Maternal & Child Nutrition

DOI: 10.1111/j.1740-8709.2012.00435.x

Original Article

Factors associated with inappropriate complementary feeding practices among children aged 6–23 months in Tanzania

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Abstract

Inappropriate complementary feeding is one of the major causes of undernutrition among young children in Tanzania. Prevalence of newly developed World Health Organization complementary feeding indicators and their associated factors were determined among 2402 children aged 6–23 months in Tanzania using data from the 2010 Tanzania Demographic and Health Survey. The survey used a multistage cluster sample of 10 300 households from the eight geographical zones in the country. The prevalence of the introduction of soft, semi-solid or solid foods among infants aged 6–8 months was 92.3%. Of all the children aged 6–23 months, the prevalence of minimum dietary diversity, meal frequency and acceptable diet were 38.2%, 38.6% and 15.9%, respectively. Results from multivariate analyses indicated that the main risk factors for inappropriate complementary feeding practices in Tanzania include young child's age (6–11 months), lower level of paternal/maternal education, limited access to mass media, lack of post-natal check-ups, and poor economic status. Overall, complementary feeding practices in Tanzania, as measured by dietary diversity, meal frequency and acceptable diet, are not adequately met, and there is a need for interventions to improve the nutritional status of young children in Tanzania.

Keywords: complementary feeding, diet diversity, meal frequency, acceptable diet, Tanzania.

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Introduction

Appropriate complementary feeding (CF) is an important determinant for the achievement of healthy growth and survival of young children in their early years of life. It has been established that appropriate CF has the potential to prevent 6% of all under-five deaths, particularly in the developing world (Lutter 2003). In recognition of the importance of CF for optimal growth and development, the World Health Organization (WHO) recommends that infants should be exclusively breastfed for the first 6 months of life, and thereafter should receive nutritionally adequate and safe complementary foods with continued breastfeeding up to 2 years or beyond (WHO 2003). Despite this recommendation and the health benefits of appropriate CF, inappropriate CF is commonly practised in many low- and middle-income countries and contributes to child growth retardation and undernutrition, morbidity and mortality in developing countries (WHO 2000).

It is estimated that mortality globally is 35% as a result of undernutrition in children aged under-five years (Black *et al.* 2008), with more than 41% of

under-five deaths occurring in Sub-Saharan Africa (Jones *et al*. 2003). Further, 40% of children under 5 years of age in Africa are stunted and 13% are wasted (UNICEF 2009). According to the Tanzania Demographic and Health Survey (TDHS) of 2010, 35% of children aged less than 5 years are stunted, 21% are underweight for their age and more than half (59%) are anaemic [National Bureau of Statistics (NBS) (Tanzania) & ICF Macro 2011]. It is estimated that over 130 000 deaths occur every year among children under-five in Tanzania because of poor feeding practices [Ministry of Health and Social Welfare (MoHSW) (Tanzania) 2004]. It has been reported that infants are not introduced to CF at an appropriate age, they are fed infrequently, and the nutritional quality of the complementary foods is mostly poor and unsafe hygienically (Mosha *et al*. 2000; Mamiro *et al*. 2005; Nyaruhucha *et al*. 2006).

Previous studies on CF practices show that younger maternal age (Sika-Bright 2010; Joshi *et al*. 2012), lower maternal education (Sika-Bright 2010; Ng *et al*. 2011; Hazir *et al*. 2012; Joshi *et al*. 2012b; Kabir *et al*. 2012; Patel *et al*. 2012; Senarath *et al*. 2012b), unemployment (Joshi *et al*. 2012b; Senarath *et al*. 2012b), inadequate antenatal clinic visits (Senarath *et al*. 2012b; Patel *et al*. 2012), lack of post-natal care visits (Senarath *et al*. 2012b), young infant age (Ng *et al*. 2011; Hazir *et al*. 2012; Kabir *et al*. 2012; Patel *et al*. 2012; Senarath *et al*. 2012b), poor household wealth status (Ng *et al*. 2011; Hazir *et al*. 2012; Kabir *et al*. 2012; Patel *et al*. 2012; Senarath *et al*. 2012b), inadequate maternal exposure to mass media such as newspapers, radio or television (Joshi *et al*. 2012; Patel *et al*. 2012), and geographical differences (Ng *et al*. 2011; Hazir *et al*. 2012; Joshi *et al*. 2012; Kabir *et al*. 2012; Patel *et al*. 2012; Senarath *et al*. 2012b) are the main risk factors associated with inappropriate CF practices among children aged 6–23 months in developing countries. Factors such as lower maternal education and lower household wealth index were found to be the most consistent determinants of inappropriate CF practices in Bangladesh, India, Nepal, Pakistan and Sri Lanka (Senarath *et al*. 2012a). Other factors however, have been reported to vary across CF indicators and among different populations.

There are few published reports about CF practices in Tanzania (Sellen 2001; Mamiro *et al*. 2005; Nyaruhucha *et al*. 2006). The WHO country profiles report of infant and young child feeding (IYCF) indicators reveal that the CF practices in Tanzania based on the 2004–2005 TDHS were far from optimal (WHO *et al*. 2010). However, there is lack of detailed description of CF practices using the current 2010 TDHS and the risk factors associated with inappropriate CF practices remain unclear. This study aimed to describe the prevalence of the new WHO CF indicators regarding the introduction of food, minimum dietary diversity, minimum meal frequency and minimum acceptable diet using the recent 2010 TDHS data, and to identify the individual-, household- and community-level factors associated with inappropriate CF practices in Tanzania.

Materials and methods

Data source and design

Secondary data analysis of the 2010 TDHS [National Bureau of Statistics (NBS) (Tanzania) & ICF Macro 2011] was undertaken in the present study. The 2010 TDHS was conducted between December 2009 and May 2010 by the NBS and the Office of the Chief

Key messages

- The majority of children aged 6–8 months receive soft, semi-solid or solid foods, but very few meet the requirements for dietary diversity, meal frequency or acceptable diet in Tanzania.
- Factors associated with inappropriate CF practices in Tanzania include age and sex of the child, lower level of parental education, limited access to mass media, lack of post-natal check-ups, and poor economic status.
- Counselling and education of mothers, carers and other key family members about optimal feeding practices, promoting the use of locally available foods, as well as strategies to improve production, increasing availability and affordability of quality local foods are essential for improving CF practices in Tanzania.

Government Statistician – Zanzibar; in collaboration with the Ministry of Health and Social Welfare (MoHSW). A representative probability sample of 10 300 households was selected for the 2010 TDHS. The survey employed a cross-sectional design and the survey sample was obtained using stratified two-stage random sampling, which provides estimates for the entire country, and both urban and rural areas in the 26 regions of Mainland Tanzania and Zanzibar. A total of 10 522 women aged 15–49 years were interviewed (response rate 96.4%) from sampled households using a woman's questionnaire to gather information regarding maternal and childcare practices including infant feeding, reproduction and use of family planning methods. A household questionnaire was used to collect socio-demographic data for all household members. Sampling procedures and data collection tools have been described in detail elsewhere [National Bureau of Statistics (NBS) (Tanzania) & ICF Macro 2011].

