

## Research

# Prevalence and predictors of appropriate complementary feeding practice among mothers with children 6–23 months in Northern Ghana

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## Introduction

Adequate assessment of appropriate complementary feeding practices requires an indicator that can measure its key components concurrently, but past studies often described the practice using single indicators. This study in northern Ghana therefore assessed the prevalence and predictors of appropriate complementary feeding practices as measured using a composite indicator.

## Methods

The source of data for this analysis is from baseline studies of a community-based quasi-experimental study conducted prior to implementing a nutrition behaviour change communication intervention on radio. The study population comprised mothers and their children selected using a two-stage cluster sampling procedure. Multivariable logistic regression was used to identify factors associated with appropriate complementary feeding practices.

## Results

The overall prevalence of appropriate complementary feeding practices combining three key indicators (timely introduction of complementary food, adequacy of meal frequency, and meeting minimum dietary diversity) was 29.8% (95% CI: 27.4 - 32.3). Children aged 12-23 months [AOR = 2.26 (95% CI: 1.41 - 3.61)], higher nutrition related knowledge of caretakers [AOR 1.51; 95% CI (1.15 - 1.98)], higher educational level of mothers [AOR 1.95; 95% CI (1.17 - 3.25)], and positive nutrition related attitudes towards appropriate complementary feeding practices [AOR 1.59; 95% CI (1.21 - 2.09)] were significantly associated with appropriate complementary feeding practice.

## Conclusions

The prevalence of appropriate complementary feeding practices was quite low among children aged 6–23 months. Sustainable nutrition education to mothers/caretakers during prenatal, delivery, postnatal, and child welfare clinic on appropriate complementary feeding should be strengthened to increase nutrition related knowledge and attitude towards appropriate complementary feeding practices.

## INTRODUCTION

Childhood undernutrition associated with poor feeding practices continues to be a public health problem in many parts of the world (Onyango et al. 2014; Shetty 2009). Every child needs an appropriate diet for proper growth and development and yet many households find it difficult to feed their children with appropriate complementary food, especially in low-income countries (Bhutta et al. 2008; Onyango et al. 2014). Complementary feeding becomes necessary when breast milk alone is no longer sufficient to meet the nutritional requirements of infants and young children

(6–23 months), and therefore the need for other foods and liquids in addition to the breast milk (WHO 2007).

Inappropriate feeding practices, in combination with other causes such as infection and food shortage, may be responsible for one-third of malnutrition, depending on population, place, time and season (Lartey 2008; Umata et al. 2003). Poor nutrition is associated with suboptimal brain development, educational performance, human capital accumulation and economic productivity in adulthood (Grantham-McGregor et al. 2007; Leroy et al. 2014; Victora et al. 2008).

Proper feeding practices during infancy are essential for attaining and maintaining proper nutrition, health, and development of infants and children (Brown, Creed-Kanashiro, and Dewey 1995; Kumar et al. 2006). Available evidence suggests that inappropriate complementary feeding practices such as poor quality and insufficient quantity of complementary foods are associated with child malnutrition (Bhandari, Mazumder, Bahl, et al. 2004; Dewey 2001; Saha et al. 2008). Furthermore, appropriate complementary feeding practice can reduce under-five mortality by 6% (Black, Morris, and Bryce 2003; Kimani-Murage et al. 2015).

Globally, as of 2017, child feeding indicators showed poor complementary feeding practices where minimum meal frequency was at 52.2%, minimum dietary diversity was 29.4% and minimum acceptable diet was at 16% (White et al. 2017). A similar situation of suboptimal feeding practices among children aged 6–23 months has been reported in Ghana since 2015 (Ghana Statistical Service, Ghana Health Service, and ICF International 2015; Issaka et al. 2015; Saaka et al. 2016, 2021), where the prevalence of appropriate complementary feeding practices was far below the World Health Organization (WHO) recommended coverage of 90%.

Poor complementary feeding practices are associated with many factors including cultural traditional barriers, maternal education, wealth index, child's age, exposure to media, ANC attendance, postnatal check-up, maternal occupation, institutional delivery, and geographical region (Ali, Arif, and Shah 2021; Epheson et al. 2018; Guldan et al. 2000; Kassa et al. 2016; Samuel and Ibadapo 2020; Wang, Wang, and Shi 2000; WHO and UNICEF 2021).

Understanding the factors influencing infant and young child feeding (IYCF) practices is, therefore, a critical step towards designing effective interventions to prevent malnutrition in children. In the Northern Region of Ghana, 33.1% of children are chronically malnourished (Ghana Statistical Service, Ghana Health Service, and ICF International 2015) and complementary feeding (CF) practices are poor (Ghana Statistical Service, Ghana Health Service, and ICF International 2015; Saaka et al. 2016).

The multidimensional nature of feeding practices requires an appropriate indicator that can incorporate its key components and determine the overall adequacy of child feeding. There is currently no such composite indicator and so studies often describe appropriate complementary feeding practice using single indicators such as minimum dietary diversity, minimum meal frequency, and minimum acceptable diet. This study, therefore, assessed the prevalence and predictors of appropriate complementary feeding practices as measured using a composite indicator among children aged 6–23 months in Northern Ghana.

## METHODS

### STUDY SETTING

The study was carried out in six selected districts of Northern Ghana namely Nadowli-Kaleo, Wa West, Tolon/Kumbungu, Savelugu/Nanton and Kassena/Nankana and Central Gonja. The majority of the people in the study area depend mainly on agriculture as their main occupation while some

are involved in trading (Ghana Statistical Service 2014). The main staple foods are maize, sorghum, millet and yam. The rainfall pattern is unimodal and the rainy period usually lasts from May to September, with dry harmattan winds common during the rest of the year. Poverty is widespread and the average household per capita daily expenditure is estimated to be \$4.91 (Zereyesus et al. 2016).

