiratory infection in the past 2 weeks			≥7	1385	65.8
No	2002	95.1	Unknown	30	1.4
Yes	104	5.0	Antenatal home visits by PHM		
<i>Parental characteristics</i>			Yes	1667	79.2
Mother's age* (years)			No	439	20.9
15–19	72	3.4	No. of post-natal home visits by PHM		
20–34	1651	78.4	None	443	21.1
35–49	382	18.1	1	585	27.8
Maternal education			2	577	27.4
Primary or no schooling	231	11.0	≥3	501	23.8
Secondary	1118	53.1	Place of birth		
Higher	757	35.9	Home	10	0.5
Maternal working status			Teaching/general/base hospital	1703	80.9
Non-working	1650	78.3	District/rural hospital/peripheral unit/maternity	303	14.4
Working	456	21.7	home		
Maternal height (cm)			Private hospital/other	90	4.3
<150	636	30.2	Mode of delivery		
150–155	715	33.9	Non-Caesarean	1595	75.7
>155	755	35.9	Caesarean section	511	24.3
Maternal BMI (kg m ⁻²)			<i>Community level characteristics</i>		
<18.5	555	26.4	Type of residence		
18.5–24.9	1078	51.2	Urban	270	12.8
≥25	473	22.5	Rural	1696	80.6
Marital status			Estate	140	6.6
Currently married	2078	98.7	Province		
Formerly married (divorced/separated/widowed)	28	1.3	Western	589	28.0
Father's education			Central	318	15.1
Primary or no education	277	13.2	Southern	258	12.2
Secondary	1169	55.5	Eastern	251	11.9
Higher	660	31.3	North Western	191	9.1
<i>Household characteristics</i>			North Central	146	7.0
No. of children under 5 years			Uva	173	8.2
One	834	39.6	Sabaragamuwa	180	8.5
Two	786	37.3			
Three or more	487	23.1			

BMI, body mass index; PHM, public health midwife. *Data available for less than 2106 children. †Reads newspaper at least once a week or watches television daily or listens to radio daily.

Table 2. Types of food given to children aged 6–23 months by age group, Sri Lanka 2006–2007 ($n=2106$)

Food group	Age of child (months)									
	6–8		9–11		12–17		18–23		6–23	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Grains, roots and tubers	67.9	(62.1, 73.1)	90.4	(86.4, 93.2)	96.3	(94.6, 97.5)	96.2	(94.1, 97.6)	90.9	(89.4, 92.2)
Legumes and nuts	42.4	(36.8, 48.2)	57.9	(53.1, 62.7)	59.8	(55.7, 63.7)	59.1	(54.2, 63.9)	56.8	(53.9, 59.6)
Dairy products	36.5	(30.7, 42.7)	50.7	(44.4, 56.9)	66.9	(62.9, 70.6)	75.1	(71.0, 78.7)	61.9	(59.0, 64.8)
Flesh foods	35.2	(29.7, 41.1)	52.0	(46.2, 57.7)	69.6	(64.8, 73.9)	72.8	(68.5, 76.7)	62.2	(59.7, 64.7)
Eggs	7.5	(4.9, 11.3)	16.2	(12.9, 20.0)	25.1	(21.7, 28.8)	30.7	(26.3, 35.5)	22.3	(20.4, 24.4)
Vitamin A-rich fruits and vegetables	60.9	(54.8, 66.8)	79.6	(74.6, 83.8)	82.9	(79.5, 85.8)	82.4	(78.5, 85.7)	78.8	(76.2, 81.2)
Other fruits and vegetables	29.6	(25.1, 34.6)	42.0	(35.7, 48.7)	46.4	(42.5, 50.3)	48.4	(44.1, 52.8)	43.8	(41.0, 46.7)
Total number of children	321		401		703		681		2106	

CI, confidence interval.

from rural areas (81%) with nearly 13% from urban area, and 7% from tea estates.

Types of food given to child by age and complementary feeding indicators

Table 2 describes the types of food given during the preceding day according to the age of the child. The rates of different food groups offered during the past 24 h were uniformly lower in the 6–8 months age group, with the lowest rates reported for eggs (7.5%), fruits and vegetables other than those rich in vitamin A (29.6%) and flesh foods (35.2%). With increasing age, an increasing trend in offering food was observed in all food groups. However, only 31% of children aged 18–23 had been offered eggs, and 48% of children had been offered fruits and vegetables other than those rich in vitamin A. The rate of offering flesh food was higher at 73% in this age group. The rate of offering vitamin A-rich foods and vegetables was around 61% in the 6–8 age group and more than 80% in all other age groups.

Table 3 presents the complementary feeding indicators by age for breastfed, non-breastfed and all children. Overall, the rate of introduction of complementary feeding was 84% at 6–8 months of age, the minimum dietary diversity was 71% at 6–23 months and the minimum meal frequency was 88% at 6–23 months. However, the rate of minimum acceptable diet was available only for breastfed children (6–23

months) and was 68%. All these feeding indicators improved with the age of the child.

Differentials of complementary feeding indicators

Table 4 describes the introduction of complementary food, minimum dietary diversity, minimum meal frequency and minimum acceptable diet according to attributes of the child, parents, household, health care provision and community. For introduction of complementary food, although an increasing trend was observed within many variables (with increasing maternal education, increasing maternal height and from estate to rural to urban sector) these factors were not significantly associated with the indicator. A discernible trend across wealth quintiles was not observed. A significant association was observed, with a higher percentage (91.5%) of overweight/obese mothers introducing complementary feeding than normal weight mothers. The introduction of complementary feeding was significantly higher among mothers with 'satisfactory' exposure to the media (86.6%) compared to those with limited exposure to media (69.1%).

