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Maternal Literacy, Facility Birth, and Education Are Positively Associated with Better Infant and Young Child Feeding Practices and Nutritional Status among Ugandan Children[1–3]

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Abstract

Background: Understanding maternal factors that influence child feeding is necessary to inform intervention planning in settings in which mothers experience substantial social vulnerabilities.

Objective: The purpose of this study was to assess maternal sociodemographic factors that may constrain women's caring capabilities and subsequent child nutrition in Uganda.

Methods: We analyzed data from the 2006 and 2011 Uganda Demographic and Health Surveys to model the associations between maternal sociodemographic factors, child feeding practices, and anthropometry with multivariate logistic regression models.

Results: The proportion of children fed according to recommended guidelines declined in Uganda from 2006 to 2011. Mothers who lacked literacy skills were less likely to achieve recommended complementary feeding indicators; however, literacy was not associated with breastfeeding practices. Mothers in the upper 60% wealth percentile were more likely to meet minimum meal frequency, diversity, and adequacy indicators. Mothers who gave birth at health facilities (2006 OR: 0.49; 95% CI: 0.26, 0.91; $P < 0.05$) and who were in the upper 60% wealth percentile (2011 OR: 0.43; 95% CI: 0.21, 0.69) were less likely to exclusively breastfeed until 6 mo. There were no significant associations between age at first pregnancy, maternal education, and infant and young child feeding practices. Women with a formal education had children with lower stunting and underweight probabilities in both time periods (OR range: 0.43–0.74). Women who delivered in childbirth facilities were less likely to have a child with low weight-for-age, length-for-age, or weight-for-length *z* scores (OR range: 0.59–0.82). Marital status, the age at first child birth, not accepting domestic violence, freedom to travel away from home, and involvement in household and reproductive decisions were not associated with child anthropometry in either time period.

Conclusions: Mothers with low literacy skills, who deliver their children at home, and who lack formal education are particularly at risk of poor child feeding and represent a group that may benefit from enhanced interventions that address their particular vulnerabilities. Factors that contribute to improved maternal feeding capabilities but may impair breastfeeding practices need to be better understood. *J Nutr* 2015;145:2578–86.

Keywords: breastfeeding, infant and young child feeding, maternal literacy, maternal social factors, Uganda

Introduction

Worldwide, approximately one-third of children <5 y of age are undernourished (1, 2). Stunting is a form of chronic undernutrition that manifests from prolonged nutrient inadequacy and impairs children's cognitive development and long-term developmental potential (2). Although the global prevalence of child stunting decreased from 40% in 1990 to 27% in 2010, the WHO Africa region has seen an increase from 45 to 60 million stunted children during this 20 y period (3, 4). In Uganda, however, the prevalence of child stunting dropped from 38% in 2006 to 33.4% in 2011, with children in rural settings nearly twice as likely to be stunted as those in urban environments (4, 5).

A conceptual model developed by UNICEF posits that inadequate infant and young child feeding (IYCF) practices comprise a chief underlying cause of child undernutrition (6). Breastfeeding practices in the first 6 mo of life are strong in

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[3] Supplemental Table 1 is available from the "Online Supporting Material" link in the online posting of the article and from the same link in the online table of contents at http://jn.nutrition.org.
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Uganda. There is widespread initiation of breastfeeding in the first hour of delivery and a high rate of exclusive breastfeeding up to 6 mo of age (7). However, complementary feeding practices do not follow the recommended evidence-based guidelines (8–10). Among children ages 6–24 mo, feeding frequency is less often than recommended, dietary diversity is low, and only 6% of children meet the overall recommendations for a minimally adequate diet (9, 10). As in many low-income countries, the timing of growth faltering is most pronounced after 6 mo of age, when breast milk is no longer sufficient for children's complete nutritional needs (2).

The WHO developed indicators to assess children's dietary adequacy according to 8 key components of feeding practices and dietary provision (11). These indicators have modest associations with child growth faltering, but are useful as metrics of population-level practices (12). Few studies have examined the relation between the sociodemographic characteristics of the caregiver and child feeding quality and indicators of dietary quality. Moreover, it is not known how well salient sociodemographic factors predict children's nutritional status in the Ugandan context. Increasingly, program planners and researchers appreciate the role of maternal-level factors in child health outcomes, especially nutrition (13).

Child feeding practices are understood to be influenced by household food security, the health environment, including hygiene, and caring practices. Overwhelmingly across cultures, mothers are responsible for giving nutritional care to children. However, the resources for women to provide this care are poorly understood, which limits the potential for social programs and policies to strengthen more distal determinants of life saving practices (14). In 1999, Engle et al. (15) made substantial progress in applying the concepts of care and the corresponding measurement needs to child nutrition and feeding by defining resources needed by caregivers to provide care, as well as characteristics of children that influence the kind of care that they receive. The authors highlighted 6 major categories of resources for care: *1*) appropriate education, knowledge, and beliefs; *2*) health and good nutritional status; *3*) mental health; *4*) lack of stress, and self-confidence; *5*) autonomy, control of resources, control of household allocation, reasonable workloads, and adequate time available; and *6*) social support from family members and the community. Educational assets, knowledge and skill acquisition, and beliefs of caregivers represent the caregiver's capacity to provide care. Moreover, the authors highlight that the mother's physical and mental health, social control, and workload and time constraints all contribute to her ability to provide care (15). A growing body of research highlights links between women's autonomy and child nutrition status, although a consistent definition of this construct is still lacking and these associations have been less strong in the African context (13, 16). Therefore, this study aimed to improve understanding of maternal-level influences on children's diets and nutritional status in Uganda by *1*) examining the maternal-level demographic predictors of the 8 principal WHO IYCF practices; and *2*) assessing the association between these demographic factors and child anthropometry in Uganda.

Methods

Data source and sampling methodology. We used data from the 2006 and 2011 Uganda Demographic and Health Surveys (DHSs)—nationally representative surveys that used 2-stage cluster sampling within 9 specified regions of Uganda. In 2006, 9864 households were selected and 8870 were interviewed (95% response rate), including 8531 women ages 14–59 y. In 2011, 10,086 households were selected and 9033 households were interviewed (95% response rate), including 8674 women. The DHS methodology collects child dietary information for all children ages 0–23 mo, and heights and weights of children 0–5 y of age in a subsample of 1 in 3 households selected. We restricted our analytic sample to include all last-born singleton birth children ages 0–23 mo with anthropometric data. These restrictions resulted in a final sample of 1009 maternal–child dyads in 2006 and 888 in 2011 (9, 10). This sample included both breastfed and nonbreastfed children, and we applied separate guidelines for assessing the IYCF indicators for these 2 groups (**Supplemental Table 1**).

