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The relationship between feeding practices and stunting among children under two years in Tanzania mainland: a mixed-method approach

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Abstract

Background Proper infant and young child feeding practices have gained attention over the years as one of the interventions to reduce childhood stunting. However, there is still a gap in research to determine these relationships in children under two years and the reasons for improper feeding.

Objective This study aimed to assess the relationship between feeding practices, stunting and barriers among children under two years.

Methodology Utilizing a mixed-method approach, the study involved secondary analysis of 1806 records of children aged 6–23 month, from the Next Generation Nutrition Program conducted in Tanzania (2015–2019). Both quantitative and qualitative data analyses were employed. Frequency distribution tables were utilized to describe study participants stratified by their stunting status. Subsequently, modified Poisson regression models identified predictors of stunting. Qualitative analysis encompassed deductive and inductive approaches, to extract themes that address the behaviors contributing to inappropriate feeding practices.

Results Stunting prevalence was 28.8% among children aged 6–23 months, with the majority (65%) of stunted children aged 1 year or older. Dietary diversity was low: 88.3% and 86.3% of stunted and non-stunted children, respectively, consumed less than 5 food groups. Surprisingly, early initiation of breastfeeding, time of stopping breastfeeding, and minimum dietary diversification were not significantly associated with child stunting (p-value > 0.05). Barriers to proper feeding practices identified were inadequate knowledge of feeding, maternal condition, economic hardship, cultural issues, and seasonality.

Conclusion Early breastfeeding and minimum dietary diversity were not significant predictors of stunting. However, the mother's age and height > 150 cm reduced stunting risk while child sex, age, birth weight, marital status, and place of delivery also influenced stunting risk. It is crucial for initiatives to emphasize good feeding practices while addressing the complex factors that may hinder optimal feeding practices in this age group to reduce childhood stunting effectively.

Keywords Stunting, Feeding practices, Minimum dietary diversity, Modified Poisson regression, Tanzania

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Introduction

Globally, stunting affects 148.1 million children and more are living in Asia (76.6 million) and Africa (63.1 million) (WHO 2023). According to Tanzania Demographic Health survey in 2022, the prevalence of stunting was 30% among children under the age of five years. The most affected regions were Iringa (56.9%), Njombe (50.4%), Rukwa (49.8%), and Ruvuma (35.6%) (Ministry of Health. 2022).

Appropriate Infant and Young Child Feeding (IYCF) is essential for growth and development of children, particularly during the first two years of life as among the critical 1000 days(from conception to age two), which is considered a window of opportunity (Shrimpton et al. 2001; Hiliza et al. 2020) due to rapid growth and development changes (Victora 2016). Early breastfeeding within the first hour of life, exclusive breastfeeding for the first six months of life, continuation of breastfeeding up to 2 years of age or beyond and dietary diversity are the recommended IYCF practices by WHO (World Health Organization and United Nations 2021). Despite these recommendations, poor IYCF is a common challenge jeopardizing the efforts to improve child nutrition and health outcomes (Victora et al. 2008). Globally, poor feeding practices contribute to 40% of child-death below two years, whereas poor breastfeeding practices during the first six months of life result in the mortality of 1.4 million children and a 10% increase in illness among children under the age of five (Heird 2012). According to WHO's research and other studies, inappropriate IYCF practices are responsible for about 25–50 percent of infant fatalities in low and middle income countries (Hassen et al. 2021; WHO 2003).

Studies reveal that the relationship between IYCF practices and a child's growth is inconsistent since a child's nutrition status and IYCF practices vary depending on the country (Marriott et al. 2012; Rakotomanana et al. 2017). In addition, most of the studies have focused on children 0–5 years. Although significant work has been done on the "first 1000 days" and the complementary feeding period of 6–23 months, gaps remain in understanding the nuances of this critical age for impacting growth (Rahman et al. 2020; Nicodemas et al. 2019; Nyaruhucha et al. 2006). Early childhood stunting prevention is crucial because stunting is linked to potential impacts on a child's health, potential delays in the development of cognitive functions, and potential implications for academic and economic performance later in life (Dewey and Mayers 2011). While stunting is associated with the possibilities of impaired cognitive function, it is important to note that being short is not necessarily the sole cause of impaired cognition. Also barriers to implementation of appropriate IYCF have been documented from cross-sectional studies (Hassen et al. 2021; Rakotomanana et al. 2017; Molla et al. 2017) ignoring the richness of information generated from qualitative work. Thus, this study aims to assess the relationship between IYCF practices and stunting in children under two years and qualitatively identifies factors that affect proper feeding behaviors among mothers to inform country social and behavioral change communication (SBCC) materials.

Methods

Secondary data analysis of the Next Generation Nutrition Program was done focusing on children aged 6–23 months. This study utilized a secondary data analysis approach. The original data were collected as part of a quasi-experimental design intervention, which included a cross-sectional survey to assess the outcomes of the intervention at a specific point in time. The Next Generation Nutrition Program was a nutrition integrated intervention program of mother and child health that was established to test the effectiveness of integrated health and nutrition intervention in reduction of stunting in Tanzania from December 2015 to December 2019. The program evaluation data were collected from July to September 2019 in five regions of Tanzania mainland, namely Simiyu, Ruvuma, Tabora, Lindi and Coast region.

The quasi-experimental design featured both intervention and control groups to enable comparative analysis, and the intervention program was widely implemented. To be more precise, certain communities (intervention group) got the entire set of interventions, while comparative communities (control group) did not receive the integrated intervention. To separating out the impact of the intervention on the reduction in stunting, this comparison framework is essential.

The data were collected using a cross-sectional survey approach to assess the outcomes of the intervention at specific point in time. The evaluation Program contained information collected from 4145 under five children. A two-stage cluster sampling was employed in the study, with the first stage involving sampling of 56 villages proportional to the district population size. The second stage involved a random selection of the households located in each cluster/village. The detailed sampling procedure has been documented in the previous study (Elisaria et al. 2021).

The Socio-demographic data, health services utilization during pregnancy, infant feeding practices, hygiene, and sanitation information were collected using a modified, pretested, validated demographic and health survey questionnaire using Swahili language. Anthropometric measurements length and weight for the infants (6–23 months) and height and weight for the mothers were taken at household level on the day of survey.

Weight measurements were obtained with an electronic SECA 874 flat scale and length was measured using a Shorr measuring board. All children were measured lying down on the board (recumbent). The weight was measured to the nearest 0.1 kg (100 g) and length in 0.1 cm. Multiple measurements were conducted for length and height. If the second measurement differed by more than 0.5, a third measurement was taken. The final value for analysis represents the average of the two closest measurements, ensuring that the final value is based on the most consistent data points. In qualitative data the information was collected through Focus Group Discussions (FGD) which generated information about provision of pre-lacteal feeds, breastfeeding initiation, exclusive breastfeeding and complementary feeding and the factors influencing feeding practices.