A significantly increasing trend was observed with regard to minimum dietary diversity as the age of the child increased (40.1% in the 6–8-month age group to 82.5% in the 18–23-month age group). During ill health, a significantly lower percentage of children

Table 3. Complementary feeding indicators among children 6–23 months of age, Sri Lanka 2006–2007 (*n*=2106)

Indicator	Sample size	<i>n</i>	Rate (%)	(95% CI)
Introduction of solid, semi-solid or soft foods (6–8 months)	321	269	83.9	(78.8, 87.9)
Minimum dietary diversity				
Minimum dietary diversity, breastfed (6–11 months)	703	377	53.6	(53.6, 57.9)
Minimum dietary diversity, non-breastfed (6–11 months)	19	9	47.8	(27.3, 67.3)
Minimum dietary diversity, all (6–11 months)	722	386	53.4	(49.0, 57.8)
Minimum dietary diversity, breastfed (12–17 months)	644	502	78.0	(74.4, 81.3)
Minimum dietary diversity rate, non-breastfed (12–17 months)	59	48	81.3	(69.1, 90.3)
Minimum dietary diversity rate, all (12–17 months)	703	550	78.3	(74.9, 81.4)
Minimum dietary diversity, breastfed (18–23 months)	572	478	83.6	(79.9, 86.6)
Minimum dietary diversity rate, non-breastfed (18–23 months)	108	83	76.9	(67.8, 84.4)
Minimum dietary diversity, all (18–23 months)	681	562	82.5	(79.1, 85.4)
Minimum dietary diversity, breastfed (6–23 months)	1920	1358	70.7	(67.9, 73.4)
Minimum dietary diversity, non-breastfed (6–23 months)	186	140	75.3	(67.3, 81.8)
Minimum dietary diversity, all (6–23 months)	2106	1498	71.1	(68.4, 73.7)
Minimum meal frequency				
Minimum meal frequency, breastfed (6–11 months)	703	576	81.9	(78.5, 84.9)
Minimum meal frequency, non-breastfed (6–11 months)	19	12	61.8	(38.4, 83.7)
Minimum meal frequency, all (6–11 months)	722	588	81.4	(77.9, 84.4)
Minimum meal frequency, breastfed (12–17 months)	644	593	92.1	(88.7, 94.6)
Minimum meal frequency, non-breastfed (12–17 months)	59	48	81.3	(69.1, 90.3)
Minimum meal frequency, all (12–17 months)	703	641	91.2	(87.8, 93.7)
Minimum meal frequency, breastfed (18–23 months)	572	548	95.7	(93.8, 97.1)
Minimum meal frequency, non-breastfed (18–23 months)	108	83	76.9	(67.8, 84.4)
Minimum meal frequency, all (18–23 months)	681	631	92.7	(89.9, 94.8)
Minimum meal frequency, breastfed (6–23 months)	1920	1718	89.5	(87.7, 91.0)
Minimum meal frequency, non-breastfed (6–23 months)	186	142	76.6	(68.2, 83.3)
Minimum meal frequency, all (6–23 months)	2106	1860	88.3	(86.5, 90.0)
Minimum acceptable diet				
Minimum acceptable diet, breastfed (6–11 months)	703	356	50.7	(46.6, 54.8)
Minimum acceptable diet, breastfed (12–17 months)	644	480	74.5	(70.2, 78.4)
Minimum acceptable diet, breastfed (18–23 months)	572	466	81.5	(77.6, 84.8)
Minimum acceptable diet, breastfed (6–23 months)	1920	1303	67.9	(65.1, 70.5)

CI, confidence interval.

received a diverse diet. A significantly increasing trend was also observed with increasing maternal age, increasing maternal education and increasing maternal height but not with body mass index (BMI). Increasing education of partner, household wealth quintile, increasing number of ANC visits and post-natal visits were also significantly associated with higher rates of dietary diversity. A significantly lower proportion of children in the estate sector reached minimum dietary diversity (50.7%) compared to the urban sector (74.7%). Children of non-working mothers, children of mothers not involved in decision making in the family and children of mothers who had no antenatal home visits by PHM were found to have significantly low dietary diversity.

The variation with regard to minimum meal frequency was not so marked as in the dietary diversity. A significantly increasing pattern of meal frequency was observed with increasing age of the child, increasing maternal education, increasing maternal BMI, increasing wealth quintile and with women having higher number of post-natal visits by the PHM. As in the above indicator, the rate of minimum meal frequency in the estate sector was lower (76.1%) compared to the rural (89.2%) and the urban sectors (88.9%).

The differentials of minimum acceptable diet were almost similar to that of minimum dietary diversity, with comparable patterns seen across the characteristics. With increasing age, an increasing percentage of

Table 4. Introduction of solid, semi-solid or soft food, minimum dietary diversity, minimum meal frequency and minimum acceptable diet according to characteristics, Sri Lanka 2006–2007