Assessment of child nutritional status. Child weight was measured with the use of a lightweight electronic SECA scale. Infants (0–11 mo of age) were weighed with their mothers and then the mother's weight was subtracted to obtain infant weights. Recumbent length of children <24 mo of age was measured with the use of a measuring board (Shorr Productions). Nutritional status was assessed based on the WHO Multicenter Growth Reference Study Standards (17). Three indexes were derived from anthropometric measures, including weight-for-age z score, length-for-age z score, and weight-for-length z score. Children with a weight-for-age z score < -2 were classified as underweight, a length-for-age z score < -2 were classified as stunted, and a weight-for-length z score < -2 were classified as wasted.

Assessment of IYCF practices and construction of indicators. To assess IYCF practices, we constructed the 8 core IYCF indicators that are recommended in the 2008 WHO report: *1*) early initiation of breastfeeding; *2*) exclusive breastfeeding to 6 mo of age; *3*) continued breastfeeding at 1 y of age; *4*) timely introduction of complementary foods; *5*) minimum meal frequency; *6*) minimum dietary diversity; *7*) consumption of iron-rich or iron-fortified foods; and *8*) feeding a minimally acceptable diet (Supplemental Table 1) (11). All dietary data were based on caregiver reports of feeding practices in the 24 h preceding the survey. Children were classified as breastfed if the caregiver reported that the child was breastfed at least once in the 24 h preceding the survey.

The most current minimum meal frequency indicator, updated in 2008, requires that nonbreastfed children be fed milk ≥2 times/d. Because frequency of milk feedings was not recorded in 2006 Uganda DHS data, our analysis only required that nonbreastfed children be fed ≥4 times/d to meet the minimum meal frequency indicator. The minimum meal frequency indicator is intended as a proxy for energy intake from foods other than breast milk. Feeding frequency for breastfed children includes only nonliquid feeds, whereas feeding frequency for nonbreastfed children includes both milk feeds and solid/semisolid feeds.

Consumption of any amount of food from each food group was sufficient to be counted, except if an item was only used as a condiment. A cutoff of 4 food groups was selected because that is associated with better quality diets for both breastfed and nonbreastfed children (11). Consumption of foods from at least 4 food groups on the previous day indicates that, in most populations, the child had a high likelihood of consuming at least one animal-source food and at least one fruit or vegetable, in addition to a staple grain, root, or tuber during the day in question (11).

Conceptual framework. The conceptual framework that guided the analysis is illustrated in **Figure 1**. Built upon the UNICEF framework (6) that describes the immediate and underlying causes of child undernutrition, and other studies that have extended this framework to parental education (18), we examined distal factors that may constrain mothers' capacities to provide care for children based on limitations to *1*) informational social support (estimated by access to media); *2*) emotional support (estimated by marital status); *3*) reproductive decision making (estimated by whether the mother first gave birth as an adolescent); *4*) marketplace access (estimated by women's formal employment); *5*) women's access to care (estimated by whether the mother delivered her baby at home); and *6*) physical autonomy (estimated by beliefs about domestic violence and freedom to travel away from home).

Analytic strategy. Predictors of IYCF practices and nutritional status were assessed with the use of multinomial logistic regression. Data were

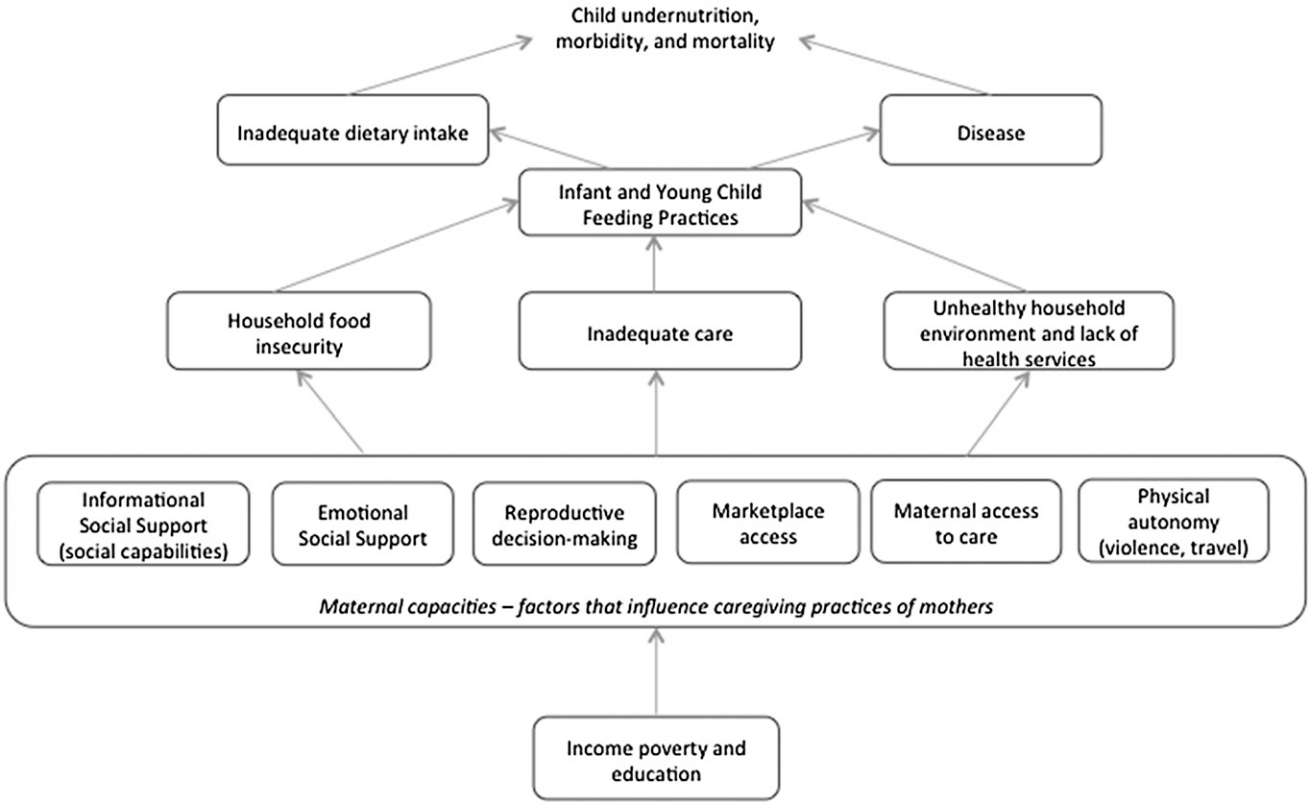

FIGURE 1 Conceptual framework of the influence of maternal capacities and infant and young child feeding practices.

weighted before analysis to account for the study design, which over-sampled households in more remote areas and under-sampled households in more densely populated areas. Given the hierarchical structure of DHS data, STATA survey (SVY) commands were used in regression analyses.