A list of variables required for this analysis was obtained from the 2010 TDHS data set. The present analysis was restricted to children who were alive, of singleton births, last-born and lived with respondents (ever-married women aged 15–49 years), yielding a weighted total of 2275 children aged 6–23 months.

CF indicators

CF practices were estimated according to the current WHO recommended definitions of the four key indicators for assessing IYCF practices (WHO 2008). The indicators comprise introduction of solid, semi-solid or soft foods, minimum dietary diversity, minimum meal frequency, and minimum acceptable diet calculated for the age ranges, 6–11, 12–17 and 18–23 months of age, and were based on a 24-h recall of the child's dietary intake. These indicators are defined as follows:

- '*Introduction to solid, semi-solid or soft foods*: The proportion of infants 6–8 months of age who receive solid, semi-solid or soft foods'.
- '*Minimum dietary diversity*: The proportion of children 6–23 months of age who received foods from four or more food groups. The seven food groups used for tabulation of this indicator included: 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 other fruits and vegetables'.
- '*Minimum meal frequency*: The proportion of breastfed and non-breastfed children 6–23 months of age, who received solid, semi-solid or soft foods (including milk feeds for non-breastfed children) the minimum number of times or more. The minimum was defined as: two times for breastfed infants 6–8 months; three times for breastfed children 9–23 months; four times for non-breastfed children 6–23 months in the previous day'. It is important to note that the information on number of non-breast milk feeds received by non-breastfed children was not available in the 2010 TDHS.
- '*Minimum acceptable diet*: The proportion of children 6–23 months of age who received 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'. The calculation of minimum acceptable diet for non-breastfed children was not possible because the data on minimum number of non-breast milk feeds as in the definition were not available in the TDHS survey data; thus, this indicator was confined to breastfed children only.

The independent variables were socio-demographic and economic characteristics of mothers and children and these variables were classified into three levels: individual-, household- and community-level factors. The individual level factors included the age and sex of the child, the mother's marital status, age, occupation, body mass index (as determined by weight (kg)/height (m^2), level of education, number of antenatal clinic visits, place of delivery, mode of delivery, type of delivery assistance, birth order, timing of post-natal check-up and the mother's access to media (newspaper, radio and television).

Household-level variables comprised information on the mother's role in household decisions and the household wealth index. In the 2010 TDHS, the household wealth index was constructed using principal components analysis to determine the weights for the index based on information collected about several household assets such as ownership of transportation devices, ownership of durable goods and household facilities (Filmer & Pritchett 1998; (Gwatkin *et al.* 2000). Each household was assigned to one of the categories regarding household wealth index, which was divided into five categories (quintiles) namely: poorest, poorer, middle, richer and richest.

Community-level variables included data regarding residential status (urban/rural) and geographical regions, which were grouped into seven geographical zones as classified by the Reproductive and Child Health Section in Ministry of Health and Social Welfare (MoHSW) [Tanzania] (2005) in Mainland Tanzania. The regions of Zanzibar were combined into one zone because of the smaller sample size. Therefore geographical zones include Central, Eastern, Southern, Southern Highland, Lake, Northern, Western and Zanzibar.

Data analysis

CF indicators were expressed as dichotomous variables with category 1 for not meeting the indicators criteria, and category 0 for meeting the indicators criteria described earlier. These indicator variables were examined against the set of independent variables (individual-, household- and community-level characteristics) in order to assess the prevalence of the CF indicators for the categories of the independent variables, and to identify factors associated with not meeting the criteria of the indicators (inappropriate complimentary feeding practices).

All statistical analyses were performed using the 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 the Taylor series linearisation method (StataCorp) to estimate confidence intervals (CIs) around prevalence estimates. Chi-squared tests were used to test the significance of associations. Survey logistic regression was performed using stepwise backwards model in order to determine the factors significantly associated with not meeting the timely introduction to soft, semi-solid or solid foods, minimum dietary diversity, minimum meal frequency and minimum acceptable diet. The factors that were not significant ($P \geq 0.05$) were eliminated in a stepwise manner, and those factors when any level of significant was ($P < 0.05$) were retained in the final model. The odds ratios (ORs) with 95% CIs were calculated in order to assess the adjusted risk of independent variables. The level of significance was set at $P \leq 0.05$ for all analyses.

Results

Characteristics of the sample

The characteristics of the study population are summarised in Table 1. About half of the mothers (44.3%) were aged between 25 and 34 years. Very few mothers (7.9%) had higher levels of education (secondary or higher education). Most mothers (86.8%) had worked in the past 12 months. The majority (84.6%) of mothers were currently married, and their husband's occupation was dominated by agricultural activities (63.9%). Ninety-seven per cent of the sampled mothers had attended antenatal care visits during pregnancy and only 32.4% made some post-natal check-ups after delivery. Forty-two per cent of the mothers made more than three antenatal clinic visits during pregnancy, but more than 68.0% did not have any post-natal check-up by 41 days. Nearly half of the children (48.6%) were born at home, and half of their mothers (50.0%) were assisted by untrained personnel at delivery. Among those who delivered in health facilities, few (5.6%) had undergone caesarean section. Most mothers were multiparous (49.1%) and 69.2% had a preceding birth interval of more than 24 months. The age and gender of the children was almost equally represented across all geographical regions. The majority of children (79.4%) were from rural areas and less than one quarter (15.4%) were from the richest households.

Table 1. Individual-, household- and community-level characteristics of children 6–23 months of age and their parents, Tanzania 2010 ($n = 2275$)