Data management and analysis

A total of 1806 records of children aged 6–23 months with anthropometric measurement were analyzed using STATA 15. The flowchart of participant is presented in Fig. 1. Frequency distribution tables were used to describe study participants stratified by stunting status. Variable categorization followed various guideline. Stunting as an outcome was categorized using the 2006 World Health Organization (WHO) growth standards reference points based on height for age z-scores < -2 standard deviation of the median. The household wealth index with four quintiles was derived from household assets ownership using the principal component analysis.

Since stunting prevalence was not rare with over 28% of children aged 6–23 month being stunted, a Modified Poisson regression was employed to examine the predictors of stunting. A forward selection procedure was adopted during the inclusion of variables in the model, this involved adding one variable at a time and evaluating the change in the exposure effect estimate and model performance based on the Akaike Information Criterion (AIC). Family size, Education level and occupation were excluded from the model as they did not improve model performance and were associated with the wealth quintile. A 5% level of significance was used to conclude variable significance. The final model included variable child age, sex, birth weight (verified based on health cards records with 100% of respondents reporting birth weight from health cards) early breastfeeding initiation, the timing of stopping breastfeeding (the age in months at which breastfeeding was ceased. For children aged 6–23 months who are still breastfeeding, their current age is noted instead), maternal height, mother's age, BMI status, pre-term birth (defined as birth before 37 completed weeks of gestation using last menstrual period), Facility delivered, MDD, and family size, place of delivery, region and wealth quintile.

Qualitative analysis

The qualitative data underwent coding, drawing upon themes identified during the FGDs and through an iterative exploration of the data. A line-by-line reading and coding process, facilitated by NVIVO 12 software, was employed to identify main and emerging themes while ensuring consistency. The analysis involved both deductive and inductive approaches, with the grouping of relevant themes addressing key issues as outlined in the study objectives. This analytical process was guided by the framework analysis, which facilitated the organization

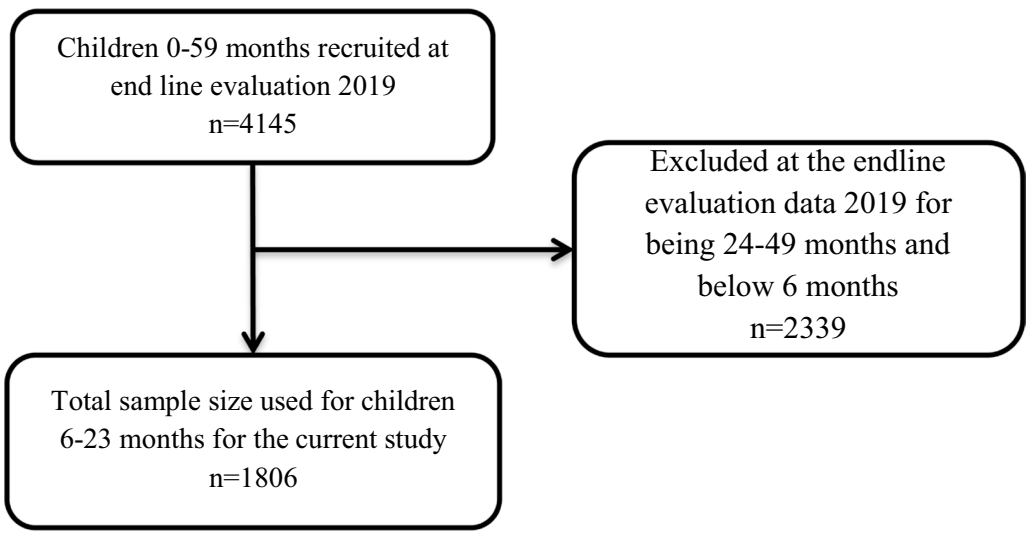

Fig. 1 The flowchart of participant recruitment

and creation of thematic frameworks for categorizing and interpreting the qualitative data. The utilization of framework analysis offered a structured and systematic approach to examining patterns and themes within the dataset. The study participants that were eligible to participate in the qualitative study were the expectant and breastfeeding women during the preceding time of the survey, fathers with children of under 2 years of age and elderly women, as shown in Table 1 as follows:

Moreover, to ensure the reliability and validity of our qualitative analysis, a collaborative approach was adopted which provided a multifaceted perspective, contributing to the depth and comprehensiveness of our findings. Two-independent investigators conducted a thorough review of the data. Each investigator independently identified initial themes and patterns within the data. Subsequently, regular meetings were held to compare and discuss the identified themes. Any inconsistencies or differing interpretations were carefully examined, and through iterative discussions and reflections, consensus was reached on the main and emerging themes.

Results

Respondents demographic characteristic

Parents/caretakers demographic and socioeconomic characteristic

The proportion of stunted children in this study varied across different maternal and socioeconomic factors. Notably, 47.1% of stunted children were born to mothers aged 15–24 years, while a slightly higher proportion (41.8%) was observed for mothers aged 25–34 years. Additionally, 86.1% of under two children born to mothers with only a primary level of education experienced stunting.

Based on the principle component analysis classification of the socialeconomic status, the distribution across quintiles indicates a relatively balanced representation among stunted and non-stunted children. A greater percentage of stunting is observed in households with the lowest socioeconomic status (25%) compared to the highest (21.5%). The proportion of stunted children is slightly higher (17.1%) among mothers who are not married compared to 12.8% for non-stunted children. The majority of mothers had a normal BMI (71.3%) of 18.5–24.9 kg/m^2, 16% were overweight and 6.8% were underweight. Geographically, Tabora has the highest representation of stunted children, accounting for 35% within the region, while Simiyu follows with 13.3%. Ruvuma and Lindi show relatively higher proportions of stunted children, each contributing to 27.5% and 14.2%, respectively, in their regions. Pwani has the lowest percentage of stunted children at 10%. (Table 2).

Table 1 Summary of qualitative interviews conducted at endline

Method	End-line
FGDs with pregnant and lactating mothers	8 FGDs 3 from each site
FGDs with older women	8 FGDs 3 from each site
FGDs with Husbands/Men	8 FGDs 3 from each site

Child demographic characteristics

Table 2 presents demographic characteristics for children 6–23 months. Half of the children were male (50.9%), and 49.1% were female. Higher proportions of children (53%) were aged 13–23 months and 47% were 6–12 months of age. Notably, a higher percentage of stunting is observed in the lower birth weight category (< 2.5 kg), with 14% stunted compared to 4.8% non-stunted children. Preterm births, especially early term, exhibit a higher prevalence of stunting (95%) compared to full-term births (5%).