We tested for an interaction between morbidity and wealth quintile. The interaction was not significant in any models (at the level of $P < 0.10$); therefore, it was excluded in final models. The threshold for statistical significance was set at the probability of a type I error <0.05. All analyses were conducted in STATA version 12.0.

Results

Description of study sample. The demographic characteristics and IYCF practices of the study sample are described in **Table 1**. Sample sizes for analyses that used IYCF indicators vary according to the age restrictions for given indicators. Whereas early initiation of breastfeeding includes the entire sample, exclusive breastfeeding includes only children 0–5 mo of age, breastfeeding at 1 y of age includes only children 12–15 mo of age, and timely introduction to complementary foods includes only children 6–8 mo of age. The remaining indicators include children 6–23 mo of age. The prevalence of optimal feeding practices was generally lower in 2011 than 2006, as was the prevalence of undernutrition. From 2006 and 2011, the prevalence of achieving feeding indicators decreased for 7 of 8 of the feeding indicators by 1–9%, with the exception of early-initiation of breastfeeding. In 2006, ~1 in 5 children were underweight, 1 in 3 were stunted, and 1 in 9 were wasted. These figures declined by 3–4% by 2011.

Sociodemographic predictors of IYCF practices. Multiple maternal level sociodemographic factors predicted IYCF practices, although these associations were more common for complementary feeding practices than for breastfeeding indicators (**Tables 2–4**).

Maternal literacy was associated with a greater likelihood of feeding children the minimum frequency, dietary diversity, iron rich foods, and minimum acceptable diet. This association was strongest for the indicator of minimally acceptable diet in 2006: mothers who were literate were >2 times as likely to achieve this indicator (OR: 2.25; 95% CI: 1.13, 4.47; $P < 0.05$). Mothers with media exposure were more likely to continue breastfeeding at 1 y of age in 2011 (OR: 5.87; 95%: 1.05, 32.8; $P < 0.05$). Media exposure had opposite effects on dietary diversity in the 2 surveys. It reduced the likelihood of meeting the indicator in 2006 and increased the likelihood in 2011. Paradoxically, women who possessed decision-making power in their households were less likely to feed children iron-rich foods in both 2006 and 2011.

Mothers who were formally employed were less likely to feed their children a minimally acceptable diet in 2006 only. Mothers who were married were more likely to initiate breastfeeding within 1 h of childbirth and to feed iron rich foods in 2006 (OR: 2.31, 95% CI: 1.24, 4.28), but not in 2011. All other indicators were nonsignificant for this variable.

Women who were not accepting of domestic violence under any circumstance were less likely to exclusively breastfeed their children (OR: 0.38; 95% CI: 0.20, 0.72; $P < 0.01$). Mothers who could travel freely from home in the previous 12 mo were more likely to feed children the minimum dietary diversity in 2006 (OR: 1.69; 95% CI: 1.18, 2.43; $P < 0.01$). Women who gave birth in a health facility were more likely to initiate breastfeeding within 1 h of childbirth in 2006 (OR: 1.32; 95% CI: 1.01, 1.72), but not 2011. Health facility birth was associated with a greater likelihood of initiating breastfeeding within 1 h of childbirth in 2006, but was associated with a reduced likelihood of exclusively breastfeeding in 2006. Neither association was significant in 2011. In 2011, women who delivered at health facilities were

TABLE 1 Demographic characteristics, feeding practices, and nutritional status of study participants[1]

	2006 DHS, % (*n*)	2011 DHS, % (*n*)	2006–2011 change, %
Child age, mo			
0–5	23.2 (235)	24.1 (216)	+0.9
6–8	13.7 (139)	14.2 (127)	+0.5
9–11	13.3 (135)	12.4 (111)	−0.9
12–15	20.0 (202)	15.6 (140)	−4.4
16–23	29.8 (301)	33.8 (303)	+4.0
Child gender			
Boy	50.4 (510)	50.6 (454)	+0.2
Girl	49.6 (501)	49.3 (443)	−0.3
Nutrition status in children aged 0–23 mo			
Underweight (weight-for-age *z* score < -2)	18.6 (188)	14.6 (131)	−4.0
Stunted (length-for-age *z* score < -2)	29.2 (295)	26.1 (234)	−3.1
Wasted (weight-for-length *z* score < -2)	11.6 (117)	8.3 (74)	−3.3
Maternal sociodemographic factors			
Literate	52.2 (527)	57.6 (511)	+5.4
Exposed to media	79.7 (804)	85.9 (763)	+5.9
Employed	92.0 (928)	77.4 (687)	−14.6
Married or living with partner	87.7 (885)	86.5 (768)	−1.2
Education			
None	22.2 (224)	14.4 (128)	−7.8
Some primary/complete primary	62.9 (635)	62.4 (554)	−0.5
Some secondary	14.9 (150)	23.2 (206)	+8.3
Upper 60% based on household assets index	55.2 (557)	54.5 (484)	−0.7
Delivered in a health facility	43.8 (452)	61.4 (545)	+17.6
Has negative beliefs about domestic violence	24.7 (249)	28.0 (249)	+3.3
Traveled away from home in the previous 12 mo	35.9 (361)	39.9 (354)	+4.0
Participates in household decision making	71.8 (724)	73.0 (648)	+1.2
Feeding practices			
Early initiation of breastfeeding (n_{2006} = 1009; n_{2011} = 888)	41.9 (423)	51.0 (458)	+9.1
Exclusive breastfeeding to 6 mo of age (n_{2006} = 234; n_{2011} = 216)	70.5 (165)	66.5 (143)	−4.0
Continued breastfeeding at 1 y of age (n_{2006} = 202; n_{2011} = 140)	93.0 (187)	89.8 (125)	−3.2
Timely introduction of complementary foods (n_{2006} = 139; n_{2011} = 127)	77.9 (108)	79.1 (100)	−1.2
Fed minimum dietary diversity (n_{2006} = 777; n_{2011} = 681)	23.1 (180)	14.6 (99)	−8.5
Fed minimum meal frequency (n_{2006} = 777; n_{2011} = 681)	33.7 (262)	37.3 (253)	−3.6
Fed iron-rich foods or iron-fortified products (n_{2006} = 777; n_{2011} = 681)	31.6 (246)	35.3 (241)	−3.7
Fed minimally adequate diet (n_{2006} = 777; n_{2011} = 681)	8.9 (69)	6.0 (41)	−2.9

[1] Overall n = 1009 in 2006 and n = 888 in 2011. n is a weighted value when in parentheses. DHS, Demographic and Health Survey.

more likely to feed their child iron-rich or iron-fortified foods (OR: 1.68; 95% CI: 1.19, 2.36; $P < 0.001$), but not in 2006.