Characteristic	*n*	%	Characteristic	*n*	%
Individual-level factors			0–2 days	342	15.3
Maternal working status			3–6 days	127	5.7
Non-working	301	13.2	7+ days	2534	11.4
Working (past 12 months)	1974	86.8	Child had diarrhoea recently		
Maternal education			No	1735	76.3
No education	574	25.2	Yes	540	23.7
Primary	1522	66.9	Child had acute respiratory infection		
Secondary and above	180	7.9	No	2052	90.2
Partner's occupation			Yes	224	9.8
Non-agriculture	665	29.2	Child had fever in last 2 weeks		
Agriculture	1453	63.9	No	1605	70.5
Not working	157	6.9	Yes	671	29.5
Partner's education ($n = 2126$)			Mother's body mass index ($n = 2258$)		
No education	382	18.0	≤18.5 kg m^{-2}	263	11.6
Primary	1526	71.8	>18.5 kg m^{-2}	1996	88.4
Secondary and above	218	10.3	Mother's literacy ($n = 2251$)		
Mother's age (years)			Can't read at all	918	40.8
15–24	805	35.4	Can read	1333	59.2
25–34	1009	44.3	Mother's frequency of reading newspaper or magazine ($n = 2274$)		
35–49	462	20.3			
Marital status			Not at all	1957	86.1
Currently married	1925	84.6	Yes	317	13.9
Formerly married (div/sep/widow)	210	9.2	Mother's frequency of listening to radio		
Never married	141	6.2			
Birth order			Not at all	1084	47.7
First-born	440	19.3	Yes	1191	52.4
Second to fourth	1118	49.1	Mother's frequency of watching TV		
Fifth or more	718	31.5	Not at all	1924	84.6
Preceding birth interval ($n = 2269$)			Yes	351	15.4
No previous birth	440	19.4	Household-level factors		
<24 months	258	11.4	Wealth index		
>24 months	1571	69.2	Poorest (lowest quintile)	499	21.9
Sex of baby			Poorer	535	23.5
Male	1110	48.8	Middle	479	21.1
Female	1166	51.2	Richer	412	18.1
Child's age in months			Richest (highest quintile)	351	15.4
6–11	793	34.9	Decisions women have final say		
12–17	772	33.9	None	1003	44.1
18–23	710	31.2	One–two	760	33.4
Place of delivery			Three and more	513	22.5
Home	1106	48.6	Community-level factors		
Health facility	1169	51.4	Residence		
Mode of delivery ($n = 2272$)			Urban	469	20.6
Non-caesarean	2145	94.4	Rural	1806	79.4
Caesarean section	127	5.6	Geographic zones		
Type of delivery assistance ($n = 2199$)			Northern	284	12.5
Health professional	1099	50.0	Eastern	292	12.8
Traditional birth attendant	368	16.7	Western	490	21.5
Relatives and other untrained personnel	731	33.3	Southern Highlands	300	13.2
			Lake	461	20.3
Antenatal clinic visits ($n = 2268$)			Southern	172	7.5
None	52	2.3	Central	214	9.4
1–2	1257	55.4	Zanzibar	63	2.8
3+	958	42.3	Total	2275	100.0
Timing of post-natal check-up					
No check-ups (including missing)	1511	67.6			

Weighted total was 2275 otherwise stated within brackets.

Consumption of food groups by age of children

Table 2 describes food groups given to the children 24 h preceding the survey. Consumption of all food groups was higher among older children (18–23 months) and lowest among younger children 6–11 months old. The diets of children aged 6–23 months were mainly dominated by staple foods made from grains, roots and tubers (92.9%). Many children (67.2%) consumed vitamin A-rich fruits and vegetables and few children consumed other fruits and vegetables (17.9%), flesh foods such as meat, fish and poultry (33.9%), dairy products (31.3%) and eggs (8.1%).

CF indicators

The prevalence of the introduction to soft, semi-solid or solid foods was high (92.3%) at 6–8 months (Table 3). Minimal dietary diversity was 38.2% for both breastfed and non-breastfed children aged 6–23 months and this prevalence was higher among non-breastfed children (45.3%) as compared with their breastfed counterparts (36.9%). The prevalence of dietary diversity was low (28.1%) for both breastfed and non-breastfed children aged 6–11 months old, but the prevalence increased to 42.6% and 43.0% at 12–17 months and 18–23 months of age, respectively.

The rate of minimum meal frequency among children aged 6–23 months was 38.6%. Compared with breastfed children, the non-breastfed children had lower rates of minimum meal frequency (34.2% vs. 11.4%). The prevalence of breastfed children (6–8 months) who received meals at least twice per day was 64.6%. The proportion of breastfed children (9–23 months) who consumed meals at least three times per day was 32.3%. Only 11.4% of non-breastfed children aged 6–23 months were fed meals at least four times a day. The rate of minimum meal frequency was decreasing with increasing age of children. Only 15.9% of breastfed children aged 6–23 months had the minimum acceptable diet. The rates of minimum acceptable diet were significantly lower (13.3%) for infants (6–11 months) than for children aged 12–17 months (15.5%). There was a significant

Table 2. Consumption of food groups by child age in months, Tanzania 2010

Child's age in months (n = 2275)	Grains, roots and tubers		Legumes and nuts		Dairy products		Flesh foods		Eggs		Vitamin A-rich fruits and vegetables		Other fruits and vegetables	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
6–11 (n = 674)	88.7	84.72, 91.69	34.8	30.62, 39.29	30.3	25.56, 35.59	27.7	23.38, 32.55	7.5	5.42, 10.21	59.2	54.51, 63.73	16.4	12.67, 20.91
12–17 (n = 772)	93.2	90.07, 95.36	42.1	37.38, 46.97	32.0	27.80, 36.55	36.7	32.22, 41.38	8.8	6.31, 12.22	72.9	68.49, 76.93	19.2	15.85, 23.11
18–23 (n = 710)	96.5	94.49, 97.75	44.9	40.45, 49.54	31.6	27.30, 36.19	41.1	36.40, 45.86	8.7	6.54, 11.59	73.4	69.08, 77.29	19.2	15.44, 23.63
6–23 (n = 2275)	92.9	91.24, 94.28	40.7	37.72, 43.89	31.4	28.35, 34.51	33.9	30.97, 36.93	8.4	6.92, 10.10	67.2	64.46, 69.75	17.9	15.45, 20.6

CI. confidence interval.

Table 3. Complementary feeding indicators (percentage and 95% confidence intervals) among children 6–23 months of age Tanzania 2010 ($n = 2275$)