Infant and young child feeding practices (IYCF)

Breastfeeding behaviors

The table provides detailed information on maternal breastfeeding behavior throughout the first two years of a child's life. The majority of mothers delivered in the health facility with an overall 83.1%. Early breastfeeding was common as over 50% of children were breastfed within the first hour after birth. Additionally, a slightly lower percent of stunted children (48.3%) were breastfed within this timeframe. Moreover, when we examined the timing of stopping breastfeeding, we found that a larger proportion of children who experienced stunted growth ceased breastfeeding after 12 months, accounting for 69.2%. Regarding dietary diversity, an overwhelming majority of children (86.9%), regardless of stunting status, had less than 5 food groups, indicating a common challenge in achieving optimal nutritional diversity. (Table 3).

Relationship between IYCF indicators and stunting

In univariate analysis, the initiation of breastfeeding between one to two hours after birth did not show a significant association with stunting ($p = 0.063$). Furthermore, ceasing breastfeeding between ages 13 to 23 months is significantly associated with a 61% higher risk of stunting compared to ceasing between ages 6 to 12 months ($p < 0.001$). However, in subsequent multivariable analysis, which employed modified Poisson regression to adjust for potential confounders, this relationship did not retain statistical significance ($p = 0.596$). Moreover, adequate dietary diversity, defined as consuming 5–8 food groups also shows a non-significant decrease in stunting risk ($p = 0.347$).

Table 2 Maternal and Child Demographic and Socioeconomic characteristics *N* = 1806

Variable	Non-stunted n (%)	Stunted n (%)	Overall N
Childs Age (months)			
6—12	667 (51.9)	182 (25)	849 (47)
13 to 23	619 (48.1)	338 (65)	957 (53)
Childs Sex			
Male	604 (47)	315 (60.6)	919 (50.9)
Female	682 (53)	205 (39.4)	887 (49.1)
Birth weight (kg)			
Small (< 2.5)	51 (4.8)	62 (14.0)	113 (7.5)
Normal (2.5–3.9)	972 (90.8)	368 (82.8)	1340 (88.5)
Large (≥ 4.0)	47 (4.4)	14 (3.2)	61 (4.0)
Preterm birth			
Early term (< 37 weeks)	1182 (91.9)	494 (95)	1676 (92.8)
Full term (≥ 37 weeks)	104 (8.1)	26 (5)	130 (7.2)
Mothers Age (years)			
15–24	485 (37.7)	245 (47.1)	730(40.4)
25–34	562 (43.7)	193 (37.1)	755(41.8)
35–49	239 (18.6)	82 (15.8)	321(17.8)
Maternal height (cm)			
< 150	147 (11.4)	110 (21.1)	257 (14.2)
> = 150	1139 (88.6)	410 (78.9)	1549 (85.8)
Marital status			
Married	1121 (87.2)	431 (82.9)	1552 (85.9)
Not married	165(12.8)	89 (17.1)	254 (14.1)
*Education level**			
Primary education	831 (82.3)	361 (86.1)	1,192 (83.1)
Secondary education and above	179 (17.7)	63 (14.9)	242 (16.9)
Occupation			
Employed	24 (1.9)	5 (0.9)	29 (1.6)
Self employed	1079 (83.9)	433 (83.3)	1512 (83.7)
Unemployed	183 (14.2)	82 (15.8)	265 (14.7)
Mother's BMI (kg/m2)			
Underweight (< 18.5)	89 (6.9)	35 (6.7)	124 (6.8)
Normal (18.5—24.9)	899(69.9)	388 (74.6)	1287 (71.3)
Overweight (25–29.9)	215(16.7)	73 (14.0)	288 (16.0)
Obese > = 30	83 (6.5)	24 (4.6)	107 (5.9)
Family size			
2–4	448 (34.8)	179 (34.4)	627 (34.7)
5–7	542 (42.1)	224 (43.1)	766 (42.4)
8+	296 (23.0)	117 (22.5)	413 (22.9)
Regions			
Ruvuma	191 (14.9)	143 (27.5)	334 (18.5)
Simiyu	191 (14.9)	69 (13.3)	260 (14.4)
Tabora	512 (39.8)	182 (35)	694 (38.4)
Lindi	186 (14.5)	74 (14.2)	260 (14.4)
Pwani	206 (16.0)	52 (10)	258 (14.3)
SES Status			
Lowest	325 (25.3)	130 (25)	455 (25.2)
Second	301 (23.4)	149 (28.7)	450 (24.9)
Middle	322 (25.0)	129 (24.8)	451 (25.0)
Highest	338 (26.3)	112 (21.5)	450 (24.9)

*372 Individuals had missing education level data, *SES* Social economic status, *BMI* Body Mass Index

*292 children had missing birth weight

N = Total number of children below two years in all 5 regions, n number of children in each region.

Table 3 Mothers breastfeeding behaviors within the first two years of life

Variable	Normal n (%)	Stunted n (%)	Overall N (%)
Place of Delivery			
Health Facility	1061 (82.5)	439 (84.4)	1500 (83.1)
Outside health facility	255 (17.5)	81 (15.6)	306 (16.9)
Early breastfeeding within the 1st hour			
Less than 1 h	665 (52)	250 (48.3)	915 (50.8)
Within 1–2 h	290 (22.6)	144 (27.8)	434 (24.1)
More than two hours	329 (25.6)	124 (23.9)	453 (25.1)
Timing of stopping breastfeeding			
6–12	593 (46.1)	160 (30.8)	753 (41.7)
Above 12	693 (53.9)	360 (69.2)	1053 (58.3)
Minimum dietary diversity			
< 5 food groups	1110 (86.3)	459 (88.3)	1569 (86.9)
5–8 food groups	176 (13.7)	61 (11.7)	237 (13.1)

N = Total number of children below two years in all 5 regions, n number of children in each region.

Maternal factors emerge as significant associated with the risk of stunting. Mothers aged 25–34 and 35+, exhibit notably lower stunting risks compared to those aged 15–24 ($p = 0.005$ and $p = 0.032$, respectively). Maternal height is an important factor, revealing a substantial impact on stunting risk among mothers taller than 150 cm demonstrating a 38% lower risk than their shorter counterparts ($p < 0.001$). Furthermore, maternal education beyond the primary level, shows a decreasing trend in stunting risk, however, did not reach statistical significance ($p = 0.268$). In terms of occupation, children of self-employed and unemployed mothers face significantly higher risks of stunting compared to those of employed mothers, with risk ratios of 1.13 and 1.27, respectively.

