

RESEARCH

Open Access



Prevalence, patterns, and determinants of breastfeeding cessation among mothers of children under 24 months in Uganda

Florence Nakaggwa^{1*†}, Derrick Kimuli^{1†}, Norah Namuwenge¹, Rebecca N. Nsubuga¹, Hellen Nayebare¹, Louis Kaboine¹, Immaculate Baseka¹, Kenneth Kasule¹, Sheila Nyakwezi², Solome Sevume², Norbert Mubiru², Barbara Amuron¹ and Daraus Bukenya¹

Abstract

Background Breastfeeding duration is a critical component of infant and child nutrition, providing immediate and long-term benefits to both children and their mothers. This study uses data from the lot quality assurance sampling (LQAS) survey to examine the prevalence, patterns, and determinants of breastfeeding cessation in Uganda.

Methods This study was a secondary analysis of data collected by the cross-sectional LQAS surveys in 2021 and 2022 covering 77 districts in Uganda. The LQAS survey methodology employs a systematic sampling approach to assess whether predefined quality standards are met within specific subgroups of a population. The study employed spatial analysis, bivariate analysis and logistic regression, both with and without clustering, to explore associations between independent variables and breastfeeding cessation. Unadjusted and adjusted odds ratios with 95% confidence intervals were calculated. Statistical significance was set at 5%.

Results Overall, the study analysed 26,377 records of mothers with children under 24 months old. The mothers' mean age was 27.9 years while that of their children was 11.0 months. While the general breastfeeding cessation rate was 17.7%, cessation was highest (49.7%) among mothers of children 18–23 months. Factors associated with increased odds of breastfeeding cessation included older child's age, older mother's age, using modern family planning, being pregnant and having an unknown pregnancy status. Lower odds of breastfeeding cessation were observed among mothers who; were married, lived in larger households, lived in rural residences, whose children received vitamin A supplementation and among all other regions compared to Kampala.

Conclusion One in five mothers ceased breastfeeding before their child reached 2 years, with a significant increase in cessation odds among mothers of older children. These findings underscore the importance of interventions to promote breastfeeding continuation and adequate nutrition for non-breastfed infants, particularly in regions with high cessation rates.

[†]Florence Nakaggwa and Derrick Kimuli contributed equally to this work.

*Correspondence:
Florence Nakaggwa
fnakaggwa@ciu.ac.ug

Full list of author information is available at the end of the article



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

Keywords Breastfeeding cessation, LQAS, Complementary feeding

Background

Breastfeeding is a critical component of infant and child nutrition, providing immediate and long-term benefits to both children and their mothers [1, 2]. For this reason, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommend that after 6 months, children should receive complementary foods with continued breastfeeding up to 2 years of age or beyond [3]. Breastmilk continues to meet up to 50% of a child's energy needs between 6 and 12 months, and more than 30% between 12 and 24 months [1, 4]. Moreover, extended breastfeeding continues to offer essential immunological support which holds the potential to decrease morbidity and mortality among infants and young children [5]. On a global scale, while breastfeeding rates are high, disparities in rates are evident both between and within countries [3]. On the other hand, sustained breastfeeding of children up to 2 years exhibits lower rates and similarly displays variations both between and within countries [3]. The observed rates of breastfeeding are partly attributed to the presence or absence of enabling environments and policies that protect breastfeeding [6, 7]. This is compounded by poor community and social support structures [4] making it a compelling case for the need to increase awareness to raise breastfeeding rates from birth through two years [3].