Compared with children in the poorest 40% of the household wealth index, children in the upper 2 wealth quintiles (richest 60%) were more likely to be fed complementary foods at the appropriate age and to be fed the minimum number of times per day, a minimally diverse diet, and a minimally acceptable diet, but were less likely to be breastfed exclusively and to continue being breastfed at 1 y of age. These associations were not always significant in the 2 time periods, although the direction of associations remained consistent in 2006 and 2011. Maternal education and whether a mother gave birth to her first child as an adolescent were not associated with any child feeding indicator in either survey year.

Sociodemographic predictors of child anthropometry. Based on 6 models (3 anthropometric indexes across 2 time points), we identified 6 sociodemographic factors that were associated with child nutritional status (**Table 5**). The most consistent predictors of nutritional status were household wealth status, maternal education, and the location of childbirth. Women with some formal education, compared with women with none, had children with consistently lower probabilities of stunting (2006 OR: 0.72; 95% CI: 0.53, 0.99; $P < 0.05$; 2011 OR: 0.43; 95% CI: 0.28, 0.56; $P < 0.05$) and childhood underweight (2006 OR: 0.65; 95% CI: 0.45, 0.94; $P < 0.05$; 2011 OR: 0.49; 95% CI: 0.30, 0.81; $P < 0.05$). Across all 3 anthropometric indexes, women who delivered their infants in health facilities were less likely to have an undernourished child than were women who birthed at home. The magnitude of this effect ranged from a 41% reduction in the likelihood of wasting in 2011 to a 32% reduction in the odds of underweight in 2006.

Mothers who were formally employed (OR: 1.54; 95% CI: 1.05, 2.25; $P < 0.05$) and with access to media (OR: 1.85; 95% CI: 1.16, 2.94; $P < 0.01$) were more likely to have a stunted child in 2011, but not in 2006. However, media access was protective against wasting in 2006 (OR: 0.61; 95% CI: 0.39, 0.95; $P < 0.05$). Although the direction of association with maternal literacy consistently demonstrated a protective effect again malnutrition, this was only statistically significant in one instance (OR for underweight in 2006: 0.60; 95% CI: 0.43, 0.82).

Measures of physical autonomy (measured by beliefs about domestic violence and travel away from home), the age at which women first gave birth, marital status, and decision-making

TABLE 2 Adjusted logistic regression coefficients of predictive power of demographic characteristics on IYCF practices[1]

		Early initiation of breastfeeding		Exclusively breastfed (children aged 0–5 mo)		Continued breastfeeding at 1 y (children aged 12–15 mo)	
Variable	Maternal construct	2006 (n = 1009)	2011 (n = 888)	2006 (n = 238)	2011(n = 220)	2006 (n = 175)	2011 (n = 140)
Maternal literacy (referent: maternal illiteracy)	Informational social support	1.06 (0.78, 1.45)	1.05 (0.76, 1.45)	1.27 (0.62, 2.61)	1.47 (0.71, 3.02)	1.83 (0.43, 7.87)	0.69 (0.12, 3.78)
Maternal exposure to media (referent: no media exposure)	Informational social support	0.91 (0.64, 1.28)	1.15 (0.78, 1.69)	0.58 (0.22, 1.51)	1.24 (0.54, 2.83)	0.14 (0.01, 1.69)	5.87 (1.05, 32.8)*
Decision making (referent: no participation in household decisions)	Autonomy–multiple domains	0.71 (0.49, 1.01)	1.39 (0.95, 2.05)	0.79 (0.34, 1.83)	0.84 (0.35, 2.03)	0.62 (0.02, 3.25)	1.22 (0.19, 7.87)
Adolescent mother (referent: first birth at age >16)	Reproductive decision making	0.94 (0.70, 1.25)	1.12 (0.81, 1.54)	1.18 (0.58, 2.39)	1.66 (0.78, 3.52)	0.81 (0.21, 3.09)	1.46 (0.33, 6.43)
Maternal employment (referent: no employment in last 12 mo)	Marketplace access	0.83 (0.52, 1.34)	1.02 (0.74, 1.41)	0.83 (0.31, 2.26)	0.69 (0.35, 1.38)	6.29 (1.45, 27.2)	0.80 (0.15, 4.21)
Married or living with partner (referent: single/separated/ divorced/widowed)	Emotional social support	1.64 (1.01, 2.70)*	0.80 (0.48, 1.32)	0.84 (0.26, 2.75)	0.75 (0.24, 2.38)	Omitted[2]	2.51 (0.24, 26.6)
Beliefs about domestic violence (referent: acceptance of husband's abuse of wife)	Physical autonomy	1.27 (0.95, 1.71)	1.15 (0.88, 1.52)	1.51 (0.72, 3.18)	0.38 (0.20, 0.72)**	0.71 (0.19, 2.71)	6.73 (1.40, 32.3)*
Travel away from home (referent: no travel away from home)	Physical autonomy	0.88 (0.67, 1.15)	0.84 (0.62, 1.13)	0.61 (0.32, 1.16)	0.74 (0.37, 1.45)	0.75 (0.23, 2.46)	0.99 (0.23, 4.16)
No maternal education (referent: any education)	Education	1.17 (0.81, 1.67)	0.96 (0.61, 1.51)	0.81 (0.33, 1.96)	1.82 (0.62, 5.31)	1.77 (0.34, 9.19)	0.58 (0.04, 7.97)
Delivered in a health facility (referent: delivered at home)	Health care access	1.34 (1.03, 1.74)*	1.14 (0.86, 1.50)	0.49 (0.26, 0.91)*	0.64 (0.33, 1.26)	1.32 (0.36, 4.91)	0.71 (0.16, 3.05)
Household is in the upper 60% wealth index	Income poverty	0.79 (0.60, 1.05)	1.23 (0.91, 1.51)	1.20 (0.61, 2.37)	0.43 (0.21, 0.89)*	1.13 (0.31, 4.21)	0.22 (0.05, 1.05)

[1] Values are ORs (95% CIs). Weighted analysis includes all children 0–23 mo of age with complete anthropometric and child feeding data, n = 1009 in 2006 and n = 888 in 2011. The sample was further divided based on age restrictions of specific IYCF indicators, noted in column headings. The proportion of risk factors according to subsamples for age-restricted IYCF subsamples reflects the risk factor prevalence for the total sample. In 2006, there was a ≤7% range across age strata for the prevalence of all risk factors except travel away from home, in which 41% of mothers of children <6 mo of age traveled away from home compared with 30.6% of mothers of children aged 12–18 mo. In 2011, there was a ≤4% range across child age stratas, except in the case of maternal literacy in 2011 (43.3% in mothers of children <6 mo of age, and 34.5% in mothers of children aged 6 to <12 mo) and negative beliefs about wife beating in 2011, in which 33.3% of mothers of children <6 mo of age had negative views compared with 47% of mothers of children aged 12–18 mo. *$P < 0.05$, **$P < 0.01$. IYCF, infant and young child feeding.
[2] Variable omitted because it predicts outcome perfectly.

capabilities were not associated with child anthropometry in either survey.