The child's sex and age were also found to be related to stunting with (50.9%) of male children being more stunted compared to female children (49.1%), at a *p*-value of 0.002. Moreover, children aged 13–23 months were

more affected by stunting (65%) than younger children at p-value ($p < 0.02$). The association between birth weight and stunting was investigated in this study. The results revealed a significant relationship, with 12.0% of children with small birth weight (< 2500 g), 55.4% with normal birth weight, and 32.7% with large birth weight being stunted ($p < 0.001$). Furthermore, children born pre-term exhibited higher levels of stunting, reaching statistical significance at the 5% level (p-value = 0.05). These findings emphasize the impact of birth weight and pre-term birth on the prevalence of stunting among children in our study population (Table 4).

Table 4 Determinants of stunting: Multivariable analysis with modified Poisson regression, N = 1086

	CRR	P	ARR[a] (95% CI)	P
Early breastfeeding				
Less than 1 h	1(Ref)		1(Ref)	
Within 1 to 2 h	1.21	0.063	1.13	0.243
More than two hours	1	0.987	0.93	0.539
Timing of stopping breastfeeding				
6–12	1(Ref)		1(Ref)	
13–23	1.61	< 0.001	1.11	0.596
Minimum Dietary diversity				
< 5 food group	1(Ref)		1(Ref)	
5–8 food groups	0.88	0.347	0.84	0.226
Mothers Age				
15–24	1(Ref)		1(Ref)	
25–34	0.76	0.005	0.86	0.120
35 +	0.76	0.032	0.82	0.122
Maternal Height				
< 150	1(Ref)		1(Ref)	
> = 150	0.62	< 0.001	0.67	< 0.001
Marital Group				
Married	1(Ref)		1(Ref)	
Not married	1.26	0.046	1.16	0.214
Education status				
Primary education	1(Ref)		*	
Secondary education and more	0.86	0.268		
Occupation				
Employed	1(Ref)		*	
Self employed	1.66	1.13		
Unemployed	1.79	1.27		
BMI status				
Normal	1(Ref)		1(Ref)	
Underweight	0.94	0.709	0.91	0.619
Overweight	0.84	0.174	0.95	0.723
Obese	0.74	0.16	0.91	0.60
Family size				
2–4	1(Ref)		*	
5–7	1.02	0.811		
8 +	0.99	0.948		
Place of delivery				
Health facility	1(Ref)		1(Ref)	
Outside health facility	0.9	0.406	1.15	0.226
Sex of the child				
Male	1(Ref)		1(Ref)	
Female	0.67	< 0.001	0.65	< 0.001
Age of the child (months)				
6–12	1(Ref)		1(Ref)	
13–23	1.65	< 0.001	1.54	0.019
Birth weight (kg)				
Normal (2.5–3.9)	1(Ref)		1(Ref)	
Small (< 2.5)	1.73	< 0.001	1.64	0.001

Overview of the qualitative results on factors affecting IYCF practices

From the qualitative analysis, various themes on factors affecting IYCF were identified. Factors that were reported included the knowledge of the IYCF practices, the mother's condition, economic hardship, inadequate time, cultural issues, and seasonality.

Exposure to Pre-lacteal feeds

Pre-lacteal feeding is the practice of giving newborns any fluids or food before breastfeeding initiation in their early days of life (Raina et al. 2012). Participants reported that they tend to introduce their children to pre-lacteal feeds if the mother delays initiating breastfeeding after birth, however, some believe that a little water, sugar/ glucose, and salt is good for stimulating the child's appetite. In addition, some participants mentioned that they tend to give their children hot water before breastfeeding since they were told by their elders that they should breastfeed after eight hours.

> *"If you're not producing enough breast milk, the baby starts to be given very little amount of small porridge so that he/she does not stay hungry" (Itilima_Pregananant and lactating women).*
>
> *"According to my understanding, the child is given boiled water mixed with a little salt and a little sugar which becomes like an oral rehydration solution if the mother is not producing enough milk. It is given to the child to stimulate appetite to breastfeed" (Bariadi_Men).*
>
> *"I was taught by my parents that the baby should begin breastfeeding after eight hours, so during that time I usually give him/her hot drinking water" (Nzega_Elders).*

Initiation of breastfeeding within the first hour of birth

The majority of the participants were aware of the time of initiating breastfeeding. Despite their knowledge,

Table 4 (continued)

	CRR	P	ARR[a] (95% CI)	*P*
Large (≥ 4)	0.69	< 0.001	0.67	< 0.001
Pre-term birth				
Early term (< 37 weeks)	1(Ref)		1(Ref)	
Full term (37 + weeks)	1.47	0.054	1.25	0.274
SES Status				
Lowest	1 (Ref)		1(Ref)	
Second	1.16	0.219	1.12	0.366
Middle	1	0.993	0.99	0.932
Highest	0.87	0.284	0.85	0.257
Regions				
Ruvuma	1(Ref)		1(Ref)	
Simiyu	0.62	0.001	0.77	0.097
Tabora	0.61	< 0.001	0.73	0.011
Coast	0.66	0.004	0.59	< 0.001
Lindi	0.47	< 0.001	0.45	< 0.001

*CRR (Crude Risk Ratio) relative risk of an outcome based on raw data, without adjusting for other variables

*ARR (Adjusted Risk Ratio) relative risk of an outcome after adjusting for potential confounding variables

*Family size, Education level, occupation excludes as they did not improve model performance and are associated with wealth

[a] The model adjusts for maternal, child and household characteristics (age of the mother, mother's height, marital status, education status, occupation, BMI status, child sex, age, birth weight, pre-term birth, family size, place of delivery and regions)

they mentioned several obstacles that hinder timely initiation such as:

Knowledge of initiation of breastfeeding

Most participants were aware of the initiation of breastfeeding, but some mothers and caregivers were uncertain about the appropriate time to initiate breastfeeding. The results from the FGDs revealed that on the initiation of breastfeeding, participants had conflicting views on the best time to start breastfeeding after giving birth. Some participants believed that breastfeeding should begin as soon as the mother's bleeding had stopped after delivery, after taking a shower, or when the baby cries.

> *"A mother should initiate breastfeeding of her child one hour after delivery because after the baby is born, the mother is supposed to be cleaned up before breastfed starts which take like an hour" (Ruangwa_Elders).*
> *"After the baby is born, you sit for like an hour or an hour and a half until bleeding is reduced, then you start to breastfeed the child" (Nyasa_Pregnant and lactating women).*

Maternal condition

The participants mentioned several maternal conditions that may restrict the timely initiation of breastfeeding. Few participants referenced maternal death in the immediate post-delivery period as a factor that limits timely initiation and total breastfeeding. Furthermore, participants revealed that most mothers delivered by cesarean section start breastfeeding their baby very late.