In Sub-Saharan Africa (SSA), addressing child malnutrition remains a significant challenge within the public health domain [8]. Among the pivotal interventions to counteract malnutrition, the duration of breastfeeding holds exceptional importance [3]. Remarkable progress has been achieved in Uganda towards reducing child malnutrition, as evidenced by substantial decreases in stunting (from 45 to 29%) and underweight (from 18 to 11%) between 2000 and 2016 [9]. Despite this advancement, a noteworthy decline in the percentage of mothers continuing breastfeeding was observed shortly after the 12-month mark. Additionally, a concern persists regarding the proportion of children under 2 years who are still breastfeeding by the 24-month milestone [9]. Previous studies in Uganda have explored breastfeeding cessation in the context of human immunodeficiency virus (HIV) [10, 11]. The present national-level findings are dated, spanning over 7 years. Moreover, these findings lack the provision of additional insights into the determinants of breastfeeding cessation or district-based estimates [9]. According to UNICEF, the factors influencing maternal and child nutrition are often multifaceted, encompassing immediate, underlying, and enabling determinants [12]. The present study harnesses the lot quality assurance sampling survey (LQAS) data to highlight determinants

of breastfeeding cessation. This study partly responds to UNICEF's call for increased awareness to promote prolonged breastfeeding duration [3, 12]. It also addresses similar initiatives like the National Information Platforms for Nutrition in Uganda, which aim to improve analysis of existing data to inform strategic decisions to prevent malnutrition [13].

Methods

Dataset used

The study used the 2021 and 2022 LQAS survey datasets. The LQAS is a large-scale survey that provides an accurate measure of the coverage of service system quality at an aggregate level, such as at the district or regional level [14, 15]. It employs a small sample size to make binary decisions about the quality of individual units within distinct categories or areas. The method is designed to minimize costs and resources by making localized assessments rather than comprehensive evaluations. LQAS is particularly useful in situations where resources are limited and quick decisions are needed [14]. It involves the subdivision of a population into smaller units, often referred to as "lots," which can encompass geographical regions, communities, or other defined subgroups. Each of these lots is categorized as either "acceptable" or "unacceptable," contingent upon whether specific criteria or thresholds are met. In contrast to alternative rapid assessment methodologies, the compilation of outcomes from diverse lots contributes to the estimation of the overall coverage.

Each district underwent division into 5 to 7 lots (referred to as supervision areas) based on established criteria such as administrative boundaries and population attributes. The study employed the probability proportionate to size sampling technique, selecting either 19 or 24 villages from each designated lot. At the village level, the reference household was determined through a straightforward random sampling procedure. The initial interview was conducted with the nearest household to the reference point, if respondents meeting the criteria were available. In instances where they were not, subsequent households were considered until the survey was concluded. For respondents within households, selection was accomplished through simple random sampling when multiple categories or respondents within a category were present. More information about the survey and its routine application in Uganda can be found here [15–21]. The surveys covered 77 districts in Uganda and elicited responses from 26,377 mothers with children under 24 months of age among other respondents. For this study, a subset of the dataset was used. Data from

mothers of children below 24 months was used for the analysis. Variables including participants background and breastfeeding history was abstracted and used for this analysis maintaining the cross-sectional design.

Study variables and measurements

The study's dependent variable was breastfeeding cessation, defined as the point at which a child younger than 24 months stopped receiving breastmilk. This variable was binary: mothers of children under 24 months were classified as either still breastfeeding or having stopped breastfeeding. This classification was based on the survey question, "*Are you currently breastfeeding this child?*" to which a *yes* or *no* response was given. To select independent variables, the study used variables from the survey that aligned with the UNICEF Conceptual Framework on Maternal and Child Nutrition [12]. According to this framework, the factors influencing maternal and child nutrition are multifaceted, encompassing immediate, underlying, and enabling determinants [12, 22]. Based on its depiction, the study chose the following as independent variables: age of the child and mother, child's sex, mother's marital status, highest level of education, geographic location characteristics, household size, antenatal care attendance, place of delivery, use of modern contraceptives, current pregnancy status, and mother's diet (specifically whether she consumed food from at least three different food groups the day before the survey).

Statistical analysis

Participant baseline and reproductive health characteristics were described using frequencies and percentages or means and corresponding standard deviations. In the bivariate analysis, categorical data were summarized using frequencies and percentages, while continuous data were summarized using means and standard deviations. The data were compared for disparities in the outcome through the Chi-square test for categorical variables and the t-test for continuous variables. Initially, at multivariate analysis, a multilevel logistic regression approach was employed, incorporating clustering at both the regional and district levels [23]. The goal was to explore differences in breastfeeding cessation between and within groups (regions and districts). The analysis grouped similar districts to facilitate the identification of distinct segments and anomalies to enable data exploration and extraction of meaningful insights. However, in the final analysis, the model without clustering was preferred after careful consideration of the estimates and corresponding standard errors.