### STUDY DESIGN, POPULATION, SAMPLE SIZE AND SAMPLING

The source of data for this analysis was the baseline data of a community-based, quasi-experimental study which was conducted prior to implementing a nutrition behaviour change communication intervention on radio in three regions of Northern Ghana (Saaka et al. 2021). The study population comprised mothers/primary caregivers and their children aged 6–23 months.

A sample size of 1400 (700 per study arm) was calculated providing a statistical power of 80% at a 95% confidence level, assuming a correction factor of 2.0 (the “design effect”) for cluster sampling and to detect a reduction of a 10-percentage point difference in the prevalence of appropriate complementary feeding practice between the study groups. A provision of 5% (70) of the total sample size was also factored into the sample size estimation to take care of incomplete/damaged questionnaires bringing the total estimated sample size to 1470.

### DATA COLLECTION PROCEDURE AND STUDY VARIABLES

A pre-tested structured questionnaire was used to collect the required data. Interviews were conducted at the household level face-to-face with mothers/caregivers. The sections of the questionnaire included information on mothers' sociodemographic characteristics (e.g., age, parity, marital status, educational level, marital status, occupation), maternal knowledge, attitudes and practices regarding child feeding practices.

### ASSESSMENT OF NUTRITION-RELATED KNOWLEDGE AND ATTITUDES

The nutritional knowledge of the mother/caregiver was assessed as her ability to correctly state basic food & nutrition information and/or skills in complementary feeding and according to the FAO guidelines (Marias and Glasauer 2014). The total knowledge score for each respondent was based on correct answers to 20 nutrition knowledge related questions. Respondents who scored > 70% in the knowledge test were classified as having a high level of knowledge and those scoring ≤ 70% were classified as having a low level of knowledge.

The nutrition-related attitudes (NRAs) related to appropriate child feeding were measured on a three-point Likert scale (response options were ‘agree’, ‘neutral’, or ‘disagree’). A score of 0 was given to responses that disagree, 1 for being neutral and 2 for “agree” giving a total attitude score for each respondent. The total scores were categorized as high if total correct responses were > 70%, and scores ≤ 70% were classified as low. A higher score was an indica-

tion of a more positive attitude toward preventive nutrition/health behaviours including appropriate IYCF practices.

#### MEASUREMENT OF DIETARY PRACTICES

The type of food fed to children was assessed through the 24-hour diet recall by their mothers or the primary caretakers. Eight food groups were used in the diet recall including the following: (i) grains, roots & tubers; (ii) legumes and nuts; (iii) dairy products; (iv) flesh foods (meat, poultry, and fish) (v) eggs; (vi) vitamin A-rich fruits and vegetables; (vii) other fruits & vegetables; and (viii) breastmilk.

The recent WHO/UNICEF recommended indicators of minimum meal frequency (MMF), minimum dietary diversity (MDD), and minimum acceptable diet (MAD) were used for assessing child feeding practices. A breast-fed child was classified to have taken an ‘adequate’ number of meals if he/she received the minimum frequency for appropriate complementary feeding in last 24 hours (2 times for 6–8 months, 3 times for 9–11 months, and 3 times for children aged 12–23 months). For non-breastfed children, the minimum meal frequency was 4 (WHO and UNICEF 2021). A child aged 6–23 months who has eaten from at least five out of eight food groups in the past 24 hours is deemed to have met minimum dietary diversity (MDD). A child who met both MMF and MDD was classified as being fed on a minimum acceptable diet (MAD).

The main outcome variable of interest was ‘complementary feeding practice’ which was defined using a composite index comprising three valid updated WHO recommended indicators that relate to complementary feeding of young children (WHO and UNICEF 2021). Scores of MMF + MDD + timely introduction of complementary foods at 6 months were added for each respondent to get the total score. The summative score was thus classified as appropriate if all the above three indicators were met and inappropriate if at least one indicator was not met. This composite indicator has been applied by a few investigators (Kassa et al. 2016; Saha et al. 2008; Samuel and Ibidapo 2020; Shagaro, Mulugeta, and Kale 2021).

#### DATA QUALITY CONTROL

A two-day training was held for the data collection team (mainly university graduates), during which the data collection tool as well as data collection procedures were discussed. The objectives of the study were clearly explained to the data collectors and supervisors. In turn, the data collectors explained to the respondents these study objectives and to seek their informed consent.

To ensure the quality of the data collected, we pre-tested the questionnaire on 5% of the sample in a community that was not part of the study prior to the start of the actual study. In the pretest, we assessed among others, the clarity of the questions to the respondents.

The interviewers were supervised in the field by daily checking questionnaires for completeness, accuracy, and consistency. Additionally, the principal investigator checked every completed questionnaire before data entry.

#### DATA ANALYSIS

The Statistical Package for the Social Sciences, version 23.0 (SPSS, Chicago, IL, USA) was used to perform the statistical analyses. The complex survey module of the SPSS was used to take care of the complex design of cluster sampling. This allowed for calculating valid standard errors from the sample data, thereby making correct population inferences. Design weights were added to each district’s sample data (that is, the total population divided by the number of respondents) to perform a weighted analysis.