> *"When you try to look at the reason why the child is not being breastfed at a young age it's because you will find out that the mother of the child is dead" (Nzega_Elders).*
> *"Some mothers fail to initiate breastfeeding immediately after delivery because she has delivered the baby through operation and may stay for three hours until she begins breastfeeding" (Mbinga_Elders).*

Cultural issues

There are myths and misperceptions concerning the practice of feeding babies on colostrum since a few participants perceived colostrum to be dirty or poisoned. The respondents said mothers express the first milk and pour it out until the milk becomes clean instead of feeding their children which delays the initiation of breastfeeding and the benefit of colostrum.

> *"The first milk normally mothers tend to express and pour them out because it is dirty" (Mbinga_Men).*
> *"Am aware of mothers first milk, but that kind of milk a child is not allowed to breastfeed, Yes, because they contain poison, therefore the mother expresses and pours it out" (Nyasa_Men).*

Continuation of breastfeeding

Though it is recommended that a child should be exclusively breastfed for six months and continue being breastfed for up to 23 months, some were not continually breastfed. Maternal health conditions and cultural concerns were two of the challenges that participants highlighted for continuing breastfeeding.

Diseases such as HIV/AIDS

Majority of the participants mentioned that mothers who are HIV/AIDS positive should breastfeed their children for 6 months only. HIV status restricted the continuation of breastfeeding. Also, some participants mentioned that if they breastfeed for more than 6 months, the child may be infected since it is a period when the child starts teething and can bite the mother causing transmission of the disease from the mother to the child.

"If the mother is infected with HIV, it means that when the child reaches six months, the mother stops breastfeeding, and the child and mother should continue taking medicine" (Itilima _Men).
"For mothers who are infected with HIV, they breastfeed their children to the end of six months only. This is because after six months the child starts to have teeth and might bite the mother while breastfeeding and when the nipple bleeds, the child might suck milk together with the infected blood and become HIV positive also" (Nyasa_Elders).

Cultural issues

Some participants had myths about the continuation of breastfeeding particularly among women who practice sex with their husbands or other men while breastfeeding. They perceived that having sex would contaminate the milk and cause the child to become malnourished (*amebemendwa*). It was also revealed that mothers who become pregnant while breastfeeding were not permitted to continue breastfeeding because the milk being produced during that time was not the best for the child and may affect his/her health.

"We were advised to use a condom if we need to practice sex. It is even worse when the child is breastfeeding, and you continue having sex with a man who is not biological father. The child will develop malnutrition (atabemendwa)" (Nyasa_Fathers).
"Getting pregnant early when your child is still young means that the mother's milk being produced at that time is not the best. It has been mixed with other things, which is why the child should not continue to breastfeed" (Ruangwa_Elders).

Complementary feeding practices

When the baby reaches the age of six months' breastfeeding alone is not sufficient to meet its nutritional needs thus, additional foods and liquids are required to complement the mother's breast milk. Although the majority were aware of complementary feeding but were less aware of the appropriate time to introduce solid or semi-solid food, the portion size needed and the whole concept of dietary diversity. Several factors were mentioned to hinder the adequate complementary feeding including time to initiate, economic hardship and seasonality.

Knowledge on complementary feeding

There were variations in the specific portion and timing of introducing complementary foods. The results also revealed that some caregivers started offering complementary foods as early as four months, while others preferred to wait until the infant is seven months old before introducing porridge.

"Now that's where I do not understand, I do not know how much we are supposed to give the child, maybe until you just think here my son would have taken enough" (Uyui_Pregnant and Lactating women).
"When a child reaches four months, you can start giving them porridge. This porridge is mixed with fruits. You may add sugar, and if it lacks oil, you may add peanuts and vegetables oil to make good millet or maize porridge. By six months, they can even eat stiff porridge (ugali)." (Itilima_Elders).
"When they reach the age of seven months, I begin introducing porridge to them. I take the flour, sieve to make thin smooth porridge" (Nzega_Pregnant Women & Breastfeeding Mothers).
Concerning diet diversification, the results revealed that the majority had some reasonable knowledge about appropriate dietary diversification but did not practice since most foods fed to the children were coming from the same food group, especially staples. The majority thought that providing a porridge of mixed grain flour (composite flour) is nutritious and enough.
"When a child is six months, we make porridge with mixed cereals, add sugar, lemon and groundnut paste" (Itilima_elderly).
"The nutritious porridge that we give to the child contains a mixture of wheat flour, millet, cassava flour, groundnuts, water and sometimes we put cow milk" (Uyui_elderly)

Economic hardship

Participants across different categories of respondents linked inappropriate feeding practices among their children to the economic hardship of the families. Poor households reported to not have enough financial resources to buy varieties of food for the child and family.

"I can say this is contributed by the problem of poor economic status. It's just the low income of an individual as the person may not have some of the other foods that your neighbor uses, and you're left with only cassava flour. Thus, you find a child is only consuming cassava flour because the family does not have a penny to buy fruits or green vegetables" (Nzega_Men).
"In rural areas or in families with poor economic conditions, inadequate feeding practices happen most of the time as you may find that one may be having his meal once a day." (Ruangwa_Preganant and lactating women).

Inadequate time

The results revealed that inadequate time is a significant factor influencing complementary feeding for the children. Some participants, particularly mothers, claimed that they are often occupied with work or household chores and farming activities that require them to spend a significant amount of time. This limits the preparation and provision of diversified foods.

> *"Most of the time we might be busy with work at home like when you are doing the laundry, cleaning and cooking therefore you may decide to leave the child to continue playing until when you are done with house chores." (Rufiji_Pregnant and lactating mothers).*

Seasonality

Seasonality was also mentioned as a factor that may affect the child's feeding practices. Food availability and accessibility were said to be impacted by seasonality which limits dietary diversification.

> *"...when it is drought season, there is no food to consume and at the end of the day the child lacks diverse food to consume during a certain season" (Uyui_Pregnant and lactating women).*

Discussion

The study used a total of 1806 mothers-child pairs from a cross-sectional survey of the Next Generation Nutrition intervention study which took place in five regions in Tanzania mainland (Elisaria et al. 2021). The findings revealed that most of the WHO recommended Infant and Young Child Feeding (IYCF) indicators such as breastfeeding indicators (early breastfeeding initiation, and continuation of breastfeeding up to 2 years of age or beyond) and complementary feeding indicators (minimum dietary diversity) showed no association with stunting after adjusting for the potential confounders. This finding is consistent with other studies conducted in Metropolitan city in India and Ghana (Aheswari and Solanki 2021; Saaka et al. 2015; Anin et al. 2020).