Characteristic	Introduction of solid, semi-solid or soft food (6–8) months			Minimum dietary diversity (6–23) months			Minimum meal frequency (6–23) months			Minimum acceptable diet* (6–23) months		
	%	95% CI	P	%	95% CI	P	%	95% CI	P	%	95% CI	P
<i>Child characteristics</i>												
<i>Gender of child</i>												
Male	83.2	(77.4, 87.7)	0.678	69.9	(66.6, 72.9)	0.246	88.5	(86.2, 90.5)	0.767	65.6	(62.3, 68.7)	0.522
Female	84.8	(76.6, 90.5)		72.4	(68.7, 75.8)		88.1	(85.6, 90.2)		67.0	(63.1, 70.8)	
<i>Age of child (months)</i>												
6–8	83.9	(78.8, 87.9)	–	40.1	(33.9, 46.6)	<0.001	77.5	(71.8, 82.2)	<0.001	39.0	(32.9, 45.5)	<0.001
9–11				64.1	(58.4, 69.4)		84.5	(80.8, 87.7)		59.0	(54.0, 63.9)	
12–17				78.3	(74.8, 81.4)		91.2	(87.8, 93.7)		74.5	(70.2, 78.4)	
18–23				82.5	(79.0, 85.5)		92.7	(89.9, 94.8)		81.5	(77.6, 84.8)	
<i>Birth order</i>												
Firstborn	86.0	(78.0, 91.4)	0.686	74.4	(71.1, 77.5)	0.017	89.5	(87.0, 91.6)	0.344	69.2	(65.6, 72.5)	0.035
Second	81.6	(70.9, 88.9)		70.1	(66.0, 73.8)		88.1	(85.0, 90.6)		65.9	(61.8, 69.8)	
Third or higher	83.3	(73.0, 90.2)		67.2	(62.4, 71.5)		86.6	(82.7, 89.8)		62.0	(57.2, 66.6)	
<i>Birthweight (g)</i>												
Low (<2500)	78.9	(63.9, 88.7)	0.277	68.3	(62.7, 73.4)	0.284	88.4	(84.2, 91.6)	0.978	63.9	(57.9, 69.5)	0.382
Normal (≥2500)	84.8	(80.1, 88.6)		71.6	(68.6, 74.4)		88.3	(86.3, 90.1)		66.7	(63.7, 69.5)	
<i>Diarrhoea in the past 2 weeks</i>												
No	84.0	(79.0, 88.0)	0.781	71.9	(69.2, 74.5)	0.002	88.6	(86.6, 90.3)	0.251	67.0	(64.1, 69.7)	0.012
Yes	82.2	(65.2, 91.9)		59.9	(51.6, 67.6)		85.1	(77.8, 90.3)		56.8	(48.5, 64.7)	
<i>Acute respiratory infection, past 2 weeks</i>												
No	84.4	(79.1, 88.6)	0.288	72.1	(69.4, 74.6)	<0.001	88.6	(86.8, 90.2)	0.043	67.3	(64.5, 70.0)	<0.001
Yes	75.3	(52.9, 89.2)		52.5	(41.7, 63.1)		82.7	(74.6, 88.6)		46.6	(36.9, 56.5)	
<i>Parental characteristics</i>												
<i>Mother's age (years)</i>												
15–19	81.1	(49.0, 95.1)	0.604	53.7	(40.5, 66.4)	0.009	84.3	(74.9, 90.7)	0.447	49.7	(37.0, 62.4)	0.026
20–34	84.9	(79.7, 88.9)		71.0	(68.1, 73.8)		88.9	(86.8, 90.7)		66.4	(63.4, 69.3)	
35–49	78.9	(60.5, 90.2)		74.7	(70.3, 78.7)		86.6	(82.6, 89.8)		68.8	(64.2, 73.0)	
<i>Maternal education</i>												
Primary or no schooling	69.1	(51.2, 82.7)	0.075	52.4	(46.1, 58.5)	<0.001	82.3	(76.2, 87.1)	0.007	47.4	(41.0, 53.9)	<0.001
Secondary	85.5	(79.5, 89.9)		67.9	(64.4, 71.2)		87.5	(84.9, 89.7)		63.1	(59.5, 66.0)	
Higher	86.0	(75.9, 92.3)		81.6	(78.5, 84.3)		91.4	(88.2, 93.8)		76.8	(73.1, 80.2)	
<i>Maternal working status</i>												
Non-working	82.9	(77.1, 87.5)	0.348	69.7	(66.7, 72.5)	0.010	88.2	(85.9, 90.1)	0.681	65.1	(62.0, 68.1)	0.058
Working	87.9	(77.2, 94.0)		76.3	(71.8, 80.3)		88.9	(85.7, 91.5)		70.4	(65.5, 75.0)	