Bivariate analysis was conducted to assess the crude association of independent variables with the dependent variable. Multivariable logistic regression was used to identify factors associated with appropriate complementary feeding practice, with age of the child, educational status of mother/caregiver, religion of the caregiver, number of children under five years in household, frequency of listening to radio, nutrition-related knowledge and attitude towards complementary feeding practices as independent variables.

Multicollinearity was investigated by using the variance inflation factor (VIF). VIF (the reciprocal of the tolerance statistics) of greater than five was considered evidence of multicollinearity. Variables with VIF greater than five were excluded from the final model. The results were reported with odds ratios and their 95% confidence intervals (CIs). Statistical significance was defined as a p-value less than 0.05.

#### ETHICS CONSIDERATION

Ethical approval was obtained from the Kwame Nkrumah University of Science and Technology ethics committee (Reference no. CHRPE/AP/472/21). Informed consent was obtained after relevant information and explanation were provided. In situations where the respondent could not write or read, verbal informed consent was obtained. Data collected was kept in the form of a file in a secured place.

#### RESULTS

##### SOCIO-DEMOGRAPHIC CHARACTERISTICS OF STUDY PARTICIPANTS

A total of 1470 mother-child pairs were sampled but 210 children were either older than two years or had some missing values and were therefore excluded from this analysis. The median age of the participating mothers was 28 years with interquartile range (IQR) being 8. A majority (65.1%) of the sample children were in the age group 12–23 months. Most of the respondents (65.3%) had no formal education; 97.1% were married. About half the mothers engaged in agriculture (51.0%) as their main occupation ([Table 1](#)).

##### PREVALENCE OF COMPLEMENTARY FEEDING PRACTICES

The overall prevalence of appropriate complementary feeding practice combining three key indicators (timely introduction of complementary food, adequacy of meal frequency, and meeting minimum dietary diversity) was 29.8%, (95% CI: 27.4, 32.3). Nearly 70% of children aged 6–23 months met the minimum meal frequency, 35.2% re-

**Table 1. Socio- demographic characteristics of sample (n= 1260)**

Characteristics	Frequency (n)	Percentage (%)
<b>Age of children (months)</b>		
6-11	440	34.9
12-23	820	65.1
<b>Maternal age (years)</b>		
Under 25 years	362	28.7
25-34 years	652	51.7
At least 35 years	246	19.5
<b>Educational level of mothers</b>		
None	823	65.3
Low (Primary & Junior High School)	362	28.7
High (At least Senior High School)	75	6.0
<b>Religion of mother</b>		
Christian	335	26.6
Moslem	916	72.7
African Traditional Religion	9	0.7
<b>Occupation</b>		
Trader/vendor	206	16.3
Agricultural worker	642	51.0
Office worker (Civil Servant)	45	3.6
Service worker (e.g. Hair-dresser, seamstress)	204	16.2
None	163	12.9
<b>Marital status</b>		
Not married	36	2.9
Married	1224	97.1

ceived minimum dietary diversity ( $\geq 5$  food groups) and 29.8% had received a minimum acceptable diet. Over 80% of children consumed grains, roots and tubers in the previous 24 h preceding the survey, whereas consumption of legumes and nuts, dairy products, vitamin A-rich fruits and vegetables was less than 50%. The proportion of mothers who practiced timely introduction of complementary foods at 6 months was 86.3%. The consumption of several food groups was low ([Table 2](#)).

#### FACTORS ASSOCIATED WITH APPROPRIATE COMPLEMENTARY FEEDING PRACTICE

In bivariate analysis, age of the child, educational status of mother/caregiver, number of children under five years in the household, mother's knowledge of complementary feeding practices, listening to radio and religion of mother were associated with appropriate complementary feeding practice ([Table 3](#)).

In the multi-variable logistic regression analysis, several variables were consistently and significantly associated with appropriate complementary feeding practice. Compared with children aged 6-11 months, children aged 12-23 months were 2.3 times more likely to receive appropriate complementary feeding (AOR = 2.26 (95% CI:1.41 - 3.61) (Table 4). Women who had higher nutrition related knowledge score were 1.5 times more likely to do appropriate

complementary feeding [AOR 1.51; 95% CI (1.15 - 1.98)], compared to their counterparts who had lower scores. Appropriate complementary feeding rates were higher among women who attained higher educational level [AOR 1.95; 95% CI (1.17 - 3.25)], compared to their counterparts who had no formal education.

Children in households with one child under five were 41.0% less likely to be fed with appropriate complementary food [AOR 0.59; 95% CI (0.42 - 0.82)], compared to children from households with at least 3 children. Mothers with a favourable nutrition-related attitude towards appropriate complementary feeding practices were 1.6 times more likely to practice appropriate complementary feeding [AOR 1.59; 95% CI (1.21 - 2.09)], compared to their counterparts with less positive attitude. The set of predictors accounted for 14.2% of the variation in appropriate complementary feeding (Nagelkerke R Square = 0.142).