The findings in the study highlighted significant association of stunting with both child sex, and birth weight. The analysis revealed that female children were 65% less likely to be stunted than male children. This aligns with the existing research, which suggests that female fetuses undergo rapid growth of their bodies and brains during their placental development thus male fetuses are more likely to experience negative outcomes than female fetuses (Eriksson et al. 2010). On the other hand, our study also shows that children who had lower birth weights were 3 times more likely to be stunted, compared to average-sized children (2500–3900 g). This finding is consistent with a previous research study that links low birth weight to increased susceptibility to various diseases such as respiratory infections, diarrhea, anemia, and malaria than babies with typical birth weights. This affects the child's food intake and nutrient absorption, contributing to the association between low birth weight and child stunting (Mrema et al. 2021).

Although our multivariable analysis, conducted using modified Poisson regression, did not reveal a significant association between the initiation of breastfeeding and stunting, our univariate analysis indicated an increased risk of stunting among children aged 12–23 months who initiated breastfeeding late. Nearly half of the children were breastfed after one hour which is against the guidelines. WHO and National IYCF Guidelines, recommends newborns to be breastfed immediately within 1 h after delivery (World Health Organization and United Nations 2021). The poor practice of early initiation to breastfeeding within the first hour of life after birth may be due to the wrong misconception mothers have about the first milk "colostrum". Colostrum was perceived to be dirty and poisonous to the child and mothers expressed and discarded it. This finding is consistent with the research done in Northern Ethiopia which reported that mothers in the community avoid colostrum feeding based on cultural beliefs that it has no nutritional value, is harmful to the baby and it's bad luck for the family (Rogers et al. 2011). In this regard, the child is denied the benefits and easily accessible nourishment of colostrum. Some participants mentioned the delay of breastfeeding initiation is caused by C-section delivery due to the long hours of recovery, anesthetic effects, and medical complications. This has also been reported by a Meta-Analysis study which found a higher risk of late breastfeeding initiation among women who deliver through C-section (Prior et al. 2012).

The timing of stopping breastfeeding at 13–23 months showed no significant association with stunting. Dissimilar to this study, other studies done in Pakistan showed a positive relationship between continuation of breastfeeding 12–23 months and stunting (Syeda et al. 2021). In Tanzania, dietary diversity showed an improvement from 24.5 to 35.1% in 2014–2018. However, this level remains below the optimal range needed to meet essential nutrient requirements. During this period, MDD was defined as the consumption of foods from at least 4 out of 7 food groups (OCGS and TNNS 2018). Given this, if a mother is still breastfeeding, breast milk is still an important source of essential nutrients for both mother and child. However, it is essential to supplement breast milk with a diverse complementary diet. Notably, the WHO Infant and Young Child Feeding has included breast milk as an eighth food group shifting the criterion for MDD from

four of seven food groups to five of eight groups (World Health Organization and United Nations 2021).

While the timing of cessation of breastfeeding at 12–23 months showed no significant association with stunting, it is crucial to emphasize the importance of this practice for the child's health with an emphasis on considering other food groups since breastfeeding alone for children above 6 months may precipitate stunting. Despite the lack of statistical link, some mothers were not engaging in this beneficial practice. The qualitative study revealed that maternal conditions such as death, sickness and pregnancy hindered the continuation of breastfeeding. Moreover, the WHO's guidelines on HIV and infant feeding recommend that EBF should be done for the first 6 months of life and continuation of breastfeeding in addition to adequate, appropriate and safe complementary feeding up to 2 years or beyond for both HIV unexposed and exposed infants (World Health Organization and United Nation Children's Fund 2016). Despite the recommendations, the majority of the FGD's participants revealed that mothers were not breastfeeding their children for no longer than six months if they are HIV positive, claiming that if it's done beyond 6 months, the child may be affected with HIV. These findings were in line with the study conducted in Kenya and South Africa where the HIV infected mothers expressed their concern about the fear of transmitting infection due to continued breastfeeding (Samburu et al. 2021; West et al. 2019).

Furthermore, some of the respondents highlighted that mothers were not allowed to continue to breastfeed their children if they were pregnant. Some women perceive that breastfeeding a child while the mother has conceived another baby will make the child malnourished as the milk being produced during that period is unhealthy. Similar to this finding, a study done in Tanzania and Kenya also reported that mothers claimed breastfeeding while pregnant causes the baby to die (Kimani-Murage et al. 2015; Mgongo et al. 2019).

Although dietary diversity was not significantly associated with stunting, only 9.4% of the studied children achieved the minimum dietary diversity (MDD) of 5–8 food groups. WHO recommends complementary feeding between the ages of 6 and 23 months with at least five of the suggested eight dietary categories (World Health Organization and United Nations 2021). Insufficient complementary foods put children at risk of nutritional inadequacy which may later result in growth faltering (Olatona et al. 2017). The study findings are consistent with a study done in Southern Ethiopia where a low percentage of children 6–23 months achieved minimum dietary diversity (22.2%) (Roba et al. 2016). More detailed information from the focus group discussion showed that inadequate knowledge of diversified food influenced feeding. Most women were unaware of the quantity, frequency, and types of foods to be given to their children. Similar findings were also reported in other qualitative studies conducted in Ethiopia and India (Athavale et al. 2020; Kahssay et al. 2019).

Moreover, findings from the qualitative study revealed that other participants were aware of the importance of dietary diversity to the child. However, they mentioned that having a low socioeconomic status influences access to various types of foods. Poverty might restrict access to nutritious food and diet due to a lack of a variety of nutritious food choices, as they may tend to eat what is available at home causing long-term impact on the child's nutrition status. Similar findings conducted in Rwanda also indicated poverty as a predictor of inappropriate IYCF practice (Athavale et al. 2020). Another study done in Ethiopia indicated that families may be forced to put other necessities such as housing, utilities, and healthcare ahead of food and nutrition when finances are scarce (Mekonnen et al. 2018).

Furthermore, seasonality was also mentioned to impact a child's minimum dietary diversification as it is a natural phenomenon that may potentially affect food availability (Madan et al. 2018). Some foods are only available at specific times of the year, it can be challenging to find some food when it is out of season or becomes very expensive to buy, making it difficult for families to afford a varied diet. In line with these findings, a study conducted in 2016 by Das found that seasonality significantly affects the minimum level of dietary diversification (Das et al. 2016).