Table 4. Continued

Characteristic	Introduction of solid, semi-solid or soft food (6–8) months			Minimum dietary diversity (6–23) months			Minimum meal frequency (6–23) months			Minimum acceptable diet* (6–23) months		
	%	95% CI	P	%	95% CI	P	%	95% CI	P	%	95% CI	P
Maternal height (cm)												
<150	79.6	(70.2, 86.7)	0.269	63.6	(59.2, 67.8)	<0.001	86.5	(83.6, 89.0)	0.112	59.2	(54.7, 63.6)	<0.001
150–155	83.1	(73.8, 89.6)		71.9	(68.0, 75.4)		87.8	(84.8, 90.4)		66.9	(63.0, 70.5)	
>155	88.0	(79.9, 93.2)		76.7	(73.4, 79.7)		90.3	(87.4, 92.6)		71.7	(68.2, 75.0)	
Maternal BMI (kg m ⁻²)												
<18.5	74.8	(60.1, 85.5)	0.041	70.6	(65.5, 75.2)	0.766	85.1	(81.3, 88.3)	0.048	64.9	(59.8, 69.6)	0.344
18.5–24.9	84.3	(77.5, 89.4)		71.9	(68.8, 74.7)		89.4	(87.5, 91.1)		67.9	(64.8, 70.9)	
≥25	91.5	(83.1, 95.9)		70.1	(65.1, 74.6)		89.6	(85.2, 92.8)		64.2	(58.4, 69.6)	
Marital status												
Currently married	84.6	(79.7, 88.5)	0.003	71.4	(68.6, 73.9)	0.026	88.5	(86.6, 90.1)	0.085	66.6	(63.8, 69.3)	0.019
Formerly married (divorced/separated/widowed)	39.7	(11.2, 77.5)		54.1	(38.4, 69.0)		78.9	(62.3, 89.4)		45.0	(28.0, 63.2)	
Father's education												
Primary or no education	77.8	(59.0, 89.5)	0.266	64.0	(57.7, 69.8)	<0.001	86.6	(81.4, 90.5)	0.363	60.0	(54.0, 65.8)	<0.001
Secondary	86.6	(80.9, 90.8)		67.6	(64.1, 71.0)		88.5	(86.4, 90.3)		62.7	(59.1, 66.3)	
Higher	83.9	(72.4, 91.2)		81.4	(77.8, 84.6)		89.6	(85.7, 92.6)		76.0	(71.6, 79.9)	
Unknown	71.0	(48.3, 86.5)		65.4	(57.0, 72.9)		84.1	(76.2, 89.8)		62.3	(53.8, 70.1)	
Household characteristics												
No. of children under 5 years												
One	86.0	(78.0, 91.4)	0.686	74.4	(71.1, 77.5)	0.017	89.5	(87.0, 91.6)	0.344	69.2	(65.6, 72.5)	0.035
Two	81.6	(70.9, 88.9)		70.1	(66.0, 73.8)		88.1	(85.0, 90.6)		65.9	(61.8, 69.8)	
Three or more	83.3	(73.0, 90.2)		67.2	(62.4, 71.5)		86.6	(82.7, 89.8)		62.0	(57.2, 66.6)	
Decision making at household												
Mother involved	84.2	(78.8, 88.4)	0.708	73.0	(70.5, 75.5)	<0.001	88.4	(86.4, 90.2)	0.710	68.2	(65.5, 70.8)	<0.001
Mother not involved	82.7	(73.4, 89.2)		63.7	(58.1, 69.0)		87.9	(85.1, 90.3)		58.9	(53.2, 64.4)	
Household wealth index												
Poorest	81.9	(65.3, 91.6)	0.387	59.3	(53.3, 65.2)	<0.001	85.6	(81.3, 89.1)	0.027	55.3	(49.0, 61.4)	<0.001
Poorer	77.2	(66.4, 85.3)		64.6	(59.0, 69.7)		84.5	(80.4, 87.8)		59.1	(53.4, 64.7)	
Middle	85.4	(74.0, 92.3)		67.7	(61.8, 73.1)		90.1	(86.8, 92.7)		64.3	(58.6, 69.6)	
Richer	90.5	(80.6, 95.6)		78.9	(74.1, 82.9)		90.9	(86.7, 93.8)		73.6	(68.3, 78.2)	
Richest	85.2	(71.1, 93.0)		83.2	(78.8, 86.8)		90.2	(85.8, 93.3)		77.4	(72.4, 81.7)	
Source of drinking water												
Improved	82.3	(76.9, 86.7)	0.024	71.0	(68.1, 73.7)	0.787	88.4	(86.4, 90.2)	0.654	66.2	(63.1, 69.1)	0.724
Not improved	97.3	(82.1, 99.6)		72.0	(64.2, 77.9)		87.5	(83.1, 90.9)		67.4	(60.9, 73.2)	

BMI, body mass index; CI, confidence interval; PHM, public health midwife. *P*-values are based on chi-squared test. *P*-values and the CIs have been adjusted to account the sampling methods. *For breastfed children only. †Reads newspaper at least once a week or watches television daily or listens to radio daily.

Table 5. Determinants of not introducing solid, semi-solid or soft food to infants 6–8 months, Sri Lanka 2006–2007: unadjusted and adjusted ORs

Characteristic	Risk for not introducing complementary food					
	Unadjusted			Adjusted		
	OR	95% CI	P	OR	95% CI	P
<i>Child characteristics</i>						
<i>Nil</i>						
<i>Parental characteristics</i>						
<i>Maternal BMI (kg m⁻²)</i>						
18.5–24.9	1.00			1.00		
<18.5	1.07	(0.75, 1.55)	0.702	1.08	(0.75, 1.54)	0.679
≥25	0.66	(0.46, 0.94)	0.020	0.63	(0.44, 0.90)	0.012
<i>Household characteristics</i>						
<i>Nil</i>						
<i>Health care characteristics</i>						
<i>Antenatal clinic visits</i>						
≥7	1.00			1.00		
4–6	1.10	(0.78, 1.56)	0.575	1.13	(0.79, 1.61)	0.50
1–3	0.63	(0.41, 0.96)	0.033	0.64	(0.41, 1.00)	0.05
Unknown	2.67	(0.59, 12.15)	0.204	2.63	(0.58, 11.96)	0.21
<i>Community level characteristics</i>						
<i>Province</i>						
Western	1.00			1.00		
Central	1.32	(0.87, 2.00)	0.196	1.33	(0.88, 2.03)	0.173
Southern	0.67	(0.47, 0.96)	0.027	0.69	(0.48, 1.00)	0.049
Eastern	1.07	(0.71, 1.61)	0.755	1.18	(0.79, 1.77)	0.420
North Western	0.88	(0.56, 1.40)	0.597	0.95	(0.60, 1.52)	0.842
North Central	1.47	(0.72, 3.01)	0.294	1.45	(0.71, 2.95)	0.306
Uva	1.05	(0.73, 1.51)	0.790	1.10	(0.77, 1.56)	0.613
Sabaragamuwa	0.92	(0.51, 1.65)	0.781	0.90	(0.50, 1.63)	0.735

BMI, body mass index; CI, confidence interval; OR, odds ratio. Adjusted odds ratios are based on the multiple logistic regression model that includes all predictor variables retained by backward elimination, and also taking account of the clustering.

children received a minimum acceptable diet, which was statistically significant. The proportion of children receiving the minimum acceptable diet significantly increased with birth order, increasing maternal age, education and height, increasing education of partner, increasing wealth quintiles, and antenatal and post-natal visits by PHM. As revealed by above indicators, in this instance too, a significantly lower percentage of children received an acceptable diet during ill health. No gender difference was observed and no association was seen with LBW in any of the above indicators.