#### DISCUSSION

This study assessed the prevalence and predictors of appropriate complementary feeding practices measured using a composite indicator among children aged 6–23 months in Northern Ghana. The composite indicator reflected three key components of child feeding, namely appropriate timing of introduction of complementary foods at 6 months,

**Table 2. Consumption of food groups (24 hr recall) and complementary feeding practices (n = 1260)**

Feeding practice	Frequency (n)	Percentage (%)
Consumption of grains, roots & tubers;	1050	83.3
Consumption of legumes and nuts	402	31.9
Consumption of dairy products	230	18.3
Consumption of flesh foods (meat, poultry, and fish	605	48.0
Consumption of eggs	96	7.6
Consumption of vitamin A-rich fruits and vegetables	478	37.9
Consumption of other fruits & vegetables	815	64.7
Timely introduction of complementary foods at 6 months	1088	86.3
Minimum meal frequency (MMF)	880	69.8
Minimum dietary diversity (MDD)	444	35.2
Minimum acceptable diet (MAD)	376	29.8
Appropriate complementary feeding practice	376	29.8

**Table 3. Factors associated with appropriate complementary feeding practice (Bivariate analysis)**

Predictor Variable	Complementary feeding n (%)		Test Statistic
	Inappropriate	Appropriate	
<b>Age of child (months)</b>			
<b>Religion of mother</b>			
Christian	175 (53.0)	155 (47.0)	Chi-squared $\chi^2 = 62.2$ , $p < 0.001$
Moslem	612 (76.3)	190 (23.7)	
African Traditional Religion	5 (50)	5 (50)	
<b>Educational level</b>			
None	525 (71.5)	209 (28.5)	$\chi^2 = 10.3$ , $p = 0.006$
Low (Primary & Junior High School)	231 (67.7)	110 (32.3)	
High (At least Senior High School)	35 (53.0)	31 (47.0)	
<b>Number of children under five in household</b>			
One	452 (77.1)	134 (22.9)	$\chi^2 = 34.6$ , $p < 0.001$
Two	194 (61.6)	121 (38.4)	
At least three	145 (60.4)	95 (39.6)	
<b>Do you listen to radio?</b>			
No	217 (73.8)	77 (26.2)	$\chi^2 = 3.7$ , $p = 0.05$
Yes	574 (67.8)	273 (32.2)	
<b>Knowledge of complementary feeding practices</b>			
Low (Under 70%)	387 (74.1)	135 (25.9)	$\chi^2 = 10.6$ , $p = 0.001$
High (> 70%)	403 (65.2)	215 (34.8)	
<b>Nutrition-related attitudes (NRAs)</b>			
Less Positive (Under 70%)	21 (80.8)	5 (19.2)	$\chi^2 = 2.9$ , $p = 0.09$
Positive (> 70%)	769 (69.0)	346 (31.0)	
<b>Age of child (months)</b>			
6-11	299 (79.1)	79 (20.9)	$\chi^2 = 23.3$ , $p < 0.001$
12-23	448 (64.9)	242 (35.1)	

minimum dietary diversity, and adequacy of meal frequency.

#### PREVALENCE OF APPROPRIATE COMPLEMENTARY FEEDING PRACTICE

The overall prevalence of appropriate complementary feeding practice was low at 29.8%. This finding is higher than that obtained in an earlier studies conducted in Northern

**Table 4. Predictors of appropriate complementary feeding (Multivariable logistic regression analysis, n = 1260)**

	Wald	Sig.	AOR	95% CI for AOR	
				Lower	Upper
<b>Mother's educational level (Reference: No formal education)</b>	5.801	0.06			
Junior High School	0.001	0.98	1.004	0.73	1.38
Senior High Secondary and above	5.51	0.02	1.98	1.12	3.51
Age of child (12-23 months)	32.58	<0.001	2.40	1.78	3.25
High NKS (Total score > 70%)	10.51	0.001	1.61	1.21	2.14
<b>Number of children under five in household (Reference: One child)</b>	16.31	<0.001			
Two children	11.42	0.001	1.75	1.27	2.43
At least three children	11.69	0.001	1.85	1.30	2.63
<b>Religion of mother (Reference: ATR)</b>	32.87	<0.001			
Christianity	29.56	0.29	0.48	0.12	1.89
Islam	1.12	0.02	0.20	0.05	0.79
High NRA ((Total score > 70%))	11.10	0.001	1.63	1.22	2.18
Constant	25.93	<0.001	0.28		

AOR: Adjusted odds ratio; NKS: Nutrition-related knowledge score,  
CI: 95% confidence level; African Traditional religion (ATR)  
NRA: Nutrition-related attitude

Ghana where the prevalence was less than 16.0% (Saaka et al. 2016, 2015). The finding is, however, lower if compared to studies done in other countries including Indonesia and Zambia (Katepa-Bwalya et al. 2015; Ng, Dibley, and Agho 2012) but similar to what was reported from Ethiopia (Bewket Zeleke et al. 2017). The differences might be partly due to the different indicators used in measuring appropriate complementary feeding in other studies which did not include timely addition of complementary foods in their composite indicator.

#### FACTORS ASSOCIATED WITH APPROPRIATE COMPLEMENTARY FEEDING PRACTICE

Using logistic regression analysis, the key predictors of appropriate complementary feeding practice were age of the child, educational level of mother/caregiver, religion of mother, number of children under five years in the household, mother's nutrition-related knowledge and positive attitude of caretakers towards complementary feeding practices.

The results show a positive association between the educational attainment of mothers and the feeding of appropriate complementary foods to their children. Women who had a higher educational level of at least Senior High School were 2.0 times more likely to feed their children with appropriate complementary foods compared to their counterparts who had no formal education. This finding is consistent with studies conducted in some other settings including Western and Northern Ethiopia, Northern Ghana, India, and Bangladesh (Belete, Awararis, and Muleta 2017; Fanta and Cherie 2020; Kabir et al. 2012; Mekbib et al. 2014; Ng, Dibley, and Agho 2012; Patel et al. 2012; Saaka et al. 2016; Shagaro, Mulugeta, and Kale 2021; Victor et al. 2014) which reported that mothers with no formal education were less often practising appropriate complementary feeding.