Discussion

This study analyzed a large, nationally representative data set of children's nutritional status and feeding practices in Uganda to identify subgroups of mothers whose children are at risk of poor feeding and growth outcomes. To our knowledge, our study is first to apply the maternal-level demographic variables to IYCF indicators and anthropometric indexes across time points in the East African context, in which the typical pattern of growth faltering suggests substantial dietary inadequacy in the period of complementary feeding (2).

Our findings indicate very poor complementary feeding practices in Ugandan children in both surveys and a decrease in the prevalence of exclusive breastfeeding from 2006 to 2011. Whereas nearly 80% of mothers introduced complementary foods at 6 mo of age, <9% of children aged 6–23 mo met the "minimally acceptable diet" criteria in 2006, and only 6% did so in 2011. A recent meta-analysis of 46 countries indicates that the majority of children in low-income countries are not fed according to complementary feeding recommendations: only 8 of the 40 countries with sufficient data to assess the "minimally acceptable diet" indicator among breastfed children had >40% of their children achieving this composite measure of dietary adequacy (19). Clearly, child feeding remains an urgent priority throughout low-income countries—especially during the first 1000 d of life, but also after 2 y, when growth faltering deficits continue to accumulate (20).

Achieving recommended complementary feeding practices requires that caregivers possess an adequate opportunity structure in the form of sufficient knowledge and resources for child feeding. By controlling for socioeconomic status, our study adds

TABLE 3 Adjusted logistic regression coefficients of predictive power of demographic characteristics on IYCF practices (timing of complementary foods, feeding frequency, and dietary diversity)[1]

		Timely introduction of complementary foods		Fed minimum times per day		Fed minimum dietary diversity	
Variable	Maternal construct	2006 (n = 140)	2011 (n = 120)	2006 (n = 771)	2011 (n = 666)	2006 (n = 771)	2011 (n = 668)
Informational social support	Maternal literacy (referent: maternal illiteracy)	0.66 (0.21, 2.08)	1.26 (0.39, 4.12)	1.87 (1.28, 2.74)**	1.66 (1.11, 2.48)*	1.27 (0.82, 1.96)	1.55 (0.86, 2.82)
Informational social support	Maternal exposure to media (referent: no media exposure)	0.89 (0.29, 2.73)	0.46 (0.09, 2.22)	0.55 (0.37, 0.83)**	1.71 (1.01, 2.91)*	1.75 (1.0, 3.08)	1.74 (0.77, 3.96)
Autonomy–multiple domains	Decision making (referent: no participation in household decisions)	0.32 (0.07, 1.50)	0.30 (0.05, 1.72)	1.12 (0.72, 1.73)	1.11 (0.69, 1.78)	1.10 (0.67, 1.79)	0.79 (0.43, 1.47)
Reproductive decision making	Adolescent mother (referent: first birth at age >16 y)	1.22 (0.46, 3.24)	3.53 (0.86, 14.5)	0.99 (0.70, 1.41)	0.91 (0.61, 1.36)	0.88 (0.59, 1.33)	0.91 (0.51, 1.59)
Marketplace access	Maternal employment (referent: no employment in last 12 mo)	0.25 (0.02, 4.14)	2.32 (0.63, 8.51)	1.31 (0.71, 2.40)	0.78 (0.52, 1.17)	0.78 (0.42, 1.45)	0.60 (0.36, 1.02)
Emotional social support	Married or living with partner (referent: single/separated/divorced/widowed)	1.58 (0.60, 4.11)	1.63 (0.10, 14.03)	1.53 (0.83, 2.83)	1.76 (0.91, 3.41)	0.83 (0.43, 1.59)	1.10 (0.48, 2.48)
Physical autonomy	Negative beliefs about domestic violence (referent: acceptance of husband's abuse of wife)	1.58 (0.60, 4.11)	1.65 (0.55, 4.98)	0.81 (0.57, 1.16)	1.16 (0.84, 1.62)	1.02 (0.68, 1.52)	0.94 (0.60, 1.48)
Physical autonomy	Travel away from home (referent: no travel away from home)	2.48 (0.93, 6.64)	0.99 (0.35, 2.78)	1.01 (0.73, 1.41)	1.13 (0.80, 1.62)	1.69 (1.18, 2.43)**	1.51 (0.94, 2.42)
Education	No maternal education (referent: any education)	1.37 (0.41, 4.60)	0.27 (0.33, 2.25)	0.97 (0.62, 1.51)	1.29 (0.72, 2.34)	1.71 (0.97, 3.03)	2.67 (0.78, 9.08)
Health care access	Delivered in a health facility (referent: delivered at home)	2.60 (0.91, 7.46)	0.21 (0.06, 0.73)	0.83 (0.60, 1.14)	0.80 (0.71, 1.45)	0.78 (0.54, 1.13)	1.18 (0.74, 1.90)
Income poverty	Household is in the upper 60% wealth index	1.14 (0.46, 2.81)	3.10 (1.01, 9.54)*	1.87 (1.33, 2.63)*	1.02 (0.71, 1.45)	2.09 (1.40, 3.10)*	1.94 (1.15, 3.29)*

[1] Values are ORs (95% CIs). Weighted analysis includes all children 0–23 mo of age with complete anthropometric and child feeding data, n = 1009 in 2006 and n = 888 in 2011. The sample was further divided based on age restrictions of specific IYCF indicators, noted in column headings. The proportion of risk factors according to subsamples for age-restricted IYCF subsamples reflects the risk factor prevalence for the total sample. In 2006, there was a ≤7% range across age strata for the prevalence of all risk factors except travel away from home, in which 41% of mothers of children <6 mo of age traveled away from home compared with 30.6% of mothers of children aged 12–18 mo. In 2011, there was a ≤4% range across child age stratas, except in the case of maternal literacy in 2011 (43.3% in mothers of children <6 mo of age, and 34.5% in mothers of children aged 6 to <12 mo) and negative beliefs about wife beating in 2011, in which 33.3% of mothers of children <6 mo of age had negative views compared with 47% of mothers of children aged 12–18 mo. *$P < 0.05$, **$P < 0.01$. IYCF, infant and young child feeding.