Determinants of inappropriate complementary feeding practices

As shown in Table 5, introduction of solid or semi-solid food was associated with the maternal BMI,

where those with higher BMI had a higher rate of introducing such food than mothers with normal BMI. In general, all three complementary feeding indicators increased significantly with increasing age of the child (Tables 6–8). Risk for inappropriate dietary diversity was high in children who had ARIs in the previous 2 weeks (adjusted OR = 2.08), but not with any diarrhoeal disease (Table 6). Compared with mothers with higher levels of education, those who had completed up to secondary education or no schooling reported a higher risk for poor diversity (OR being 1.97 and 1.48, respectively). Even after adjusting for maternal education and other potential confounders, 'working mother' remained as a significant protective factor for inadequate dietary diversity (OR = 0.71). Paternal education was not associated with any of complementary feeding indicators.

Table 6. Determinants of inappropriate dietary diversity among children aged 6–23 months: unadjusted and adjusted ORs, Sri Lanka 2006–2007

Characteristic	Risk for inappropriate dietary diversity					
	Unadjusted			Adjusted		
	OR	95% CI	P	OR	95% CI	P
<i>Child characteristics</i>						
Age of child (months)						
18–23	1.00			1.00		
12–17	1.31	(1.01, 1.69)	0.042	1.37	(1.05, 1.80)	0.023
6–11	4.10	(3.13, 5.38)	<0.001	4.71	(3.53, 6.29)	<0.001
Acute respiratory infection, past 2 weeks						
No	1.00			1.00		
Yes	2.34	(1.50, 3.64)	<0.001	2.08	(1.22, 3.54)	0.007
<i>Parental characteristics</i>						
Maternal education						
Higher	1.00			1.00		
Secondary	4.03	(2.99, 5.44)	<0.001	1.97	(1.38, 2.82)	<0.001
Primary or no schooling	2.10	(1.67, 2.64)	<0.001	1.48	(1.11, 1.98)	0.009
Maternal working status						
Non-working	1.00			1.00		
Working	0.71	(0.55, 0.92)	0.010	0.71	(0.52, 0.98)	0.040
Maternal height (cm)						
>155	1.00			1.00		
150–155	1.88	(1.46, 2.43)	<0.001	1.45	(1.11, 1.89)	0.006
<150	1.29	(1.03, 1.61)	0.024	1.06	(0.84, 1.34)	0.637
<i>Household characteristics</i>						
Decision making at household						
Mother involved	1.00			1.00		
Mother not involved	1.54	(1.22, 1.92)	<0.001	1.33	(1.03, 1.71)	0.028
Household wealth index						
Richest	1.00			1.00		
Richer	1.33	(0.90, 1.95)	0.15	1.12	(0.75, 1.68)	0.579
Middle	2.36	(1.65, 3.38)	<0.001	1.79	(1.19, 2.68)	0.005
Poorer	2.72	(1.88, 3.94)	<0.001	1.85	(1.16, 2.97)	0.010
Poorest	3.39	(2.34, 4.93)	<0.001	2.05	(1.32, 3.19)	0.001
<i>Health care characteristics</i>						
No. of antenatal clinic visits						
≥7	1.00			1.00		
4–6	1.39	(1.11, 1.75)	0.005	1.30	(1.01, 1.66)	0.04
1–3	1.34	(0.97, 1.85)	0.079	1.20	(0.84, 1.73)	0.31
Unknown	0.65	(0.27, 1.55)	0.330	0.67	(0.26, 1.76)	0.42
No. of post-natal home visits by PHM						
≥3	1.00			1.00		
2	0.93	(0.69, 1.26)	0.653	0.89	(0.65, 1.22)	0.457
1	1.47	(1.13, 1.92)	0.004	1.44	(1.08, 1.92)	0.013
None	2.11	(1.61, 2.77)	<0.001	1.57	(1.13, 2.17)	0.007
<i>Community level characteristics</i>						
Type of residence						
Urban	1.00			1.00		
Rural	1.13	(0.84, 1.52)	0.402	0.99	(0.70, 1.39)	0.947
Estate	2.87	(2.00, 4.10)	<0.001	2.38	(1.49, 3.80)	<0.001
Province						
Western	1.00			1.00		
Central	1.36	(0.99, 1.87)	0.060	0.85	(0.57, 1.26)	0.412
Southern	1.22	(0.89, 1.68)	0.209	0.93	(0.64, 1.37)	0.727
Eastern	2.83	(1.84, 4.34)	<0.001	1.75	(1.13, 2.72)	0.012
North Western	1.52	(1.12, 2.08)	0.008	1.31	(0.91, 1.87)	0.146
North Central	1.99	(1.21, 3.27)	0.007	1.60	(0.93, 2.76)	0.089
Uva	2.32	(1.42, 3.77)	0.001	1.46	(0.80, 2.67)	0.217
Sabaragamuwa	1.32	(0.80, 2.18)	0.279	0.84	(0.55, 1.27)	0.404

CI, confidence interval; OR, odds ratio; PHM, public health midwife. Adjusted odds ratios are based on the multiple logistic regression model that includes all predictor variables retained by backward elimination, and also taking account of the clustering.