One possible reason why educated mothers feed their children more appropriately is the fact such women might read books, leaflets and magazines that contain useful messages on child feeding. Educated mothers also have a better chance of exposure to nutrition education about IYCF through mass media than their counterparts. Thus, education may improve mothers' knowledge and ability to make decision about their children nutritional needs. They may also have paid jobs that enhance their economic access to diverse foods.

Compared to children aged 6-11 months, children aged 12-23 months were 2.3 times more likely to receive appropriate complementary foods. This finding is consistent with studies done in Ethiopia, Ghana, Tanzania, and Nepal in which older children received appropriate feeding more often than younger ones (Bewket Zeleke et al. 2017; Joshi et al. 2012; Kingsley 2012; Mekbib et al. 2014; Ng, Dibley, and Agho 2012; Saaka et al. 2016; Shagaro, Mulugeta, and Kale 2021). This might be because mothers tend to introduce a greater variety of semisolid and soft food to children as they grow older. Mothers usually are concerned that young children cannot digest foods like meat, eggs as well as fruits and vegetables. Therefore, this behaviour needs to be changed through behaviour change communication messages on appropriate childcare practices to mothers during their antenatal as well as post-natal care visits.

Women who had higher nutrition-related knowledge scores and favourable nutrition-related attitude towards appropriate complementary feeding practices were 1.6 times more likely to provide their children with adequate complementary feeding. This observation may be explained by the fact that improvement in nutrition knowledge is usually expected to lead to better nutrition outcomes in the long term (Bushamuka et al. 2005; Jones et al. 2005; The World Bank 2007). Empowering family members with nutrition knowledge will lead them to make better choices and eventually would lead to better nutrition outcomes for

household members (Galhena, Freed, and Maredia 2013; The World Bank 2007; Webb 2013). In particular, when women participate in training programs and gain better nutrition knowledge, there is an improvement in the nutrition of the household (Faber and Benadé 2003; Faber et al. 2002; Kulwa et al. 2014; The World Bank 2007).

In the bivariable analysis, frequency of listening to the radio associated positively with appropriate complementary feeding practice but this association did not reach significance level in the multivariable regression analysis. Mothers who reported inadequate complementary feeding practices listened to the radio rarely and less frequently than mothers with appropriate practices. This finding is important and may be explained by virtue of the fact mothers who frequently listen to radio may become more aware of the need for appropriate complementary feeding practices (Senarath et al. 2012). Since high nutrition-related knowledge was a significant predictor of child feeding practices in this analysis, it could also be the reason why frequency of listening to the radio was not a significant predictor in multivariable logistic regression analysis.

#### STRENGTHS AND LIMITATIONS OF THE STUDY

One of the strengths of this study is that it is one of a few studies that have assessed appropriate complementary feeding practice more comprehensively using a composite index comprising three key indicators of child feeding. It is worth mentioning that adequate assessment of appropriate complementary feeding practices requires an indicator that can measure its key components concurrently, but past studies often described the practice using single indicators.

There are some limitations of this study that are worth mentioning. First, the study was cross-sectional and so no causality can be inferred from the results. Second, there may be residual unaccounted for confounders not available in the data set or recall biases which are inevitable in self-reported feeding practices. Third, socially desirable answers with respect to dietary intake could not be ruled out. This might have led to measurement bias though we do not expect this bias to be differential, and thus we do not expect that the observed associations would be changed.

## CONCLUSION

The overall prevalence of appropriate complementary feeding practice combining three key indicators (timely introduction of complementary food at 6 months, adequacy of meal frequency, and meeting minimum dietary diversity) was low at 29.9 %, (95% CI: 27.4, 32.3).

Sustainable nutrition education to mothers/caretakers, particularly targeting mothers of none or low educational level and who have 6–11 months old children should be strengthened to increase nutrition-related knowledge and attitude towards appropriate complementary feeding practice. This can be done at prenatal, delivery, postnatal service delivery points.

#### AUTHORS' CONTRIBUTIONS

MS, SA and EN conceived, designed, and supervised the execution of the study. MS analysed the data set with inputs from SA and EN. MS, SA, and EN were involved in drafting the manuscript and revising it critically for important intellectual content. All authors read and approved the final draft.

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#### CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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## REFERENCES