The results revealed minimal disparities between the clustered and non-clustered models, indicating that the choice of the model had negligible impact on parameter estimates or their precision. In line with the principle of

parsimony, the simpler model was the preferred option, adhering to the well-known Occam's razor principle [24]. Unadjusted odds ratios (uORs) and adjusted odds ratios (aORs) were calculated alongside corresponding 95% confidence intervals (CI) as part of the analysis. Variables with a p-value below 0.05 were regarded as statistically significant. This selection ensured that the model's complexity remained proportional to the data and research question, enhancing the clarity, transparency, and robustness of our findings. As such, the study confidently proceeded with the model without clustering, aligning with established statistical practices and promoting the interpretability of the results. The analysis was performed utilizing STATA version 17 [25]. Spatial analysis was an additional integral component of this study, enabling the exploration of geographic patterns and relationships within the dataset. To accomplish this, Quantum Geographic Information System (QGIS), an open-source GIS software, was employed. QGIS provides a versatile platform for performing various spatial analyses, ranging from basic geoprocessing tasks to more advanced geospatial modelling [26].

Results

Prevalence of breastfeeding cessation

In total, approximately 17.7% (95% CI 17.3–18.2) of mothers had ceased breastfeeding their children under the age of 2. Within age groups, the rates of breastfeeding cessation were highest among mothers of children aged 12–17 months and 18–23 months at 19.7% and 49.7% respectively. Also, the spatial analysis showed that the prevalence of cessation of breastfeeding differed by district, 28 of the 76 districts had an overall cessation rate of more than 20%. Figures 1 and 2 below show the prevalence of cessation of breastfeeding. Further details are also presented in Table 1.

Participant characteristics and the prevalence of breastfeeding cessation of children under 24 months

Table 1 presents an overview of the participants' sociodemographic characteristics concerning breastfeeding cessation. The dataset encompassed records from 26,377 mothers with children under 24 months of age. The average household size was 5.3 (standard deviation [SD] ± 2.4). The mean age of the children was 11.0 months (SD ± 6.8) [Median=11, Interquartile range=5–17], with a slight majority being female (51.2%). The mothers' average age was 27.9 years (SD ± 37.6), and a significant portion was above 30 years old (33.1%). Most mothers were married (93.2%), had completed primary education (69.2%), lived in households with less than the mean household size (62.7%), and resided in rural areas of Uganda (80.1%). Significant statistical differences ($p < 0.05$) were observed in the rates of breastfeeding cessation based