Indicator	Sample size (weighted)	*n* (weighted)	Rate (%)	95% CI
Introduction of solid, semi-solid or soft foods rate (6–8 months)*	386	356	92.3	88.38, 95.00
Minimum dietary diversity rate				
Minimum dietary diversity rate BOTH (6–11 months)†	793	224	28.2	24.53, 32.14
Minimum dietary diversity rate BF (6–11 months)†	767	216	28.1	24.41, 32.19
Minimum dietary diversity rate NON-BF (6–11 months)†	27	8	29.4	11.79, 56.44
Minimum dietary diversity rate BOTH (12–17 months)‡	772	323	41.9	37.50, 46.43
Minimum dietary diversity rate BF (12–17 months)‡	706	301	42.6	38.08, 47.29
Minimum dietary diversity rate NON-BF (12–17 months)‡	66	22	34.0	21.71, 49.00
Minimum dietary diversity rate BOTH (18–23 months)§	710	323	45.5	40.81, 50.27
Minimum dietary diversity rate BF (18–23 months)§	431	185	42.9	37.53, 48.47
Minimum dietary diversity rate NON-BF (18–23 months)§	279	138	49.5	42.15, 56.85
Minimum dietary diversity rate BOTH (6–23 months)¶	2275	870	38.2	35.45, 41.10
Minimum dietary diversity rate BF (6–23 months)¶	1904	702	36.9	34.04, 39.76
Minimum dietary diversity rate NON-BF (6–23 months)¶	372	168	45.3	38.78, 52.02
Minimum meal frequency rate				
Two times for breastfed (6–8 months)	374	242	64.6	58.08, 70.58
Three times for breastfed (9–23 months)	1530	494	32.3	29.10, 35.63
Four times for non-breastfed (6–23 months)	372	42	11.4	8.05, 15.78
Minimum meal frequency rate BOTH (6–11 months)†	793	340	42.9	38.05, 47.89
Minimum meal frequency rate BF (6–11 months)†	767	339	44.3	39.26, 49.37
Minimum meal frequency rate NON-BF (6–11 months)†	27	1	3.9	0.61, 21.65
Minimum meal frequency rate BOTH(12–17 months)‡	772	236	30.6	26.82, 34.57
Minimum meal frequency rate BF (12–17 months)‡	706	230	32.5	28.45, 36.82
Minimum meal frequency rate NON-BF (12–17 months)‡	66	6	9.7	3.99, 21.76
Minimum meal frequency rate BOTH (18–23 months)§	710	201	28.4	24.61, 32.41
Minimum meal frequency rate BF (18–23 months)§	431	167	38.7	33.13, 44.48
Minimum meal frequency rate NON-BF (18–23 months)§	279	35	12.5	8.53, 17.83
Minimum meal frequency rate BOTH(6–23 months)¶	2275	778	34.2	31.34, 37.12
Minimum meal frequency rate BF (6–23 months)¶	1904	735	38.6	35.38, 41.97
Minimum meal frequency rate NON-BF (6–23 months)¶	372	42	11.4	8.05, 15.78
Minimum acceptable diet rate				
Minimum acceptable diet rate (6–11 months)†	767	101	13.2	10.42, 16.64
Minimum acceptable diet rate (12–17 months)‡	706	110	15.5	12.60, 18.96
Minimum acceptable diet rate (18–23 months)§	431	91	21.2	16.80, 26.37
Minimum acceptable diet rate (6–23 months)¶	1904	302	15.9	13.74, 18.28

*Infants 6–8 months. †Infants 6–11 months. ‡Children 12–17 months. §Children 18–23 months. ¶Children 6–23 months.

increase in the prevalence of minimum acceptable diet after the age of 17 months.

CF indicators across individual-, household- and community-level factors:

Table 4 describes the prevalence of the four CF indicators according to the individual-, household- and community-level attributes. Children whose mothers were in paid work showed a significantly higher prevalence of meeting the minimum meal frequency than those whose mothers were not working ($P = 0.002$), but maternal working status was not associated with other CF indicators. Children whose parents had a higher level of education (secondary school and above) had a significantly higher prevalence of meeting minimum dietary diversity ($P < 0.001$) and minimum acceptable diets ($P < 0.001$). There was no significant difference between maternal levels of education and the prevalence of introduction of complementary foods and minimum meal frequency. First-born children had a

Table 4. Complementary feeding indicators across individual-, household- and community-level factors

Characteristic	Introduction of solid, semi-solid or soft foods rate			Minimum dietary diversity			Minimum meal frequency			Minimum acceptable diet		
	%	95% CI	*P*	%	95% CI	*P*	%	95% CI	*P*	%	95% CI	*P*
Individual level factors												
Maternal working status												
Non-working	93.2	83.14, 97.42	0.799	40.8	34.47, 47.46	0.423	44.3	37.08, 51.77	0.002	17.1	12.70, 22.52	0.092
Working (past 12 months)	92.2	87.63, 95.13		37.9	34.79, 41.01		32.6	29.69, 35.70		12.7	10.78, 14.93	
Maternal education												
No education	89.1	77.74, 95.07	0.393	27.1	21.83, 33.05	<0.001	29.8	24.90, 35.14	0.080	8.1	5.775, 11.19	<0.001
Primary	94.2	89.97, 96.65		39.9	36.79, 43.27		35.1	31.85, 38.44		14.1	11.96, 16.45	
Secondary and above	87.6	59.51, 97.16		59.1	48.96, 68.43		40.6	31.28, 50.56		23.4	16.65, 31.86	
Partner's occupation												
Non-agriculture	91.5	80.64, 96.50	0.718	48.4	43.57, 53.18	<0.001	40.3	35.46, 45.38	0.004	18.1	14.79, 21.91	0.001
Agriculture	92.3	87.35, 95.41		32.7	29.43, 36.16		31.1	27.85, 34.50		11.0	9.079, 13.32	
Not working	96.8	79.48, 99.57		46.6	36.81, 56.60		36.8	27.43, 47.18		13.9	8.312, 22.37	
Partner's education												
No education	88.6	74.67, 95.31	0.699	24.8	17.97, 33.19	<0.001	28.3	22.61, 34.86	0.243	6.9	4.539, 10.39	0.005
Primary	92.8	88.14, 95.74		37.8	34.71, 40.99		35.0	31.99, 38.23		14.2	12.06, 16.55	
Secondary and above	91.6	59.75, 98.78		58.2	50.08, 65.91		37.0	28.19, 46.83		17.9	12.43, 25.01	
Mother's age (years)												
15–24	95.4	87.45, 98.43	0.392	39.8	35.45, 44.34	0.091	34.2	30.15, 38.41	0.389	13.7	10.94, 16.99	0.745
25–34	90.5	83.45, 94.76		39.5	35.70, 43.38		32.8	29.16, 36.67		13.5	11.29, 16.09	
35–49	90.8	81.2, 95.77		32.8	27.51, 38.55		37.2	31.47, 43.24		12.1	8.986, 16.10	
Marital status												
Currently married	93.1	89.31, 95.64	0.198	37.2	34.41, 40.03	0.052	33.8	30.89, 36.79	0.734	12.9	11.11, 14.81	0.467
Formerly married (div/sep/widow)	82.1	50.50, 95.37		39.8	31.05, 49.30		36.8	29.03, 45.31		16.5	10.87, 24.10	
Never married	96.5	77.93, 99.53		50.3	39.73, 60.91		35.7	26.29, 46.30		14.6	8.566, 23.64	
Birth order												
First-born	93.0	84.64, 96.98	0.606	45.3	39.70, 51.05	0.001	35.3	29.51, 41.63	0.564	15.7	11.82, 20.60	0.040
Second to fourth	93.6	86.84, 97.03		39.1	35.42, 42.80		34.9	31.38, 38.67		14.3	11.83, 17.12	
Five or more	90.0	81.05, 95.00		32.6	28.48, 37.09		32.3	28.02, 36.84		10.3	8.043, 13.01	
Preceding birth interval												
No previous birth	93.0	84.64, 96.98	0.533	45.3	39.70, 51.05	0.033	35.3	29.51, 41.63	0.567	15.7	11.82, 20.60	0.260
<24 months	96.7	84.17, 99.37		35.9	28.48, 44.11		37.5	30.64, 44.83		16.2	11.31, 22.56	
>24 months	91.5	86.1, 94.94		36.8	33.65, 40.04		33.4	30.19, 36.72		12.2	10.28, 14.39	