- Ali, Muhammad, Muhammad Arif, and Ashfaq Ahmad Shah. 2021. "Complementary Feeding Practices and Associated Factors among Children Aged 6–23 Months in Pakistan." *PLoS ONE* 16 (2): e0247602. <http://doi.org/10.1371/journal.pone.0247602>.
- Belete, Y, W Awararis, and M Muleta. 2017. "Appropriate Complementary Feeding Practice Was Relatively Low and Associated with Mother's Education, Family Income, and Mother's Age: A Community Based Cross-Sectional Study in Northern Ethiopia." *Journal of Nutritional Health & Food Engineering* 6 (2): 29–35. <https://doi.org/10.15406/jnhfe.2017.06.00191>.
- Bewket Zeleke, Liknaw, Mengistu Welday Gebremichael, Yohannes Mehretie Adinew, and Kelemeu Abebe Gelaw. 2017. "Appropriate Weaning Practice and Associated Factors among Infants and Young Children in Northwest Ethiopia." *Journal of Nutrition and Metabolism* 2017 (9608315): 1–7. <https://doi.org/10.1155/2017/9608315>.
- Bhandari, N., S. Mazumder, R. Bahl, et al. 2004. "An Educational Intervention to Promote Appropriate Complementary Feeding Practices and Physical Growth in Infants and Young Children in Rural Haryana." *India J Nutr* 1334: 2342–48.
- Bhutta, Zulfiqar A, Tahmeed Ahmed, Robert E Black, Simon Cousens, Kathryn Dewey, Elsa Giugliani, Batool A Haider, et al. 2008. "What Works? Interventions for Maternal and Child Undernutrition and Survival." *The Lancet* 371 (9610): 417–40. [http://doi.org/10.1016/s0140-6736\(07\)61693-6](http://doi.org/10.1016/s0140-6736(07)61693-6).
- Black, Robert E, Saul S Morris, and Jennifer Bryce. 2003. "Where and Why Are 10 Million Children Dying Every Year?" *The Lancet* 361 (9376): 2226–34. [https://doi.org/10.1016/s0140-6736\(03\)13779-8](https://doi.org/10.1016/s0140-6736(03)13779-8).
- Brown, Kenneth H., Hilary Creed-Kanashiro, and Kathryn G. Dewey. 1995. "Optimal Complementary Feeding Practices to Prevent Childhood Malnutrition in Developing Countries." *Food and Nutrition Bulletin* 16 (4): 1–21. <https://doi.org/10.1177/156482659501600407>.
- Bushamuka, Victor N., Saskia de Pee, Aminuzzaman Talukder, Lynnnda Kiess, Dora Panagides, Abu Taher, and Martin Bloem. 2005. "Impact of a Homestead Gardening Program on Household Food Security and Empowerment of Women in Bangladesh." *Food and Nutrition Bulletin* 26 (1): 17–25. <https://doi.org/10.1177/156482650502600102>.
- Dewey, Kathryn G. 2001. "The Challenges of Promoting Optimal Infant Growth." *The Journal of Nutrition* 131 (7): 1879–80. <https://doi.org/10.1093/jn/131.7.1879>.
- Epheson, Bereket, Zewdie Birhanu, Dessalegn Tamiru, and Garumma Tolu Feyissa. 2018. "Complementary Feeding Practices and Associated Factors in Damot Weydie District, Welayta Zone, South Ethiopia." *BMC Public Health* 18 (1): 1–7. <https://doi.org/10.1186/s12889-018-5245-8>.
- Faber, Mieke, and A Benadé J, Spinnler. 2003. "Integrated Home-Gardening and Community-Based Growth Monitoring Activities to Alleviate Vitamin A Deficiency in a Rural Village in South Africa." *Food Nutr Agric* 32: 24–30.
- Faber, Mieke, Michael AS Phungula, Sonja L Venter, Muhammad A Dhansay, and A.J. Spinnler Benadé. 2002. "Home Gardens Focusing on the Production of Yellow and Dark-Green Leafy Vegetables Increase the Serum Retinol Concentrations of 2–5-y-Old Children in South Africa." *The American Journal of Clinical Nutrition* 76 (5): 1048–54. <https://doi.org/10.1093/ajcn/76.5.1048>.
- Fanta, M., and H.A. Cherie. 2020. "Magnitude and Determinants of Appropriate Complementary Feeding Practice among Mothers of Children Age 6–23 Months in Western Ethiopia." *PLoS ONE* 15 (12). <https://doi.org/10.1371/journal.pone.0247602>.
- Galhena, Dilrukshi Hashini, Russell Freed, and Karim M Maredia. 2013. "Home Gardens: A Promising Approach to Enhance Household Food Security and Wellbeing." *Agriculture & Food Security* 2 (1): 1–13. <https://doi.org/10.1186/2048-7010-2-8>.
- Ghana Statistical Service. 2014. *2010 Population and Housing Census: Saboba District Analytical Report*. Accra, Ghana: Ghana Statistical Service.
- Ghana Statistical Service, Ghana Health Service, and ICF International. 2015. "Ghana Demographic and Health Survey 2014." Rockville, Maryland, USA: GSS, GHS, and ICF International.
- Grantham-McGregor, Sally, Yin Bun Cheung, Santiago Cueto, Paul Glewwe, Linda Richter, and Barbara Strupp. 2007. "Developmental Potential in the First 5 Years for Children in Developing Countries." *The Lancet* 369 (9555): 60–70. [https://doi.org/10.1016/s0140-6736\(07\)60032-4](https://doi.org/10.1016/s0140-6736(07)60032-4).
- Guldan, G.S., H.-C. Fan, X. Ma, Z.-Z. Ni, X. Xiang, and M.-Z. Tang. 2000. "Culturally Appropriate Nutrition Education Improves Infant Feeding and Growth in Rural Sichuan, China." *The Journal of Nutrition* 130 (5): 1204–11. <https://doi.org/10.1093/jn/130.5.1204>.
- Issaka, Abukari I, Kingsley E Agho, Penelope Burns, Andrew Page, and Michael J Dibley. 2015. "Determinants of Inadequate Complementary Feeding Practices among Children Aged 6–23 Months in Ghana." *Public Health Nutrition* 18 (4): 669–78. <http://doi.org/10.1017/s1368980014000834>.
- Jones, Katharine M., Sheila E. Specio, Parvati Shrestha, Kenneth H. Brown, and Lindsay H. Allen. 2005. "Nutrition Knowledge and Practices, and Consumption of Vitamin A-Rich Plants by Rural Nepali Participants and Nonparticipants in a Kitchen-Garden Program." *Food and Nutrition Bulletin* 26 (2): 198–208. <https://doi.org/10.1177/156482650502600204>.