clarity to the question about which mothers experience the most difficulty in feeding children according to these recommendations. Maternal education has been associated with poor child health outcomes in many instances; however, a review of IYCF practices and growth in 14 countries concluded that the relation between maternal education, feeding practices, and child growth varies by the specific feeding practice in question (21). Our study found fewer associations between maternal education, feeding practices, and undernutrition than for maternal literacy. Although advocacy for improving health through maternal literacy has been made in the African context, for example in Sudan, most quantitative associations of this finding have been in Southeast Asia (22–24). It may be that, in a context of extreme poverty with limited job prospects even for those with formal education, the impact of literacy may be more important for processing the information needed to perform healthy child feeding and to protect children against undernutrition. Notably, women who first gave birth as adolescents did not feed children differently or have different child nutrition outcomes than peers who became mothers as adults. Social vulnerabilities that associate with adolescent pregnancy, and not the timing of the pregnancy itself, may be stronger predictors of feeding practices and nutrition outcomes. A recent study in postconflict northern Uganda found that social stressors were not associated with earlier menarche; however, little research has examined the health vulnerabilities of adolescents in Uganda (25).

An early study on the topic of literacy and undernutrition identified the fact that maternal knowledge of child nutrition concepts was protective against undernutrition, even among mothers who lack literacy skills (26). Recently, attention has been drawn to the concept of "health literacy" in Uganda as a means of understanding vulnerable maternal groups (27). The combination of IYCF programming and policies or interventions that increase women's literacy and information access may alleviate structural barriers to adequate child feeding and ultimately be necessary for appreciable improvements in undernutrition. Whereas improvements in education may be a slower—albeit essential—development goal, improving health literacy among vulnerable maternal groups may be a more efficient target for reducing undernutrition in high-risk groups.

Predictors of exclusive breastfeeding are of some concern, because several factors that are positive for women may have an unintended effect on children's nutrition. Women who did not believe domestic violence was justified under any circumstances, who gave birth in health facilities, and who were in the wealthier 60% of the study population were less likely to exclusively breastfeed their infants through 6 mo of age. Although it is possible that wealthier women with greater health care access

TABLE 4 Adjusted logistic regression coefficients of predictive power of demographic characteristics on IYCF practices (iron-rich and iron-fortified foods and minimum acceptable diet)[1]

Maternal construct	Variable	Fed iron rich foods or iron fortified products (children aged 6–23 mo)		Fed minimum acceptable diet (children 6–23 mo)	
		2006 (n = 771)	2011 (n = 668)	2006 (n = 771)	2011 (n = 581)
Informational social support	Maternal literacy (referent: maternal illiteracy)	1.61 (1.10, 2.37)*	0.86 (0.58, 1.30	2.25 (1.13, 4.47)*	2.34 (0.90, 6.14)
Informational social support	Maternal exposure to media (referent: no media exposure)	1.08 (0.71, 1.66)	1.36 (0.83, 2.26)	1.49 (0.64, 3.48)	Omitted[2]
Autonomy–multiple domains	Decision making (referent: no participation in household decisions)	0.62 (0.41, 0.95)*	0.48 (0.30, 0.76)**	1.30 (0.64, 3.48)	0.87 (0.35, 2.20)
Reproductive decision making	Adolescent mother (referent: first birth at age >16 y)	0.75 (0.52, 1.08)	1.19 (0.81, 1.75)	1.30 (0.62, 2.71)	0.87 (0.36, 2.04)
Marketplace access	Maternal employment (referent: no employment in last 12 mo)	0.77 (0.43, 1.38)	0.78 (0.52, 1.17)	0.87 (0.50, 1.59)	0.34 (0.17, 0.67)**
Emotional social support	Married or living with partner (referent: single/separated/divorced/widowed)	1.38 (0.78, 2.46)	2.25 (1.21, 4.20)*	0.91 (0.36, 2.32)	1.36 (0.37, 4.99)
Physical autonomy	Negative beliefs about domestic violence (referent: acceptance of husband's abuse of wife)	1.03 (0.72, 1.47)	0.98 (0.71, 1.37)	0.40 (1.12, 3.79)*	0.97 (0.50, 1.89)
Physical autonomy	Travel away from home (referent: no travel away from home)	1.12 (0.81, 1.56)	1.37 (0.96, 1.95)	2.36 (1.38, 4.04)**	1.43 (0.71, 2.91)
Education	No maternal education (referent: any education)	1.01 (0.64, 1.58)	0.98 (0.56, 1.70)	0.66 (0.29, 1.46)	2.44 (0.28, 21.12)
Health care access	Delivered in a health facility (referent: delivered at home)	1.06 (0.76, 1.46)	1.68 (1.19, 2.37)**	0.39 (0.22, 3.78)	1.02 (0.51, 2.05)
Income poverty	Household is in the upper 60% wealth index	0.89 (0.64, 1.24)	0.78 (0.54, 1.11)	2.06 (1.12, 3.78)*	1.10 (0.53, 2.28)

[1] Values are ORs (95% CIs). Weighted analysis includes all children 0–23 mo of age with complete anthropometric and child feeding data, n = 1009 in 2006 and n = 888 in 2011. The sample was further divided based on age restrictions of specific IYCF indicators, noted in column headings. The proportion of risk factors according to subsamples for age-restricted IYCF subsamples reflects the risk factor prevalence for the total sample. In 2006, there was a ≤7% range across age strata for the prevalence of all risk factors except travel away from home, in which 41% of mothers of children <6 mo of age traveled away from home compared with 30.6% of mothers of children aged 12–18 mo. In 2011, there was a ≤4% range across child age stratas, except in the case of maternal literacy in 2011 (43.3% in mothers of children <6 mo of age, and 34.5% in mothers of children aged 6 to <12 mo) and negative beliefs about wife beating in 2011, in which 33.3% of mothers of children <6 mo of age had negative views compared with 47% of mothers of children aged 12–18 mo. * $P < 0.05$, ** $P < 0.01$. IYCF, infant and young child feeding.
[2] Variable omitted because it predicts outcome perfectly.

and physical autonomy have more access to alternative feeding options, more research is needed into how these factors may negatively influence breastfeeding practices.