Strengths and limitations of the study

The primary drawback of the study is its cross-sectional design, which only captures information from data collected at a single point in time and may not be able to explain the causal effect relationship. Furthermore, given the prevalence of stunting in the study population, the odds ratio might have overestimated the true relative risk, caution is needed in the interpretation and generalization of the results. Another drawback of the data used was that it came from a secondary data analysis which may not be complete depending on how the data were gathered or how the sampling was done. As our study relies on data obtained through secondary data analysis, we inherited the limitations present in the original study. One noteworthy limitation is the potential recall bias in reporting feeding practices. However, the original study employed structured interviews, reduction of recall period, and validation procedures against objective measures using medical records to mitigate recall bias.

A comprehensive understanding of IYCF goes beyond breastfeeding practices i.e., physiological influence, meal

environment and child raising practices. Further research to delve into these unexplored domains is recommended. While acknowledging certain drawbacks, it is crucial to highlight the specific strengths that contribute to the robustness and trustworthiness of the study results. These strengths include utilization of mixed-method approach, a substantial sample size, timely data collection and feedback facilitated by digital data collection, the acquisition of high-quality anthropometric data and the consideration of relevant confounding variables.

Conclusion

In Tanzania, our study revealed that the feeding practices (early breastfeeding, timing of stopping breastfeeding 12–23 months and MDD) did not reach statistical significance in its connection to a lower percentage of stunting in children 6–23 months. Additionally, we identified several challenges hindering proper feeding practices, such as limited awareness of infant and young child feeding recommendations, economic difficulties, cultural factors, and seasonal variations. The prevalence of stunting is a pressing issue both in Tanzania and worldwide. To address this issue, it is crucial to emphasize the importance of following the breastfeeding recommendations for various reasons, including optimizing child nutrition and development, enhancing immunity against diseases, fostering mother–child bonding and promoting long-term health outcomes. Additionally, it is also essential to address the multitude of factors that may hinder optimal feeding practices and impede child growth and development. A holistic approach to nutrition intervention services is necessary, involving education for mothers on nutrition and health, empowering them to make informed choices for better feeding practices and implementing an economic empowerment and gender-transformative approach to reduce women's workloads.

Abbreviations

ANC	Antenatal care
ARR	Adjusted risk ratio
BMI	Basal mass index
CUAMM	University College for Aspiring Missionary Doctors
CRR	Crude risk ratio
IYCF	Infant and young child feeding
LAZ	Length for age z-score
LBW	Low birth weight
SBCC	Social and Behavior Change Communication
SDG's	Sustainable development goals
WHO	World Health Organization

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Author contributions

FM, EE, and HDM designed research; CF and SL analyzed data; and FEM, EK, JM and FK wrote the paper. EE, HDM and EK had primary responsibility for final content. All authors have read and approved the final manuscript.

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Availability of data and material

All data used in this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The Ifakara Health Institutional Review Board (IRB) granted ethical clearance for the commencement of the research study with approval number (IHI/IRB/No: 17– 2022) and national (NIMR/HQ/R.8a/Vol.IX /2208). The program's principal investigator issued a written letter of consent to use the data from the Next Generation Nutrition Program.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

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References

Aheswari P, Solanki MJ (2021) Infant and Child Feeding Index and nutritional status of children aged 6 to 24 months in a Metropolitan city. J Fam Med Prim Care 10:175–181. https://doi.org/10.4103/jfmpc.jfmpc_1023_20

Anin SK, Saaka M, Fischer F, Kraemer A (2020) Association between infant and young child feeding (Iycf) indicators and the nutritional status of children (6–23 months) in Northern Ghana. Nutrients 12(9):1–18. https://doi.org/10.3390/nu12092565

Athavale P, Hoeft K, Dalal RM, Bondre AP, Mukherjee P, Sokal-gutierrez K (2020) A qualitative assessment of barriers and facilitators to implementing recommended infant nutrition practices in Mumbai, India. J Heal Popul Nutr 39(7):1–12. https://doi.org/10.1186/s41043-020-00215-w

Das A, Chatterjee R, Karthick M, Mahapatra T, Chaudhuri I (2016) The influence of seasonality and community-based health worker provided counselling on exclusive breastfeeding-findings from a cross-sectional survey in. PLoS ONE 8:1–17. https://doi.org/10.1371/journal.pone.0161186

Dewey KG, Mayers DR (2011) Early child growth: How do nutrition and infection interact? Matern Child Nutr 7(3):129–142. https://doi.org/10.1111/j.1740-8709.2011.00357.x

Elisaria E, Mrema J, Bogale T, Segafredo G, Festo C (2021) Effectiveness of integrated nutrition interventions on childhood stunting: a quasi-experimental evaluation design. BMC Nutr 7(17):1–8. https://doi.org/10.1186/s40795-021-00421-7

Eriksson JG, Kajantie E, Osmond C, Thornburg K, Barker DJP (2010) Boys Live Dangerously in the Womb. Am J Hum Biol 335:330–335. https://doi.org/10.1002/ajhb.20995

Hassen SL, Temesgen MM, Marefiaw TA, Ayalew BS, Abebe DD, Desalegn SA (2021) Infant and young child feeding practice status and its determinants in Kalu District, Northeast Ethiopia: community-based cross-sectional study. Nutr Diet Suppl 13:67–81. https://doi.org/10.2147/nds.s294230

Heird WC (2012) Infant nutrition. https://doi.org/10.1002/9781119946045.ch40

Hiliza JN, Germana L, Kasangala A, Flora J (2020) Prevalence and Factors associated with stunting among school public primary school pupils in Kasulu, Western Tanzania. East African Heal Res J 4(2):172–181. https://doi.org/10.24248/eahrj.v4i2.641

Kahssay M, Ebrahim E, Seid O, Woldu E, Reddy S (2019) Infant and young child feeding practices and associated factors among children aged 0–23 months in Assayita District Afar Region Ethiopia. J Food Nutr Sci 7(6):96–104. https://doi.org/10.11648/j.jfns.20190706.13

Kimani-Murage EW et al (2015) Factors affecting actualisation of the WHO breastfeeding recommendations in urban poor settings in Kenya. Matern Child Nutr 11(3):314–332. https://doi.org/10.1111/mcn.12161

Madan EM, Haas JD, Menon P, Gillespie S (2018) Seasonal variation in the proximal determinants of undernutrition during the first 1000 days of life in rural South Asia: a comprehensive review. Glob Food Secur 19:11–23. https://doi.org/10.1016/j.gfs.2018.08.008

Marriott BP, White A, Hadden L, Davies JC, Wallingford JC (2012) World Health Organization (WHO) infant and young child feeding indicators: associations with growth measures in 14 low-income countries. Matern Child Nutr 8(3):354–370. https://doi.org/10.1111/j.1740-8709.2011.00380.x

Mekonnen N, Asfaw S, Mamo A, Mulu Y, Fentahun N (2018) Barriers and facilitators of child-feeding practice in a small sample of individuals from Gozamin District, Northwest of Ethiopia: a qualitative study. BMC Nutr 4(1):1–7. https://doi.org/10.1186/s40795-018-0233-z

Mgongo M, Hussein TH, Stray-Pedersen B, Vangen S, Msuya SE, Wandel M (2019) Facilitators and barriers to breastfeeding and exclusive breastfeeding in Kilimanjaro Region, Tanzania: a qualitative study. Int J Pediatr (United Kingdom). https://doi.org/10.1155/2019/8651010

Ministry of Health (MoH) [Tanzania Mainland], Ministry of Health (MoH) [Zanzibar], National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS) (2022) Tanzania Demographic and Health Survey and Malaria Indicator Survey 2022 Key Indicators Report. Dodoma, Tanzania, and Rockville, Maryland, USA: MoH, NBS, OCGS, and ICF.