Table 4. Continued

Characteristic	Introduction of solid, semi-solid or soft foods rate			Minimum dietary diversity			Minimum meal frequency			Minimum acceptable diet		
	%	95% CI	*P*	%	95% CI	*P*	%	95% CI	*P*	%	95% CI	*P*
Sex of baby												
Male	92.9	86.79, 96.33	0.498	38.0	33.85, 42.36	0.870	37.1	33.43, 41.03	0.012	13.9	11.43, 16.99	0.430
Female	91.6	85.32, 95.35		38.5	35.04, 41.98		31.3	27.92, 34.97		12.6	10.53, 15.07	
Child's age in months												
6–11	44.9	40.69, 49.15	<0.001	28.2	24.51, 32.17	<0.001	42.9	38.00, 47.94	<0.001	12.8	10.07, 16.09	0.727
12–17	0.0	0		41.9	37.47, 46.45		30.6	26.71, 34.70		14.2	11.50, 17.41	
18–23	0.0	0		45.5	40.76, 50.32		28.4	24.55, 32.49		12.8	10.21, 16.07	
Place of delivery												
Home	90.5	83.99, 94.50	0.376	31.6	28.06, 35.39	<0.001	30.9	27.21, 34.98	0.021	10.2	8.019, 12.86	0.001
Health facility	93.7	87.33, 97.02		44.5	40.79, 48.30		37.2	33.38, 41.20		16.2	13.66, 19.14	
Antenatal clinic visits												
None	94.7	67.93, 99.33	0.400	33.2	18.97, 51.24	0.083	28.5	14.40, 48.65	0.630	13.8	4.81, 33.57	0.055
One to three	94.4	89.62, 97.10		35.6	32.16, 39.11		33.0	29.51, 36.74		11.0	8.904, 13.54	
More than four	89.3	81.28, 94.11		42.1	37.95, 46.42		35.9	32.10, 40.05		16.1	13.46, 19.24	
Timing of post-natal check-up												
No check-ups (including missing)	89.5	83.63, 93.46	0.522	33.8	30.51, 37.20	<0.001	31.4	28.17, 34.82	0.003	10.5	8.658, 12.74	<0.001
0–2 days	95.3	86.45, 98.46		48.2	42.12, 54.30		36.4	30.79, 42.30		17.9	13.48, 23.60	
3–6 days	100.0	0		48.9	37.46, 60.57		51.1	40.24, 61.84		25.3	16.90, 36.00	
7+ days	96.8	80.22, 99.56		42.8	35.37, 50.66		37.9	30.48, 46.05		17.2	12.70, 22.93	
Mother's BMI												
≤18.5 kg/m2	88.3	71.49, 95.81	0.696	31.9	25.58, 39.00	0.140	31.0	24.19, 38.86	0.275	10.5	6.70, 16.12	0.206
>18.5 kg/m2	92.7	88.41, 95.49		39.2	36.21, 42.20		34.7	31.78, 37.82		13.8	11.91, 15.86	
Mother's literacy												
Cannot read at all	90.1	82.51, 94.61	0.470	30.1	26.14, 34.54	<0.001	31.6	27.73, 35.65	0.137	9.8	7.754, 12.35	<0.001
Can read	93.9	88.5, 96.90		43.3	39.91, 46.70		35.9	32.47, 39.40		15.4	13.14, 17.92	
Mother's frequency of reading newspaper or magazine												
Not at all	92.9	88.71, 95.67	0.418	35.6	32.74, 38.51	<0.001	34.0	31.04, 37.13	0.727	12.3	10.43, 14.38	0.023
Yes	89.2	75.27, 95.74		54.9	48.09, 61.49		35.3	28.32, 42.97		19.6	14.18, 26.56	
Mother's frequency of listening to radio												
Not at all	87.3	80.08, 92.14	0.002	30.9	27.12, 35.00	<0.001	33.3	29.31, 37.63	0.552	10.7	8.401, 13.49	0.007
Yes	97.4	92.98, 99.07		44.9	41.12, 48.73		34.9	31.38, 38.65		15.7	13.26, 18.39	

Table 4. Continued

Characteristic	Introduction of solid, semi-solid or soft foods rate			Minimum dietary diversity			Minimum meal frequency			Minimum acceptable diet		
	%	95% CI	*P*	%	95% CI	*P*	%	95% CI	*P*	%	95% CI	*P*
Mother's frequency of watching TV												
Not at all	90.9	86.38, 94.14	<0.001	34.1	31.29, 36.97	<0.001	33.4	30.44, 36.40	0.153	11.8	10.09, 13.82	<0.001
Yes	99.7	98.55, 99.92		61.1	54.71, 67.07		38.6	31.74, 46.01		21.3	16.66, 26.77	
Household-level factors												
Wealth Index												
Poorest	87.8	77.69, 93.75	0.538	24.3	19.65, 29.66	<0.001	30.6	25.77, 35.98	0.142	8.4	5.792, 11.98	<0.001
Poorer	92.3	82.76, 96.76		31.5	26.85, 36.48		32.6	27.63, 38.07		8.8	6.327, 11.99	
Middle	93.8	76.69, 98.59		38.3	33.27, 43.65		35.0	29.86, 40.57		16.2	12.68, 20.47	
Richer	97.1	90.22, 99.20		43.0	37.20, 49.07		33.1	26.77, 40.07		12.3	9.057, 16.61	
Richest	90.9	73.30, 97.34		62.6	56.65, 68.14		41.6	34.08, 49.60		24.3	19.09, 30.36	
Decisions women have final say												
None	90.5	83.51, 94.77	0.328	38.4	34.17, 42.87	0.852	38.1	34.12, 42.28	0.014	14.9	12.19, 18.15	0.146
One to two	91.7	83.45, 96.09		37.3	33.09, 41.68		31.1	27.02, 35.40		13.1	10.53, 16.02	
Three to four	96.8	88.45, 99.19		39.3	33.79, 45.06		31.1	26.12, 36.47		10.5	7.444, 14.52	
Community-level factors												
Residence												
Urban	95.3	80.65, 99.00	0.437	53.6	48.02, 58.98	<0.001	37.3	29.83, 45.37	0.363	17.2	13.06, 22.41	0.040
Rural	91.5	87.03, 94.48		34.3	31.17, 37.49		33.4	30.31, 36.56		12.3	10.36, 14.45	
Geographic zones												
Northern	96.3	86.34, 99.07	0.502	44.3	36.68, 52.14	<0.001	51.2	43.78, 58.49	<0.001	20.4	14.84, 27.27	<0.001
Eastern	93.4	66.70, 99.02		48.5	41.04, 55.98		35.9	28.08, 44.65		16.2	12.08, 21.48	
Western	91.6	82.16, 96.29		28.9	23.09, 35.49		26.5	21.13, 32.57		7.8	4.603, 12.99	
Southern Highlands	95.1	85.06, 98.47		51.6	45.18, 57.89		27.7	19.62, 37.42		15.1	10.19, 21.68	
Lake	86.8	74.37, 93.71		40.1	33.10, 47.55		35.7	29.65, 42.32		15.6	11.41, 20.85	
Southern	90.4	73.36, 96.95		34.1	26.93, 42.04		43.5	34.68, 52.84		13.8	9.723, 19.45	
Central	97.4	84.47, 99.60		18.7	13.31, 25.57		23.5	16.33, 32.68		3.7	1.628, 8.059	
Zanzibar	95.7	88.28, 98.49		36.9	31.96, 42.28		39.6	34.69, 44.65		16.2	12.63, 20.60	

BMI, body mass index; CI, confidence interval. Chi-squared test was applied to test statistical significance.

significantly higher prevalence of meeting minimum dietary diversity ($P = 0.001$) and minimum acceptable diet ($P = 0.04$) compared with the second-, third- and fourth-born children.