Limitations. Our study was limited by factors related to the design and comprehensiveness of the DHS data. We applied variables from nationally representative secondary data to proxy

TABLE 5 Association of socio-demographic factors and child nutritional status of DHS 2006 and 2011[1]

	Underweight (WAZ < −2)		Stunted (LAZ < −2)		Wasted (WLZ < −2)	
	2006	2011	2006	2011	2006	2011
Maternal literacy (referent: maternal illiteracy)	0.60 (0.43, 0.82)**	0.76 (0.53, 1.10)	0.77 (0.58, 1.00)	0.84 (0.62, 1.14)	0.87 (0.59, 1.29)	0.87 (0.54, 1.41)
Maternal exposure to media (referent: no media exposure)	0.78 (0.53, 1.15)	1.38 (0.80, 2.40)	0.82 (0.59, 1.16)	1.85 (1.16, 2.94)**	0.61 (0.39, 0.95)*	0.89 (0.48, 1.67)
Decision making (referent: no power to make decisions)	1.25 (0.87, 1.80)	0.94 (0.63, 1.42)	1.04 (0.78, 1.42)	0.88 (0.64, 1.23)	1.07 (0.70, 1.66)	1.12 (0.65, 1.92)
Adolescent mother (referent: first birth at age >16 y)	1.03 (0.72, 1.47)	1.39 (0.92, 2.10)	1.21 (0.89, 1.63)	1.07 (0.75, 1.51)	0.96 (0.62, 1.49)	1.00 (0.57, 1.75)
Maternal employment (referent: no employment in previous 12 mo)	1.85 (0.91, 3.77)	1.14 (0.72, 1.79)	1.01 (0.61, 1.68)	1.54 (1.05, 2.25)*	1.86 (0.76, 4.55)	0.57 (0.34, 0.95)*
Married or living with partner (referent: single/separated/divorced/ widowed)	1.60 (0.93, 2.73)	1.20 (0.68, 2.12)	1.10 (0.73, 1.67)	0.82 (0.54, 1.25)	0.97 (0.55, 1.71)	1.64 (0.72, 3.72)
Negative beliefs about domestic violence (referent: acceptance of husband's abuse of wife)	0.91 (0.63, 1.31)	0.90 (0.63, 1.31)	0.89 (0.65, 1.21)	0.88 (0.64, 1.21)	1.00 (0.65, 1.56)	1.00 *9.65, 1.56)
Travel away from home (referent: no travel away from home)	0.93 (0.66, 1.30)	0.96 (0.69, 1.33)	0.80 (0.60, 1.07)	0.78 (0.58, 1.03)	1.33 (0.90, 1.99)	1.33 (0.90, 1.96)
Maternal education (referent: no education)	0.65 (0.45, 0.94)*	0.49 (0.30, 0.81)**	0.72 (0.53, 0.99)*	0.43 (0.28, 0.66)*	0.74 (0.47, 1.15)	0.58 (0.31, 1.11)
Delivered in a health facility (referent: delivered at home)	0.64 (0.46, 0.88)**	0.68 (0.47, 0.99)*	0.78 (0.59, 1.03)	0.67 (0.50, 0.91)*	0.82 (0.56, 1.21)	0.59 (0.38, 0.96)*
Upper 60% percentile in wealth index	0.76 (0.55, 1.04)	0.79 (0.54, 1.14)	0.82 (0.62, 1.06)	1.17 (0.87, 1.58)	1.00 (0.68, 1.49)	0.80 (0.50, 1.29)

[1] Values are ORs (95% CIs), n = 1009 in 2006 and n = 888 in 2011. Weighted analysis includes all children 0–23 mo of age with complete anthropometric and child feeding data. *$P < 0.05$, **$P < 0.01$. DHS, Demographic and Health Survey; LAZ, length-for-age z score; WAZ, weight-for-age z score; WLZ, weight-for-length z score.

for constructs involved in women's caring capabilities for child nutrition. Whereas the available variables each represent constructs of women's caring capabilities, the variables stand for these constructs imperfectly. Thus, some factors may appear nonsignificant in this analysis, given the imperfect measurement of the indicator. For example, women's workloads—represented by maternal employment—did not significantly predict the achievement of recommended IYCF practices. Whereas women's employment and economic involvement may benefit women's ability to feed children (28), the hard physical labor common in the Ugandan context may limit mothers' abilities to provide diverse diets (as was marginally significant in the present study). Other factors that were not assessed because of limitations in variable availability, such as breastfeeding self-efficacy or parenting sense of competence, may also play a role in the relation between caring capabilities and IYCF practices. These factors and others are important to consider in more in-depth community-based studies.

Dietary assessment was based on a single 24 h dietary recall. Thus, our study assumes that the measurements used in the survey reflect the habitual dietary patterns of infants and children. This method has been used in other cross-sectional studies in Uganda, and is considered to be the standard method for deriving IYCF indicators (29, 30). We also assume that maternal-related demographic factors in households are stable over time, because these too were assessed at one time point. Sample size varies throughout models as a result of different age restrictions on feeding indicators. A small number of models could not be analyzed because of an inadequate sample size of 6–8-mo-old children who were not breastfed. Secular trends in Uganda between 2006 and 2011 make comparisons across these time periods difficult, given the changes that occurred during the period, including general infrastructure development and rapidly expanding mobile telephone coverage. Nutrition has gained priority in Uganda's political agenda: specific goals for nutrition were part of the 2010–2015 National Development Plan, and the Office of the Prime Minister, together with partners in the Scaling Up Nutrition Movement, has developed the Uganda Nutrition Action Plan (31, 32). These trends partially may be responsible for the decline in undernutrition prevalence, but likely would not influence the relations examined in this study between maternal factors, child feeding, and nutrition.

Conclusions. IYCF practices remain an important and modifiable component of children's nutritional status, and children belonging to certain subgroups of Ugandan women are at higher risk of poor feeding and nutrition. Achievement of complementary feeding-related IYCF indicators by Ugandan mothers is generally low. Feeding practices and the corresponding undernutrition in children are particularly common in poorer households, as well as among the maternal caregivers who lack literacy skills and education, and who give birth at home. More research is needed into how economic growth, employment, and women's beliefs about domestic violence influence breastfeeding practices in the Ugandan context. Interventions that seek to improve child feeding practices in Uganda may benefit from strengthening maternal characteristics that are associated with poor feeding and growth outcomes in this context, where substantial progress has been made improving children's nutritional status, but where feeding practices remain unacceptably poor and undernutrition is still too common.