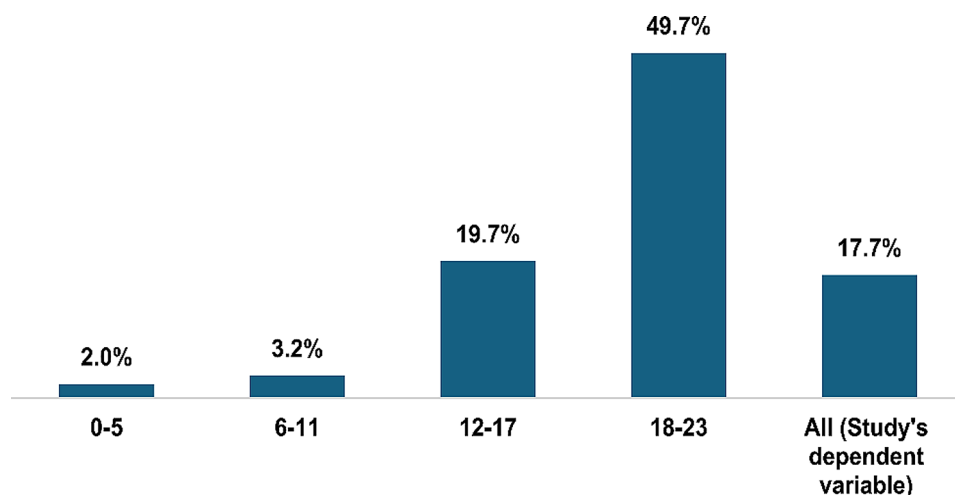


Fig. 1 Cessation of breastfeeding by child's age group

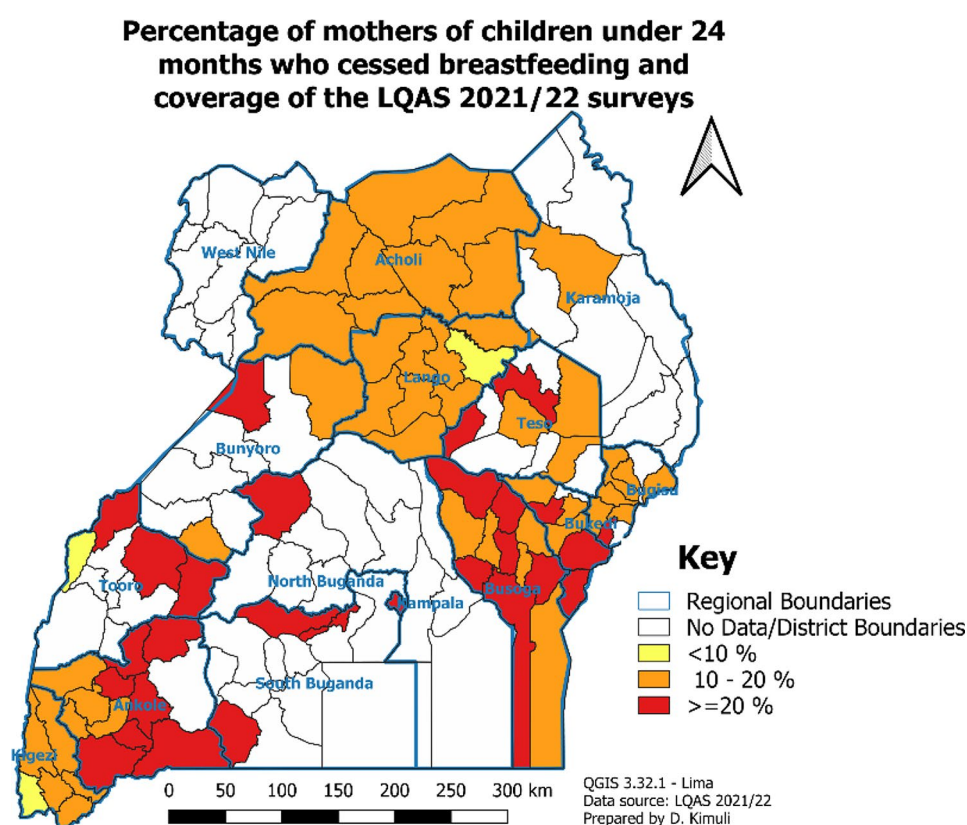


Fig. 2 Cessation of breastfeeding before 24 months by district

on marital status, mother's age, educational attainment, mean household size, and place of residence. Breastfeeding cessation was more prevalent among mothers who were divorced, separated, or widowed (24.7%, $p < 0.001$), aged 30 years and older (19.9%, $p < 0.001$), with secondary education (19.4%, $p = 0.001$), living in households smaller than the mean household size (18.1%, $p = 0.046$), and residing in urban areas (18.9%, $p = 0.011$).