Similarly, the prevalence of meeting dietary diversity increased as the age of the children increased. Older infants (18–23 months) had significantly higher prevalence of meeting minimum dietary diversity than younger infants aged 6–11 months (45.5% vs. 28.2%, respectively, $P < 0.001$). The prevalence of meeting minimum dietary diversity, meal frequency and acceptable diet was high among children whose mothers made some post-natal check-ups than those whose mothers did not made any post-natal check-ups within 41 days after delivery. Children from urban areas and those from the richest households had a higher prevalence of meeting minimum dietary diversity and acceptable diet indicators. The prevalence of meeting minimum dietary diversity, meal frequency and acceptable diet was significantly higher in the Northern zone as compared with other geographic zones ($P < 0.001$).

Determinants of inappropriate CF indicators

Table 5 shows the unadjusted and adjusted odds ratios for factors that were significantly associated with inappropriate CF indicators: (delayed introduction of soft, semi-solid or solid foods; not meeting minimum dietary diversity; not meeting minimum meal frequency; and not meeting minimal acceptable diets). The risk of delayed introduction of soft, semi-solid or solid foods was lower among children whose mothers frequently listened to radio and/or watched television compared with children whose mothers had limited access to mass media (radio or television) [adjusted odd ratios (AOR) for listening to radio = 0.20; 95% CI, 0.06–0.64; $P = 0.007$ and AOR for watching television = 0.06 95% CI, 0.01–0.27; $P < 0.001$].

Children whose mothers did not have any post-natal check-ups had higher risk for not meeting minimum dietary diversity meal frequency and acceptable diet than those whose mothers had post-natal check-ups within 41 days after delivery. The risk of not meeting minimum dietary diversity consistently decreased with increasing age of the children. Older children (12–23 months) had a lower risk for children aged 18–23 months) of not meeting minimum dietary diversity compared with younger children (6–11 months) (AOR for children aged 12–17 months and 18–23 months were 0.56 and 0.47, respectively). The risk of not meeting minimum meal frequency increased as the children became older (AOR = 1.97; 95% CI, 1.48–2.61; $P < 0.001$). The odds of not meeting minimum meal frequency were significantly higher among female (AOR = 1.40; 95% CI, 1.11–1.76; $P = 0.004$) compared with male children. Maternal education was not significantly associated with inappropriate CF practices. However, when maternal education was replaced by father's education in the final model for non-minimum acceptable diet, children whose father had no formal education were less likely to meet minimum acceptable diet compared with children whose father had attained at least primary school education (AOR = 0.59; 95% CI, 0.36–0.96; $P = 0.03$). The odds for not meeting minimum dietary diversity and acceptable diet were significantly higher among children from the poorest households compared with those from the richest households (AOR being 4.13 and 2.56, respectively).

Children from the Central, Eastern, Western, Southern and Zanzibar geographic zones had a higher risk for not meeting the minimum dietary diversity compared with children residing in Southern Highland zone. However, children from the Central, Eastern, Western, Southern Highland and Zanzibar geographic regions were at a higher risk of not meeting minimum meal frequency and minimum acceptable diets compared with children from the Northern geographic region.

Discussion

In Tanzania, the majority of aged infants 6–8 months receive soft, semi-solid or solid foods. However, very few children meet the requirements for minimum dietary diversity, minimum meal frequency and minimum acceptable diet. We found that limited exposure to mass media such as radio and television was a risk factor for delayed introduction to soft, semi-solid or solid foods at 6–8 months. Young child's age (6–11 months), lack of post-natal check-ups and

Table 5. ORs (95% CIs) for delayed introduction of CF at 6–8 months, not meeting minimum dietary diversity, meal frequency and acceptable diet among children aged 6–23 months, Tanzania 2010

Outcome variable	Characteristic	Unadjusted ORs			Adjusted odds ORs		
		OR	95% CI	*P*	OR	95% CI	*P*
Delay introduction to complementary feeding	Child's age (months)	0.57	0.36, 0.90	0.017	0.53	0.32, 0.90	0.018
	Mother's frequency of listening to radio						
	Not all/once a week	1.0			1.0		
	Yes	0.18	0.06, 0.60	0.005	0.20	0.06, 0.64	0.007
	Mother's frequency of watching television						
	Not all/once a week	1.0			1.0		
	Yes	0.03	0.01, 0.16	<0.001	0.06	0.01, 0.27	<0.001
Not meeting minimum diet diversity	Child's age (months)						
	6–11	1.0			1.0		
	12–17	0.54	0.42, 0.70	<0.001	0.56	0.42, 0.74	<0.001
	18–23	0.47	0.36, 0.62	<0.001	0.47	0.34, 0.64	<0.001
	Timing of post-natal visits						
	No visit	1.0			1.0		
	1–2 days	0.55	0.41, 0.73	<0.001	0.58	0.42, 0.81	0.002
	3+ days	0.63	0.46, 0.85	0.003	0.74	0.52, 1.06	0.096
	Wealth index						
	Richest (highest quintile)	1.0			1.0		
	Rich	2.21	1.54, 3.19	<0.001	2.48	1.64, 3.77	<0.001
	Middle	2.69	1.93, 3.74	<0.001	2.65	1.82, 3.87	<0.001
	Poor	3.64	2.62, 5.07	<0.001	3.15	2.11, 4.71	<0.001
	Poorest (lowest quintile)	5.21	3.62, 7.48	<0.001	4.13	2.73, 6.21	<0.001
	Geographic zones						
	Southern Highland	1.0			1.0		
	Lake	1.58	1.07, 2.36	0.022	1.33	0.78, 2.29	0.297
	Northern	1.34	0.89, 2.01	0.158	1.30	0.79, 2.16	0.305
	Eastern	1.13	0.76, 1.68	0.539	1.84	1.08, 3.12	0.024
	Southern	2.06	1.34, 3.15	0.001	1.89	1.08, 3.26	0.023
	Western	2.62	1.76, 3.89	<0.001	2.46	1.45, 4.14	0.001
	Zanzibar	1.81	1.29, 2.55	0.001	2.76	1.69, 4.51	<0.001
	Central	4.63	2.87, 7.47	<0.001	3.66	2.02, 6.63	<0.001
Not meeting minimum meal frequency	Child gender						
	Male	1.00			1.00		
	Female	1.29	1.06, 1.59	0.012	1.40	1.11, 1.76	0.004
	Child's age (months)						
	6–11	1.0			1.0		
	12–17	1.71	1.34, 2.18	<0.001	1.66	1.28, 2.17	<0.001
	18–23	1.89	1.45, 2.48	<0.001	1.97	1.48, 2.61	<0.001
	Timing of post-natal visits						
	No visit	1.0			1.0		
	1–2 days	0.80	0.60, 1.07	0.137	0.87	0.63, 1.21	0.424
	3+ days	0.62	0.47, 0.83	0.001	0.64	0.46, 0.88	0.006
	Geographic zones						
	Northern	1.00			1.00		
	Southern	1.36	0.84, 2.19	0.208	1.39	0.84, 2.31	0.201
	Zanzibar	1.60	1.11, 2.30	0.011	1.62	1.11, 2.37	0.012
	Lake	1.88	1.26, 2.88	0.002	1.85	1.21, 2.83	0.005
	Eastern	1.87	1.17, 2.98	0.009	2.05	1.25, 3.35	0.004
	Southern Highlands	1.91	1.92, 4.42	<0.001	2.95	1.90, 4.57	<0.001
	Western	2.74	1.60, 4.69	<0.001	3.02	1.79, 5.08	<0.001
	Central	3.40	1.98, 5.86	<0.001	3.54	1.89, 6.59	<0.001