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References

1. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, Ezzati M, Granthan-McGregor S, Katz J, Martorell R, et al. Maternal and child under nutrition and overweight in low and middle income countries. Lancet 2013;382:427–51.
2. Victora CG, de Onis M, Hallal PC, Blössner M, Shrimpton R. Worldwide timing of growth faltering: revisiting implications for interventions. Pediatrics 2010;125:e473–80.
3. World Health Organization. Millennium Development Goals: progress towards the health related Millennium Development Goals. [Internet] Geneva (Switzerland): WHO. 2014 May [cited 2015 Jan 30]. Available from: http://www.who.int/mediacentre/factsheets/fs290/en/index.html.
4. de Onis M, Blossner M, Borghi E. Prevalence and trends of stunting among pre-school children, 1990–2020. Public Health Nutr 2012;15:142–8.
5. The World Bank Group Uganda. Millennium Development Goals. [Internet] The World Bank Group. 2010 [cited 2015 Jan 31]. Available from: http://ddp-ext.worldbank.org/ext/ddpreports/ViewSharedReport?&CF=&REPORT_ID=1305&REQUEST_TYPE=VIEWADVANCED&DIMENSIONS=213.
6. UNICEF. Strategy for improved nutrition of children and women in developing countries. [Internet] New York: United Nations Children's Fund; 1990 [cited 2015 Mar 1]. Available from: http://eric.ed.gov/?id=ED323004.
7. Engebretsen IM, Tylleskär T, Wamani H, Karagami C, Tumwine JK. Determinants of infant growth in Eastern Uganda: a community-based cross-sectional study. BMC Pub Health 2008;8:418–30.
8. Wamani H, Astrøm AN, Peterson S, Tylleskär T, Tumwine JK. Infant and young child feeding in western Uganda: knowledge, practices, and socio-economic correlates. J Trop Pediatr 2005;51:356–61.
9. Uganda Demographic and Health Survey 2006; Calverton (MD): Uganda Bureau of Statistics (UBOS) and Macro International Inc; 2007 [cited 2015 Jan 31]. Available from: http://dhsprogram.com/pubs/pdf/FR194/FR194.pdf.
10. Uganda Demographic and Health Survey 2011; Calverton (MD): Uganda Bureau of Statistics (UBOS) and ICF International Inc; 2012 [cited 2015 Jan 31]. Available from: http://dhsprogram.com/what-we-do/survey/survey-display-399.cfm.
11. World Health Organization. World Health Organization indicators for assessing infant and young child feeding practices: part 1: definitions. World Health Organization 2008; Geneva (Switzerland).
12. Jones AD, Ickes SB, Smith LE, Mbuya MN, Chasekwa M, Heidkamp RA, Menon P, Zongrone A, Stoltzfus RJ. World Health Organization infant and young child feeding indicators and their associations with child anthropometry: a synthesis of recent findings. Matern Child Nutr 2014;10:1–17.
13. Carlson GJ, Kordas K, Murray-Kolb L. Associations between women's autonomy and child nutritional status: a review of the literature. Matern Child Nutr 2014 Feb 13 (Epub ahead of print; DOI: 10.1111/mcn.12113).
14. Engle P, Bentley M, Pelto G. The role of care in nutrition programmes: current research and a research agenda. Proc Nutr Soc 2000;59:25–35.
15. Engle PL, Menon P, Haddad L. Care and nutrition: concepts and measurement. World Dev 1999;27:1309–37.
16. Smith L, Ramakrishnan U, Ndiaye A, Haddad L, Martorell R. The importance of women's status for child nutrition in developing countries. IFPRI Reports 2003; 131: Washington (DC).
17. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. World Health Organization. 2006; Geneva (Switzerland).
18. Hatt LE, Waters HR. Determinants of child morbidity in Latin America: A pooled analysis of interactions between parental education and economic status. Soc Sci Med 2006;62:375–86.

19. World Health Organization. Indicators for assessing infant and young child feeding practices part 3: country profiles. World Health Organization 2010; Geneva (Switzerland) [cited 2015 Jan 31]. Available from: http://whqlibdoc.who.int/publications/2008/9789241596664_eng.pdf?ua=1.
20. Leroy JL, Ruel M, Habicht JP, Frongillo EA. Linear growth deficit continues to accumulate beyond the first 1000 days in low- and middle-income countries: global evidence from 51 national surveys. J Nutr 2014;144:1460–6.
21. Marriott BP, White A, Hadden L, Davies JC, Wallingford JC. World Health Organization (WHO) infant and young child feeding indicators: associations with growth measures in 14 low-income countries. Matern Child Nutr 2012;8:354–70.
22. Rai RK, Ramadhan AA, Tulchinsky TH. Prioritizing maternal and child health in independent South Sudan. Matern Child Health J 2012;16:1139–42.
23. Meshram II, Kodavanti MR, Chitty GR, Manchala R, Kumar S, Kakani SK, Kodavalla V, Avula L, Ginnela Narsimhachary Veera B. Influence of feeding practices and associated factors on the nutritional status of infants in rural areas of Madhya Pradesh State, India. Asia Pac J Public Health 2015;27:NP1345–61.
24. Ali SS, Karim N, Billoo AG, Haider SS. Association of literacy of mothers with malnutrition among children under three years of age in rural area of district Malir, Karachi. J Pak Med Assoc 2005;55:550–3.
25. Ondongkara Mpora B, Piloya T, Awor T, Ngwiri T, Laigon P, Mworozi EA, Hochberg Z. Age at menarche in relation to nutritional status and critical life events among rural and urban secondary school girls in post-conflict Northern Uganda. BMC Womens Health 2014;14:66–73.
26. Christian P, Abbi R, Gujral S, Gopaldas T. The role of maternal literacy and nutrition knowledge in determining children's nutritional status. Food Nutr Bull 1988;10:35–40.
27. Naigaga MD, Guttersrud Ø, Peterson KS. Measuring maternal health literacy in adolescents attending antenatal care in a developing country - the impact of selected demographic characteristics. J Clin Nurs 2015;24:2402–9.
28. Woldemicael G. Do women with higher autonomy seek more maternal health care? Evidence from Eritrea and Ethiopia. Health Care Women Int 2010;31:599–620.
29. Tidemann-Andersen I, Acham H, Maage A, Malde MK. Iron and zinc content of selected foods in the diet of schoolchildren in Kumi district, east of Uganda: a cross-sectional study. Nutr J 2011;10:1–12.
30. Moursi MM, Arimond M, Dewey KG, Trèche S, Ruel MT, Delpeuch F. Dietary diversity is a good predictor of the micronutrient density of the diet of 6- to 23-month-old children in Madagascar. J Nutr 2008;138:2448–53.
31. Pelletier D, Haider R, Hajeebhoy N, Mangasaryan N, Mwadime R, Sarkar S. The principles and practices of nutrition advocacy: evidence, experience and the way forward for stunting reduction. Matern Child Nutr 2013;9 Suppl 2:83–100.
32. SUN Movement Secretariat [Internet]. Scaling Up Nutrition in Practice. Social mobilization, advocacy, and communication for nutrition. c2015. [cited 2015 Mar 20]. Available from: http://scalingupnutrition.org/wp-content/uploads/2014/09/Green_External_InPractice_no03_ENG_20140904_web_pages.pdf.