Molla M, Ejigu T, Nega G (2017) Complementary feeding practice and associated factors among mothers having children 6–23 months of age, Lasta District, Amhara Region, Northeast Ethiopia. Hindawi, London. https://doi.org/10.1155/2017/4567829

Mrema JD, Elisaria E, Mwanri AW, Nyaruhucha CM (2021) Prevalence and determinants of undernutrition among 6- to 59-months-old children in lowland and highland areas in Kilosa District, Tanzania: a cross-sectional study. J Nutr Metab. https://doi.org/10.1155/2021/6627557

Nicodemas D, Fweja LWT, Magoha SH (2019) Association between feeding patterns and nutritional status of the under five children (6–59 months) in Mtwara Rural District, Tanzania. J. Food, Nutrition Agric 2(1):20–26. https://doi.org/10.21839/jfna.2019.v2i1.278

Nyaruhucha C, Msuya J, Mamiro PS (2006) Nutritional status and feeding practices of under-five children in Simanjiro. Tanzan J Health Res 8(3):162–167. https://doi.org/10.4314/thrb.v8i3.45114

O. of the C. G. S. (OCGS) [Zanzibar] and U. 2018. T. N. N. S. using S. M. (TNNS). Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) [Tanzania Mainland], Ministry of Health (MoH) [Zanzibar], Tanzania Food and Nutrition Centre (TFNC), National Bu- reau of Statistics (NBS) (2018) Tanzania National Nutrition Survey

Olatona FA, Adenihun JO, Aderibigbe SA, Adeniyi OF (2017) Complementary feeding knowledge, practices, and dietary diversity among mothers of under-five children in an urban community in Lagos State, Nigeria. Int J Matern Child Heal AIDS 6(1):46–59

Prior E, Santhakumaran S, Gale C, Philipps LH, Modi N, Hyde MJ (2012) Breastfeeding after cesarean delivery: a systematic review and meta-analysis of world literature. Am J Clin Nutr 95(5):1113–1135. https://doi.org/10.3945/ajcn.111.030254

Rahman T, Chakrabarty S, Rakib M, Afrin S, Saltmarsh S, Winn S (2020) Factors associated with stunting and wasting in children under 2 years in Bangladesh. Heliyon 6:e04849. https://doi.org/10.1016/j.heliyon.2020.e04849

Raina SK, Mengi V, Singh G (2012) Determinants of prelacteal feeding among infants of RS Pura block of Jammu and Kashmir, India. J Fam Med Prim Care 1(1):27

Rakotomanana H, Gates GE, Hildebrand D, Stoecker BJ (2017) Situation and determinants of the infant and young child feeding (IYCF) indicators in Madagascar: analysis of the 2009 Demographic and Health Survey. BMC Public Health 17(1):1–9. https://doi.org/10.1186/s12889-017-4835-1

Roba KT, O'Connor TP, Belachew T, O'Brien NM (2016) Variations between post- and pre-harvest seasons in stunting, wasting, and Infant and Young Child Feeding (IYCF) practices among children 6–23 months of age in lowland and midland agro-ecological zones of rural Ethiopia. Pan Afr Med J 24:163

Rogers NL et al (2011) Colostrum avoidance, prelacteal feeding and late breast-feeding initiation in rural Northern Ethiopia. Public Health Nutr 14(11):2029–2036. https://doi.org/10.1017/S1368980011000073

Saaka M, Wemakor A, Abizari AR, Aryee P (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):1–12. https://doi.org/10.1186/s12889-015-2494-7

Samburu BM et al (2021) Realities and challenges of breastfeeding policy in the context of HIV: a qualitative study on community perspectives on facilitators and barriers related to breastfeeding among HIV positive mothers in Baringo County, Kenya. Int Breastfeed J 16(1):1–13. https://doi.org/10.1186/s13006-021-00385-1

Shrimpton R, Victora CG, De Onis M, Lima C, Blo M (2001) Worldwide timing of growth faltering: implications for nutrition interventions. Pediatricts 107(5):e75

Syeda B, Agho K, Wilson L, Maheshwari GK, Raza MQ (2021) Relationship between breastfeeding duration and undernutrition conditions among children aged 0–3 Years in Pakistan. Int J Pediatr Adolesc Med 8(1):10–17. https://doi.org/10.1016/j.ijpam.2020.01.006

Victora CG et al (2008) Maternal and child undernutrition 2 maternal and child undernutrition: consequences for adult health and human capital. Lancet 371:340–357. https://doi.org/10.1016/S0140-6736(07)61692-4

Victora CG et al (2016) Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet. https://doi.org/10.1016/S0140-6736(15)01024-7

West NS et al (2019) Infant feeding by South African mothers living with HIV: Implications for future training of health care workers and the need for consistent counseling. Int Breastfeed J 14(1):1–7. https://doi.org/10.1186/s13006-019-0205-1

WHO (2003) Guiding principles for complementary feeding of the breastfed child. 8

WHO (2023)Tracking the Triple Threat of Child Malnutrition [Online]. Available: https://www.who.int/publications/i/item/9789240073791

World Health Organization and United Nation Children's Fund (2016) Updates on HIV and Infant Feeding: the duration of breastfeeding, and support from health services to improve feeding practices among mothers living with HIV. Available: https://apps.who.int/iris/bitstream/handle/10665/246260/9789241549707-

World Health Organization and United Nations (2021) Indicators for assessing infant and young child feeding practices: definitions and measurement methods. Geneva. [Online]. Available: http://apps.who.int/iris/bitstream/handle/10665/44306/9789241599290_eng.pdf?sequence=1%0Ahttp://whqlibdoc.who.int/publications/2008/9789241596664_eng.pdf%5Cnhttp://www.unicef.org/programme/breastfeeding/innocenti.htm%5Cnhttp://innocenti15.net/declaration

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