Table 7. Determinants of inadequate meal frequency in children aged 6–23 months, Sri Lanka 2006–2007: unadjusted and adjusted ORs

Characteristic	Risk for inadequate meal frequency					
	Unadjusted			Adjusted		
	OR	95% CI	P	OR	95% CI	P
<i>Child characteristics</i>						
Age of child (months)						
18–23	1.00			1.00		
12–17	1.23	(0.80, 1.88)	0.346	1.30	(0.85, 1.99)	0.231
6–11	2.91	(1.86, 4.55)	<0.001	3.09	(1.99, 4.81)	<0.001
<i>Parental characteristics</i>						
Maternal BMI (kg m ⁻²)						
18.5–24.9	1.00			1.00		
<18.5	1.48	(1.08, 2.02)	0.014	1.60	(1.15, 2.22)	0.005
≥25	0.98	(0.65, 1.49)	0.924	1.05	(0.66, 1.67)	0.846
<i>Household characteristics</i>						
Exposure to media						
Satisfactory*	1.00			1.00		
Limited	1.76	(1.27, 2.43)	0.001	1.55	(1.08, 2.21)	0.015
<i>Health care characteristics</i>						
No. of antenatal clinic visits						
≥7	1.00			1.00		
4–6	1.44	(1.04, 2.00)	0.030	1.56	(1.10, 2.21)	0.014
1–3	1.52	(1.03, 2.24)	0.036	1.54	(1.00, 2.36)	0.048
Unknown	1.33	(0.37, 4.73)	0.659	1.65	(0.50, 5.48)	0.411
Antenatal home visits by PHM						
Yes	1.00			1.00		
No	1.89	(1.34, 2.65)	<0.001	1.85	(1.26, 2.73)	0.002
<i>Community level characteristics</i>						
Province						
Western	1.00			1.00		
Central	2.70	(1.63, 4.46)	<0.001	3.16	(1.87, 5.34)	<0.001
Southern	1.52	(0.94, 2.48)	0.090	1.51	(0.89, 2.55)	0.124
Eastern	1.67	(0.93, 3.00)	0.084	1.24	(0.68, 2.27)	0.477
North Western	1.38	(0.62, 3.06)	0.425	1.40	(0.62, 3.18)	0.417
North Central	3.20	(1.97, 5.20)	<0.001	3.97	(2.31, 6.82)	<0.001
Uva	2.67	(1.55, 4.62)	<0.001	2.65	(1.52, 4.62)	0.001
Sabaragamuwa	1.15	(0.54, 2.42)	0.720	1.13	(0.51, 2.50)	0.770

BMI, body mass index; CI, confidence interval; OR, odds ratio; PHM, public health midwife. Adjusted odds ratios are based on the multiple logistic regression model that includes all predictor variables retained by backward elimination, and also taking account of the clustering. *Reads newspaper at least once a week or watches television daily or listens to radio daily.

Inadequate diversity was also associated with lower maternal height (OR = 1.45 for heights 150–155 cm) and if the mother was not involved in household decisions (OR = 1.33). Dietary diversity gradually declined with lower wealth index quintiles. Of the health care attributes, fewer ANC visits and fewer post-natal home visits by the PHM were predictive of inappropriate dietary diversity and the latter being more pronounced when there were no post-natal home visits at all (OR = 1.57). Children living in the

tea estate sector were found to have a significantly greater risk for failed diversity (OR = 2.38) compared to urban children. The Eastern province had a higher risk for inadequate diversity (OR = 1.75) with compared to the Western province in Sri Lanka.

As shown in Table 7, inadequate meal frequency was significantly associated with low maternal BMI (OR = 1.60), limited exposure to media (OR = 1.55), less ANC visits and no antenatal home visits (OR = 1.85). The Central, North Central and Uva

Table 8. Determinants of not meeting the minimum acceptable diet in children aged 6–23 months, Sri Lanka 2006–2007: unadjusted and adjusted ORs