Table 5. Continued

Outcome variable	Characteristic	Unadjusted ORs			Adjusted odds ORs		
		OR	95% CI	*P*	OR	95% CI	*P*
Not meeting minimum acceptable diet	Timing of post-natal visits						
	No visit	1.0			1.0		
	1–2 days	0.50	0.33, 0.76	0.001	0.55	0.35, 0.70	0.012
	3+ days	0.46	0.32, 0.67	<0.001	0.52	0.35, 0.76	0.001
	Partner's education						
	No education	1.0			1.0		
	Primary	0.43	0.26, 0.70	0.001	0.59	0.36, 0.96	0.035
	Secondary and higher	0.36	0.19, 0.70	0.003	0.97	0.46, 2.05	0.937
	Wealth index						
	Richest (highest quintile)	1.0			1.0		
	Rich	2.18	1.36, 2.31	0.001	2.28	1.84, 3.82	0.002
	Middle	1.66	1.08, 2.55	0.021	1.55	0.92, 2.62	0.102
	Poor	3.25	1.99, 5.32	<0.001	2.87	1.55, 5.32	0.001
	Poorest (lowest quintile)	3.37	2.80, 5.67	<0.001	2.56	1.33, 4.97	0.005
	Geographic zones						
	Northern	1.0			1.0		
	Southern	1.50	0.86, 2.60	0.151	1.18	0.67, 2.08	0.564
	Zanzibar	1.57	0.85, 2.89	0.152	1.56	0.83, 2.94	0.168
	Lake	1.53	0.92, 2.56	0.102	1.57	0.88, 2.83	0.129
	Eastern	1.66	0.92, 3.00	0.091	1.69	0.91, 3.15	0.095
	Southern Highlands	1.56	0.91, 2.68	0.109	2.02	1.12, 3.67	0.020
	Western	3.27	1.64, 6.51	0.001	2.73	1.41, 5.30	0.003
	Central	8.90	3.26, 24.33	<0.001	7.86	2.92, 21.16	<0.001

Survey logistic regression models for risk factors associated with delayed introduction of CF at 6–8 months, not meeting minimum dietary diversity, meal frequency and acceptable diet among children aged 6–23 months. The independent variables adjusted for were: child sex, child age, mother's age, mother's education, mother's literacy, mother's employment status, mother's BMI, marital status, father's education, father's occupation, birth order, preceding birth interval, antenatal visits, place of delivery, post-natal visits, mother's access to media (radio, television and newspapers), household wealth index, area of residence and geographical zones.
BMI, body mass index; CI, confidence interval; CF, complementary feeding; OR, odds ratio.

lower household wealth were predictors of not meeting minimum dietary diversity. Being a female child younger than 12 months and lack of post-natal check-ups were determinants of not meeting meal frequency. Lower paternal education, lack of post-natal check-ups and lower household wealth/poor economic status were the risk factors for not meeting minimum acceptable diet. The results of this study highlight the need for nutrition interventions to improve dietary quality and feeding practices in Tanzania.

The main strengths of this study include the use of a nationwide survey sample, comprehensive data on standard CF indicators and appropriate statistical adjustment for the cluster sampling design in the analysis. There are currently few published studies from Africa including Tanzania that have reported analyses of feeding indicators using the most recent national surveys and examined risk factors associated with inappropriate complementary practices based on the new WHO indicators (WHO 2008). Apart from being a cross-sectional survey analysis, this study did not examine the nutritional adequacy of diet because of lack of information on the amount of food fed. Furthermore, this study was limited by the lack of data regarding milk feeds given to non-breastfed children and therefore the indicator for minimum meal frequency for non-breastfed children was based on number of times a non-breastfed child consumed soft, semi-solid of soft foods on the previous day only. Similarly, we were unable to estimate the prevalence of minimum acceptable diet for non-breastfed children in Tanzania because of lack of data on number of milk feeds in the TDHS data set. However, the

proportion of non-breastfed children aged 6–23 months was relatively small at 16.3% and made a small influence on the overall estimation of the minimum acceptable diet. Collection of data on the number of milk feeds given to non-breastfed children needs to be considered in the future DHS surveys.

One of the key finding from this study is that complementary foods given to most children are mainly made from grains, roots and tubers, which have low nutrient density. This dietary pattern is similar to that reported in previous studies conducted in Tanzania (Wandel & Holmboe-Ottesen 1992; Mamiro *et al*. 2005; Nyaruhucha *et al*. 2006; Maseta *et al*. 2008) and other Sub-Saharan African countries (Vaahtera *et al*. 2001; Faber 2004; Mutie *et al*. 2010; Sika-Bright 2010). Meat products, fish, poultry, dairy products and vitamin A-rich foods are consumed infrequently by young children; however, the consumption levels tend to increase with children's age. Likewise, other studies in Kenya (Mutie *et al*. 2010), South Africa (Faber 2004), China (Dang *et al*. 2005) and South Asia (Kudlova & Rames 2007; Joshi *et al*. 2012; Kabir *et al*. 2012; Patel *et al*. 2012; Senarath *et al*. 2012b) have also reported similar trends. Limited opportunities to access these foods have been reported to be the main limiting factor for their daily consumption (Dang *et al*. 2005). In addition to poor access, high cost may also prohibit their daily consumption among low-income families in Tanzania.