Reproductive health, feeding patterns, and prevalence of breastfeeding cessation of children under 24 months

Table 2 provides a comprehensive bivariate analysis of reproductive health factors, feeding patterns, and breastfeeding cessation. The participants' mean attendance at ANC was 4.7 times (SD 1.7), with a vast majority having engaged in ANC (97.7%). Notably, 31.5% attended ANC in the 3rd month of pregnancy, and 52.6% attended

Table 1 Bivariate analysis of participant characteristics and breastfeeding cessation of children under 24 months

Variables	Frequency N=26,377	Ceased breast-feeding before 24 months		p-value
		No. n=21,706	Yes, n=4,671	
Child age				< 0.001*
0–5 months	7,246 (27.5)	7,103 (98.0)	143 (2.0)	
6–11 months	5,949 (22.6)	5,761 (96.8)	188 (3.2)	
12–17 months	7,362 (27.9)	5,912 (80.3)	1,450 (19.7)	
18–23 months	5,814 (22.1)	2,926 (50.3)	2,888 (49.7)	
Child sex				0.543
Male	12,880 (48.8)	10,618 (82.4)	2,262 (17.6)	
Female	13,497 (51.2)	11,088 (82.2)	2,409 (17.8)	
Mother marital status				< 0.001*
Never married	645 (2.5)	487 (75.5)	158 (24.5)	
Married	24,591 (93.2)	20,360 (82.8)	4,231 (17.2)	
Divorced/separated/ widowed	1,141 (4.3)	859 (75.3)	282 (24.7)	
Mother age				< 0.001*
10–19	2,563 (9.7)	2,288 (89.3)	275 (10.7)	
20–24	8,389 (31.8)	6,965 (83.0)	1,424 (17.0)	
25–29	6,686 (25.3)	5,455 (81.6)	1,231 (18.4)	
30+	8,744 (33.1)	6,998 (80.1)	1,741 (19.9)	
Mother education level				0.001*
None	1,628 (6.2)	1,318 (81.0)	310 (19.0)	
Primary	18,251 (69.2)	15,107 (82.8)	3,144 (17.2)	
Secondary	4,892 (18.5)	3,943 (80.6)	949 (19.4)	
Above secondary	1,606 (6.1)	1,338 (83.3)	268 (16.7)	
Household size (hhs)				0.046*
≤ mean hhs	16,541 (62.7)	13,552 (81.7)	2,989 (18.1)	
> mean hhs	9,836 (37.3)	8,154 (82.9)	1,682 (17.1)	
Residence				0.011*
Urban	5,239 (19.9)	4,248 (81.1)	991 (18.9)	
Rural	21,138 (80.1)	17,458 (82.6)	3,680 (17.4)	

N=Overall Total, n=subtotal, *Denotes statistical significance at $p < 0.05$, Percentages shown in brackets

within the first trimester. Also a significant majority delivered their child at a health facility (86.3%), received infant feeding counselling (77.3%), received vitamin A supplementation for their child (59.7%), refrained from introducing solid foods before 6 months (78.5%), were not members of a mother care group (94.1%), ate at least three food groups the day preceding the survey (78.8%), did not employ modern family planning (FP) methods (75.0%), and were not pregnant during the survey (91.9%).

Statistically significant disparities in the rate of breastfeeding cessation were observed with numerous factors, including ANC attendance, the timing of the 1st ANC visit, frequency of ANC visits, ANC attendance within the first trimester, place of childbirth, receipt of child's vitamin A supplementation, maternal diet, use of modern FP methods, and pregnancy status. Mothers who, did not attend ANC (28.5%, $p = 0.001$), initiated their first ANC visit at 4 months (18.3%, $p = 0.035$), missed ANC within the first trimester (17.9%, $p = 0.043$), gave birth at home (19.2%, $p = 0.014$), were uncertain about their child's vitamin A supplementation status (20.8%, $p < 0.001$), maintained a good maternal diet (19.4%, $p < 0.001$), employed modern FP methods (28.5%, $p < 0.001$), and were currently pregnant (62.3%, $p < 0.001$) ceased to breastfeed.

Factors associated with breastfeeding cessation of children under 24 months

Table 3 presents a detailed multivariate analysis of factors linked to the cessation of breastfeeding. In the final model, ANC attendance in the first trimester, months at first ANC and ANC attendance times were excluded due to collinearity concerns, ensuring model convergence and appropriateness. The odds of breastfeeding cessation were as high as almost 7-fold and 28-fold with child's age: 12–17 months (aOR 6.9, 95% CI 5.8–8.1, $p < 0.001$) and 18–23 months (aOR 28.33, 95% CI 24.0–33.5, $p < 0.001$), respectively. Similarly, the odds were higher by 20% among mothers who used modern FP methods (aOR 1.2, 95% CI 1.1–1.3, $p < 0.001$), 50% or 8 times higher among mothers who were either unaware of their pregnancy or currently pregnant (aOR 1.5, 95% CI 1.2–2.0, $p < 0.001$) and (aOR 8.0, 95% CI 6.9–9.3, $p < 0.001$) respectively.