Characteristic	Risk for inadequate acceptable diet					
	Unadjusted			Adjusted		
	OR	95% CI	P	OR	95% CI	P
<i>Child characteristics</i>						
Age of child (months)						
18–23	1.00			1.00		
12–17	1.17	(0.92, 1.49)	0.193	1.24	(0.96, 1.59)	0.096
6–11	3.84	(2.45, 4.17)	<0.001	3.61	(2.71, 4.79)	<0.001
Acute respiratory infection, past 2 weeks						
No	1.00			1.00		
Yes	2.36	(1.59, 3.52)	<0.001	2.13	(1.37, 3.31)	0.001
<i>Parental characteristics</i>						
Maternal education						
Higher	1.00			1.00		
Secondary	3.68	(2.67, 5.07)	<0.001	1.84	(1.24, 2.76)	0.003
No schooling or primary	1.94	(1.52, 2.48)	<0.001	1.48	(1.21, 1.96)	0.006
Maternal height (cm)						
>155	1.00			1.00		
150–155	1.75	(1.37, 2.23)	<0.001	1.34	(1.05, 1.72)	0.021
<150	1.26	(1.03, 1.54)	0.027	1.03	(0.83, 1.27)	0.800
<i>Household characteristics</i>						
Household wealth index						
Richest	1.00			1.00		
Richer	1.23	(0.85, 1.765)	0.27	1.10	(0.75, 1.61)	0.618
Middle	1.90	(1.36, 2.642)	<0.001	1.45	(1.00, 2.10)	0.049
Poorer	2.36	(1.67, 3.341)	<0.001	1.52	(1.00, 2.31)	0.050
Poorest	2.76	(1.92, 3.987)	<0.001	1.45	(0.94, 2.24)	0.089
Exposure to media						
Satisfactory*	1.00			1.00		
Limited	2.10	(1.59, 2.77)	<0.001	1.36	(1.01, 1.85)	0.044
<i>Health care characteristics</i>						
No. of post-natal home visits by PHM						
≥3	1.00			1.00		
2	0.93	(0.71, 1.23)	0.608	0.90	(0.67, 1.21)	0.482
1	1.38	(1.07, 1.78)	0.012	1.34	(1.02, 1.76)	0.033
None	2.24	(1.68, 2.99)	<0.001	1.71	(1.22, 2.38)	0.002
<i>Community level characteristics</i>						
Type of residence						
Urban	1.00			1.00		
Rural	0.94	(0.70, 1.26)	0.683	0.82	(0.58, 1.17)	0.266
Estate	2.81	(1.99, 3.97)	<0.001	2.04	(1.23, 3.38)	0.006
Province						
Western	1.00			1.00		
Central	1.68	(1.20, 2.34)	0.002	1.15	(0.70, 1.91)	0.579
Southern	1.19	(0.90, 1.59)	0.220	0.98	(0.70, 1.38)	0.924
Eastern	2.73	(1.85, 4.03)	<0.001	1.77	(1.16, 2.70)	0.008
North Western	1.42	(0.98, 2.05)	0.063	1.23	(0.85, 1.78)	0.262
North Central	2.08	(1.35, 3.21)	0.001	1.80	(1.11, 2.88)	0.016
Uva	2.36	(1.48, 3.75)	<0.001	1.58	(0.94, 2.66)	0.082
Sabaragamuwa	1.26	(0.79, 2.02)	0.339	0.90	(0.59, 1.36)	0.614

CI, confidence interval; OR, odds ratio; PHM, public health midwife. Adjusted odds ratios are based on the multiple logistic regression model that includes all predictor variables retained by backward elimination, and also taking account of the clustering. *Reads newspaper at least once a week or watches television daily or listens to radio daily.

provinces reported lower meal frequency compared to the Western province.

Table 8 summarizes the risk factors for poor acceptable diet in children 6–23 months. Consistent with the poor dietary diversity, determinants of inadequate acceptable diet were: child having ARI (OR = 2.13), lower maternal education (OR for secondary = 1.84; no schooling = 1.48), shorter maternal height (OR for 150–155 cm = 1.34), lower wealth index (OR for poorest = 1.45), lack of post-natal visit (OR = 1.71) and estate sector (OR = 2.04). It was also associated with limited media exposure of mother (OR = 1.36). Eastern and North Central provinces showed significantly poor practices (OR = 1.77 and 1.80, respectively) while Uva province showed poor practices but it was non-significant in the multivariate analysis.

Discussion

Overall, the complementary feeding practices as indicated by timely introduction, dietary diversity, meal frequency and minimal acceptable diet were above 65% in Sri Lanka. According to the country profiles available in the WHO report of IYCF indicators, only three out of the 40 countries – Peru (65.6%), Republic of Moldova (60.3%) and Honduras (51.9%) – reported a minimum acceptable diet rate above 50% (WHO *et al.* 2010). The corresponding rate of 68% in Sri Lanka revealed by the present study is a satisfactory situation.

This paper is one of the first articles to describe the factors associated with complementary feeding using the recently released indicators for IYCF by the WHO. The main strengths of this study are the use of appropriately sampled household data and the statistical adjustment made to account for cluster sampling design. The quality of DHS data is high because the investigators have used standard instruments and procedure for data collection, conducted adequate training and supervision of enumerators and adopted necessary data cleaning procedures. The number of missing values in this analysis was comparatively small (3.4%) and will not have a considerable impact on the final results. However, exclusion of the Northern province in the sample may pose a limitation

regarding generalizability of the findings to the entire country. Another limitation of this analysis is the failure to estimate the minimum acceptable diet for all children because the information regarding the number of milk feeds for the non-breastfed child was not available in the DHS data. However, only a small percentage of children in this age category were non-breastfed in Sri Lanka, thus it has a minimal influence on the overall estimate of minimal acceptable diet.

The complementary feeding practices have been described recently using these new indicators in the Sri Lanka complementary feeding study and the Nutrition and Food Security Survey (Ministry of Healthcare and Nutrition & UNICEF 2008; Jayatissa & Hossain 2010). The rate of introducing solid, semi-solid or soft foods in the present analysis based on DHS data was consistent with those figures reported by the two other studies. There were no marked differences in the rate of minimum meal frequency too across the studies. However, the rates of minimum dietary diversity and minimum acceptable diet reported in both the Sri Lanka complementary feeding study and the Nutrition and Food Security Survey were markedly low in contrast to rates in the present study. The reasons may be attributed to the differences in the questionnaire, the method of interview and the categorization into food groups in the analysis, and this suggests the need to comply with a standard procedure in assessing feeding practices in young children.

It may not be reasonable to compare our findings based on the DHS data with these two studies because the methodologies were different. However, both studies have not examined the risk factors for inappropriate complementary feeding practices. Though feeding practices could be associated with cultural and social perspectives, our study does not provide such evidence as detailed data on socio-cultural aspects are not available with the DHS survey. In contrast, the Sri Lanka complementary feeding study has looked into those aspects through qualitative research (Ministry of Healthcare and Nutrition & UNICEF 2008).