Introduction of nutritionally adequate and safe complementary foods promotes growth and good nutritional status among infants and young children (WHO 2003). In this study, most infants aged 6–8 months receive food on the previous day, implying that majority of mothers and carers comply with the WHO recommendation for the introduction of complementary foods at targeted ages. However, the frequencies of feeding and dietary diversity were inadequate to provide sufficient nutrients to support optimal growth and development. Hence, there is a need for effective interventions to educate mothers, carers, key family members and the communities as a whole on how to improve the quality of complementary foods in Tanzania.

In this study, we found that lack of post-natal check-ups was one of the main risk factors for not meeting the minimum dietary diversity, minimum meal frequency and minimum acceptable diet. These findings are consistent with those reported in Sri Lanka (Senarath *et al*. 2012b) whereby lack of post-natal visits was predictive of inappropriate CF practices. Mothers should also be encouraged to attend antenatal and post-natal care clinics to enhance their knowledge about IYCF practices, including appropriate CF practices.

Distribution of information, education and communication (IEC) materials such as leaflets and brochures about CF should target mothers and caregivers, especially those in remote rural areas with no access to radio/television. These materials should be available in all health facilities for easy accessibility by mothers/caregivers. Village health workers should assist in the distribution of the IEC materials in their communities to reach mothers who are not attending the antenatal/post-natal clinics. In addition to distribution of IEC materials, community peer counselling on optimal CF practices could be another strategy to support mothers and carers with low literacy levels. This is recommended in view of the finding in this study that, mothers who had frequent access to mass media (radio/television) had a lower risk of delayed introduction to complementary foods at 6–8 months. Similar findings were reported in India (Patel *et al*. 2012), that the risk of not introducing complementary foods at the age of 6–8 months was three times higher for mothers who did not have access to media (newspapers) than those who reads newspapers almost every day. In other studies (Joshi *et al*. 2012), limited exposure to mass media was found to be a negative predictor of inadequate dietary diversity, meal frequency and acceptable diet, but not on delayed introduction to complementary foods. However, having frequent access to mass media also exposes household members to nutritional information that may improve child feeding practices. Thus, these findings suggest that mass media such as television, radio and newspapers can be used as an effective means of promoting CF practices.

Nutrition education interventions that aim to improve child feeding in Tanzania should target all family members, including fathers, because they often provide the main source of family income and lead

decisions made at the household-level in matters related to women's and children's well-being. Father's education revealed a protective effect towards attainment of child minimum acceptable diet in this study. There is evidence suggesting that father's and other key household members' education improve infant feeding and child nutrition (Moestue & Huttly 2008; Kabir *et al*. 2012). For example, children of fathers with lower education in Bangladesh (Kabir *et al*. 2012) had 2.5 more risk of not meeting minimum dietary diversity compared with children of educated fathers.

Consistent with previous studies (Vaahtera *et al*. 2001; Faber 2004; Ng *et al*. 2011; Joshi *et al*. 2012; Kabir *et al*. 2012; Patel *et al*. 2012; Senarath *et al*. 2012a,b), this study also confirmed that improved household wealth has a significant effect on appropriate CF practices (i.e. meeting requirement for minimum dietary diversity and minimum meal frequency). Seasonal variation may influence daily availability of variety of quality raw foods among low-income households that depend on their own agricultural produce as the main source of food in Tanzania. In addition, financial constraints might be the limiting factor for poor people to adequately secure nutritious foods for their children on a daily basis. High-quality processed foods are available in the markets, but they are expensive and the vast majority of the low-income population in Tanzania cannot afford these foods. In Western Uganda for example, lack of financial resources was a barrier for majority of mothers to provide adequate diverse diet to their children although these mothers were aware that dietary diversity plays an important role in child's health (Wamani *et al*. 2005). This suggests that cash transfers for the poorest might allow the families to purchase more nutritious foods for children and lead to improvements in their nutritional status.

We also found a large variation in CF practices across the geographic regions of Tanzania. Of major concern was the higher risk of inappropriate CF among children from Central, Eastern, Western and Zanzibar zones compared with the other geographic zones. Large regional variation of CF practices has been observed in recent surveys from Bangladesh (Kabir *et al*. 2012), India (Patel *et al*. 2012), Indonesia (Ng *et al*. 2011), Nepal (Joshi *et al*. 2012) and Sri Lanka (Senarath *et al*. 2012b). Different cultural feeding practices and adult level of education were some reasons for these variations in other countries (Ng *et al*. 2011; Kabir *et al*. 2012). In Tanzania however, different agro-ecological characteristics, ethnicity and taboos could be some of the possible explanations for the geographic differences in not meeting dietary diversity. Variability in the agricultural potentials would account for the discrepancy in food potential observed in the various agro-ecological zones. Some zones have high agricultural potential while others (e.g. Central) have very low potential [Ministry of Agriculture Food Security and Co-operatives (MAFC) & Food Security Information Team (FSIT) 2009], which account for the variability in their compliance to recommended CF practices. The existence of cultural beliefs that prohibit young children from eating selected nutritious foods (Paul *et al.* 2011) may also contribute to variation in CF patterns particularly in not meeting minimum dietary diversity in Tanzania. For example, most recently, Paul *et al*. (2011) found that children were not given nutritious foods like fish and vegetables in Pemba-Zanzibar because of the indigenous belief that children cannot chew these foods. Consequently, educational strategies are also needed to change some of the beliefs that prevent adoption of good CF practices in different communities. Moreover, interventions to improve feeding practices should also focus on other ways to improve food security at the household level by creating activities that will eradicate poverty and hence improve people's income.

In conclusion, the results of our study show that in Tanzania, a high percentage of children aged 6–8 months received soft, semi-solid or solid foods on the previous day, but very few met the requirements for dietary diversity, meal frequency or acceptable diet. The individual-, household- and community-level factors such as the age of children, parental education, access to mass media, post-natal check-ups, area of residence and household wealth index are significantly associated with inappropriate CF practices. Effective nutrition programmes to enhance CF practices need to be implemented in the entire country and should target uneducated mothers and carers with young children who lacked post-natal contacts with health workers and/or mass media, those from

poor families and residing in the Central, Eastern, Western and Zanzibar zones. In addition, nutrition education programmes should counsel mothers, carers and key family members about the basic principles of CF and strategies to improve the quality of complementary foods using locally available ingredients in the household.

Acknowledgements

We acknowledge the Australian Agency for International Development (AusAID) for sponsoring an MPhil fellowship for RV.

Source of funding

None.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

RV designed the study, performed the analysis and prepared the paper; SKB provided advice on study design and critically revised the paper for intellectual content; KEA provided advice on study design and statistical guidance in data analysis, and critically revised the paper for intellectual content; and MJD provided advice on study design and critically revised the paper for intellectual content. All authors read and approved the final paper.

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