- Joshi, Nira, Kingsley E. Agho, Michael J. Dibley, Upul Senarath, and Kalpana Tiwari. 2012. "Determinants of Inappropriate Complementary Feeding Practices in Young Children in Nepal: Secondary Data Analysis of Demographic and Health Survey 2006." *Maternal & Child Nutrition* 8 (1): 45–59. <https://doi.org/10.1111/j.1740-8709.2011.00384.x>.
- Kabir, Iqbal, Mansura Khanam, Kingsley E. Agho, Seema Miharshahi, Michael J. Dibley, and Swapan K. Roy. 2012. "Determinants of Inappropriate Complementary Feeding Practices in Infant and Young Children in Bangladesh: Secondary Data Analysis of Demographic Health Survey 2007." *Maternal & Child Nutrition* 8 (1): 11–27. <https://doi.org/10.1111/j.1740-8709.2011.00379.x>.
- Kassa, Tigist, Berhan Meshesha, Yusuf Haji, and Jemal Ebrahim. 2016. "Appropriate Complementary Feeding Practices and Associated Factors among Mothers of Children Age 6–23 Months in Southern Ethiopia, 2015." *BMC Pediatrics* 16 (1). <https://doi.org/10.1186/s12887-016-0675-x>.
- Katepa-Bwalya, Mary, Victor Mukonka, Chipepo Kankasa, Freddie Masaninga, Olusegun Babaniyi, and Seter Siziya. 2015. "Infants and Young Children Feeding Practices and Nutritional Status in Two Districts of Zambia." *International Breastfeeding Journal* 10 (1): 5. <https://doi.org/10.1186/s13006-015-0033-x>.
- Kimani-Murage, Elizabeth W., Frederick Wekesah, Milka Wanjohi, Catherine Kyobutungi, Alex C. Ezeh, Rachel N. Musoke, Shane A. Norris, Nyovani J. Madise, and Paula Griffiths. 2015. "Factors Affecting Actualization of the WHO Breastfeeding Recommendations in Urban Poor Settings in Kenya." *Maternal & Child Nutrition* 11 (3): 314–32. <https://doi.org/10.1111/mcn.12161>.
- Kingsley, A. 2012. "Factors Associated with Inappropriate Complementary Feeding Practices among Children Aged 6–23 Months in Tanzania." *Maternal and Child Nutrition* 10 (4): 545–61.
- Kulwa, Kissa BM, Roosmarijn Verstraeten, Kimberley P Bouckaert, Peter S Mamiro, Patrick W Kolsteren, and Carl Lachat. 2014. "Effectiveness of a Nutrition Education Package in Improving Feeding Practices, Dietary Adequacy and Growth of Infants and Young Children in Rural Tanzania: Rationale, Design and Methods of a Cluster Randomised Trial." *BMC Public Health* 14 (1). <https://doi.org/10.1186/1471-2458-14-1077>.
- Kumar, Dinesh, N. K. Goel, Poonam C. Mittal, and Purnima Misra. 2006. "Influence of Infant-Feeding Practices on Nutritional Status of under-Five Children." *The Indian Journal of Pediatrics* 73 (5): 417–21. <https://doi.org/10.1007/bf02758565>.
- Lartey, Anna. 2008. "Maternal and Child Nutrition in Sub-Saharan Africa: Challenges and Interventions." *Proceedings of the Nutrition Society* 67 (1): 105–8. <http://doi.org/10.1017/s0029665108006083>.
- Leroy, Jef L., Marie Ruel, Jean-Pierre Habicht, and Edward A. Frongillo. 2014. "Linear Growth Deficit Continues to Accumulate beyond the First 1000 Days in Low- and Middle-Income Countries: Global Evidence from 51 National Surveys." *The Journal of Nutrition* 144 (9): 1460–66. <https://doi.org/10.3945/jn.114.191981>.
- Marias, Y.F., and P. Glasauer. 2014. "Guidelines for Assessing Nutrition- Related Knowledge, Attitudes and Practices." In *Food and Agriculture Organization (FAO)*. Rome. <http://www.fao.org/docrep/019/i3545e/i3545e00.htm>.
- Mekbib, E, A Shumey, S Ferede, and F Haile. 2014. "Magnitude and Factors Associated with Appropriate Complementary Feeding among Mothers Having Children 6-23 Months-of-Age in Northern Ethiopia; a Community-Based Cross-Sectional Study." *Journal of Food and Nutrition Sciences* 2 (2): 36. <https://doi.org/10.11648/j.jfns.20140202.13>.
- Ng, Charmaine S, Michael J Dibley, and Kingsley E Agho. 2012. "Complementary Feeding Indicators and Determinants of Poor Feeding Practices in Indonesia: A Secondary Analysis of 2007 Demographic and Health Survey Data." *Public Health Nutrition* 15 (5): 827–39. <https://doi.org/10.1017/s1368980011002485>.
- Onyango, Adelheid W, Elaine Borghi, Mercedes de Onis, Ma del Carmen Casanovas, and Cutberto Garza. 2014. "Complementary Feeding and Attained Linear Growth among 6–23-Month-Old Children." *Public Health Nutrition* 17 (9): 1975–83. <https://doi.org/10.1017/s1368980013002401>.
- Patel, A., Y. Pusdekar, N. Badhoniya, J. Borkar, K.E. Agho, and M.J. Dibley. 2012. "Determinants of Inappropriate Complementary Feeding Practices in Young Children in India: Secondary Analysis of National Family Health Survey 2005–2006." *Matern Child Nutr* 8 (1): 28–44. <https://doi.org/10.1111/j.1740-8709>.
- Saaka, Mahama, Asamoah Larbi, Sofo Mutaru, and Irmgard Hoeschle-zeledon. 2016. "Magnitude and Factors Associated with Appropriate Complementary Feeding among Children 6–23 Months in Northern Ghana." *BMC Nutrition* 2 (1): 1–8. <https://doi.org/10.1186/s40795-015-0037-3>.
- Saaka, Mahama, Khadija Wemah, Fred Kizito, and Irmgard Hoeschle-Zeledon. 2021. "Effect of Nutrition Behaviour Change Communication Delivered through Radio on Mothers' Nutritional Knowledge, Child Feeding Practices and Growth." *Journal of Nutritional Science* 10. <https://doi.org/10.1017/jns.2021.35>.
- Saaka, Mahama, Anthony Wemakor, Abdul-Razak Abizari, and Paul Aryee. 2015. "How Well Do WHO Complementary Feeding Indicators Relate to Nutritional Status of Children Aged 6–23 Months in Rural Northern Ghana?" *BMC Public Health* 15 (1): 1157. <https://doi.org/10.1186/s12889-015-2494-7>.
- Saha, Kuntal K, Edward A Frongillo, Dewan S Alam, Shams E Arifeen, Lars Åke Persson, and Kathleen M Rasmussen. 2008. "Appropriate Infant Feeding Practices Result in Better Growth of Infants and Young Children in Rural Bangladesh." *The American Journal of Clinical Nutrition* 87 (6): 1852–59. <https://doi.org/10.1093/ajcn/87.6.1852>.