Another key finding of our study was the lower dietary diversity in the age group 6–11 months despite high rates of timely introduction of solid/semi-solid

foods. Further, the study found that consumption of foods of animal origin was poor especially for younger age groups. For example, only 22% of children aged 6–23 months consumed eggs, a rate consistent with that of the Nutrition and Food Security Survey which reported 18% (Ministry of Healthcare and Nutrition & UNICEF 2008). Efforts should be made to promote intake of such food items by young children through policies and programmes. The measures should be taken to improve the quality of diet to ensure adequacy of energy, protein and micronutrients in the diet.

Feeding during illness warrants mention because our study found that those with ARI had a poor dietary diversity. This could be attributed to impaired feeding due to illness, loss of appetite or parents' attitudes that feeding may be harmful to child's health. As ARI is a common illness in pre-school children, caregivers and clinicians should emphasize to parents the importance of continuing appropriate feeding practices during illness. In Sri Lanka, home visits are made by the PHM during pregnancy and after childbirth until the child completes 5 years of age. These home visits are expected to promote feeding and nutrition of mother and baby. Our results indicated that early post-natal care by the PHM was significantly associated with appropriate feeding practices, so ensuring recommended post-natal home visits by PHM would be an effective strategy to enhance feeding. This information would be internationally relevant for countries, which do not have post-natal home visitation programmes by a primary health care worker, to explore feasibility of piloting such programmes.

Dietary diversity and acceptable diet showed an upward trend with increasing wealth quintiles indicating a relationship between wealth and feeding practices. This relationship may reflect food insecurity which could be a proxy determinant for inadequate feeding, undernutrition and child ill health. As a long term and sustainable goal, enhancing household food security may be an effective strategy; however, further investigation would be required to examine the effects of food security interventions on child nutrition. Independent of wealth, maternal education showed a stronger association with feeding practices.

This association supports the previous evidence that maternal education is a strong predictor of child nutrition (Frost *et al.* 2005). Media can be used as an effective means of promoting complementary feeding practices. Women who had limited exposure to media showed an increased risk for suboptimal practices indicating the positive influence of media on feeding in Sri Lanka.

Children living in the 'estate' sector, i.e. tea plantations in the central hills of the country, showed poor feeding practices. The rate of stunting in children less than 5 years of age is remarkably higher in the estate sector (40.2%), compared to rural (16.2%) and urban (13.8%) areas (Department of Census and Statistics (DCS) & Ministry of Healthcare and Nutrition (MOH) 2009). Findings through national surveys over the last decade consistently indicated that ongoing health and nutrition programmes have not made much progress in reducing the level of child under nutrition in the estate sector in Sri Lanka (Department of Census and Statistics 2002; Medical Research Institute of the Ministry of Healthcare and Nutrition 2006; Department of Census and Statistics (DCS) & Ministry of Healthcare and Nutrition (MOH) 2009; Jayatissa & Hossain 2010). These surveys emphasized the urgent need for targeted interventions and evidence for sustainable strategies through community trials.

There was a consistent relationship between dietary diversity and minimum acceptable diet across various characteristics examined. This could be due to the fact that the variation of dietary diversity (standard error of proportion = 1.30) was higher than that of meal frequency (standard error of proportion = 0.84). A similar pattern of coherence has been observed in some countries (WHO *et al.* 2010). Further, most of the explanatory factors that came out as significant were common to both these indicators. Thus, we suggest further analysis and discussion to see whether dietary diversity can be used as a proxy for minimum acceptable diet.

This study did not make an attempt to investigate the relationship between feeding indicators and anthropometric outcomes of the child. There has been little evidence regarding this association so far (Arimond & Ruel 2004; Marriott *et al.* 2010; Rah *et al.*

2010). It seems to be interesting to observe whether these new indicators would be predictive of stunting, wasting and underweight by further research. It is also important to validate these new indicators before recommending them for wider application in Sri Lanka and other South Asian countries.

Some of the limitations of using DHS data to describe the complementary feeding practices include the difficulties of determining the food item or items for mixed food preparations during data collection, combinations of foods and local food recipes. This would pose a limitation in interpreting the dietary diversity. Further, meal frequency was based on the answer to the question 'how many times did the child eat solid, semisolid or soft foods other than liquids during yesterday in the day or at night?' which may be difficult for the respondents to recall and does not reflect the amount of food on each occasion. We present 95% confidence intervals for the prevalence estimates across subcategories, but these need to be interpreted with some caution given that there are many of them and no adjustments have been made.

In conclusion, this study revealed several subgroups with inappropriate feeding practices despite relatively good indicators of complementary feeding indicators. Attempts should be made to improve the dietary diversity of younger children, especially those aged 6–11 months, and add protein-rich food and fruits to their diet. Maternal education level, household wealth and exposure to media are very important social determinants of feeding practices of a child, while fathers' education level was not so important in promoting IYCF. Occurrence of diarrhoea did not affect feeding patterns but it has been true in case of respiratory infections. Children living in tea estate sectors will require special IYCF interventions to improve their situation.

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Conflicts of interest

None of the authors have any conflict of interest on the content of this manuscript.

Contributions

US designed the study, obtained data sets, guided the analysis and wrote the manuscript. SG obtained literature, checked results, and reviewed and revised the manuscript. HJ wrote the Results section, interpreted results and revised the manuscript. IS converted data files, conducted statistical analysis and compiled results tables. MD conceptualized the research question, designed and guided the analysis, and edited the manuscript.

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