- Samuel, F.O., and E.G. Ibidapo. 2020. “Complementary Feeding Practices and Associated Factors among Nursing Mothers in Southwestern Nigeria.” *Int J Matern Child Heal AIDS* 9 (2): 223–31.
- Senarath, Upul, Kingsley E. Agho, Dur-e-Samin Akram, Sanjeeva S.P. Godakandage, Tabish Hazir, Hiranya Jayawickrama, Nira Joshi, et al. 2012. “Comparisons of Complementary Feeding Indicators and Associated Factors in Children Aged 6-23 Months across Five South Asian Countries.” *Maternal & Child Nutrition* 8: 89–106. <https://doi.org/10.1111/j.1740-8709.2011.00370.x>.
- Shagaro, Sewunet Sako, Be'emnet Tekabe Mulugeta, and Temesgen Dileba Kale. 2021. “Complementary Feeding Practices and Associated Factors among Mothers of Children Aged 6-23 Months in Ethiopia: Secondary Data Analysis of Ethiopian Mini Demographic and Health Survey 2019.” *Archives of Public Health* 79 (1). <https://doi.org/10.1186/s13690-021-00725-x>.
- Shetty, Prakash. 2009. “Community-Based Approaches to Address Childhood Undernutrition and Obesity in Developing Countries.” In *Nestlé Nutrition Institute Workshop Series: Pediatric Program*, 227–57. <https://doi.org/10.1159/000209984>.
- The World Bank. 2007. “From Agriculture to Nutrition Pathways, Synergies and Outcomes.” Washington, DC: The World Bank.
- Umeta, Melaku, Clive E. West, Hans Verhoef, Jemal Haidar, and Joseph G.A.J. Hautvast. 2003. “Factors Associated with Stunting in Infants Aged 5–11 Months in the Dodota-Sire District, Rural Ethiopia.” *The Journal of Nutrition* 133 (4): 1064–69. <https://doi.org/10.1093/jn/133.4.1064>.
- Victor, Rose, Surinder K. Baines, Kingsley E. Agho, and Michael J. Dibley. 2014. “Factors Associated with Inappropriate Complementary Feeding Practices among Children Aged 6-23 Months in Tanzania.” *Maternal and Child Nutrition* 10 (4): 545–61. <https://doi.org/10.1111/j.1740-8709.2012.00435.x>.
- Victora, Cesar G, Linda Adair, Caroline Fall, Pedro C Hallal, Reynaldo Martorell, Linda Richter, and Harshpal Singh Sachdev. 2008. “Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital.” *The Lancet* 371 (9609): 340–57. [https://doi.org/10.1016/s0140-6736\(07\)61692-4](https://doi.org/10.1016/s0140-6736(07)61692-4).
- Wang, X.L., Y. Wang, and L. Shi. 2000. “Analysis on Breast-Feeding and Complementary Feeding of Children under 2 Years of Age in Rural China.” *Chinese J Child Health Care* 8: 144–46.
- Webb, P. 2013. “Impact Pathways from Agricultural Research to Improved Nutrition and Health: Literature Analysis and Research Priorities.” Rome: FAO, WHO.
- White, Jessica M., France Bégin, Richard Kumapley, Colleen Murray, and Julia Krasevec. 2017. “Complementary Feeding Practices: Current Global and Regional Estimates.” *Maternal & Child Nutrition* 13 (Suppl 2): e12505. <https://doi.org/10.1111/mcn.12505>.
- WHO. 2007. “Planning Guide for National Implementation of the Global Strategy for Infant and Young Child Feeding.” Geneva: World Health Organization.
- WHO and UNICEF. 2021. “Indicators for Assessing Infant and Young Child Feeding Practices: Definitions and Measurement Methods.” Geneva: World Health Organization and the United Nations Children’s Fund (UNICEF).
- Zereyesus, Y.A., C. Guvele, K.L. Ross, E.G. Gutierrez, A. Mzyece, and V. Amanor-Boadu. 2016. *Feed the Future Indicators for Northern Region, Ghana 2015 District Baseline Estimates*. Manhattan, Kansas State: Department of Agricultural Economics, Kansas State University.