Moreover, compared to younger mothers aged 10–19, the odds were higher by 30–50% based on maternal age brackets: 20–24 years (aOR 1.3, 95% CI 1.1–1.5, $p = 0.004$); 25–29 years (aOR 1.4, 95% CI 1.1–1.6, $p = 0.001$); and 30 years and above (aOR 1.5, 95% CI 1.2–1.8, $p < 0.001$). Additionally, compared to Kampala, the odds of breastfeeding cessation were lower in all but 2 regions (North and South central). Conversely, odds were lower by 40% for children of married mothers compared to unmarried mothers (aOR 0.6, 95% CI 0.4–0.7, $p < 0.001$), 10% for households exceeding the mean

Table 2 Bivariate analysis of reproductive health, feeding patterns and breastfeeding cessation of children under 24 months

Variables	Frequency N = 26,377	Ceased breastfeeding		p-value
		No, n = 21,706	Yes, n = 4,671	
ANC Attendance				0.001*
No	613 (2.3)	438 (71.5)	175 (28.5)	
Yes	25,764 (97.7)	21,268 (82.5)	4,496 (17.5)	
Months at 1st ANC				0.035*
1	1,564 (6.1)	1,315 (84.1)	249 (15.9)	
2	3,870 (15.0)	3,242 (83.8)	628 (16.2)	
3	8,110 (31.5)	6,685 (82.4)	1,425 (17.6)	
4	6,544 (25.4)	5,343 (81.7)	1,201 (18.3)	
5	5,676 (22.0)	4,683 (82.5)	993 (17.5)	
ANC attendance times				0.001*
Mean (SD)	4.7 (1.7)	4.8 (1.7)	4.6 (1.7)	
ANC attendance in 1st trimester				0.043*
No	12,220 (47.4)	10,026 (82.1)	2,194 (17.9)	
Yes	13,544 (52.6)	11,242 (83.0)	2,302 (17.0)	
Delivery place				0.014*
Home/other	3,617 (13.7)	2,924 (80.8)	693 (19.2)	
Health facility	22,760 (86.3)	18,782 (82.5)	3,978 (17.5)	
Counselling on infant feeding				0.669
No	5,856 (22.7)	4,845 (82.7)	1,011 (17.3)	
Yes	19,908 (77.3)	16,423 (82.5)	3,485 (17.5)	
Vitamin A supplementation				< 0.001*
No	10,088 (38.3)	8,737 (86.6)	1,351 (13.4)	
Don't know	528 (2.0)	418 (79.2)	110 (20.8)	
Yes	15,761 (59.7)	12,551 (79.6)	3,210 (20.4)	
Solid food introduced before 6 months				0.709
No	14,961 (78.5)	11,439 (76.5)	3,522 (23.5)	
Yes	4,093 (21.5)	3,118 (76.2)	975 (23.8)	
Member mother care group				0.733
No	24,824 (94.1)	20,433 (82.3)	4,391 (17.7)	
Yes	1533 (5.9)	1,273 (82.0)	280 (18.0)	
Mother diet				< 0.001*
No	20778 (78.8)	17,192 (82.7)	3,586 (17.3)	
Yes	5599(21.2)	4,514 (80.6)	1,085 (19.4)	
Modern FP use				< 0.001*
No	19,788 (75.0)	16,992 (85.9)	2,796 (14.1)	
Yes	6589 (25.0)	4,714 (71.5)	1,875 (28.5)	
Currently pregnant				< 0.001*
No	23230 (91.9)	19,861 (85.5)	3,369 (14.5)	
Don't know	514 (2.0)	374 (72.8)	140 (27.2)	
Yes	1522 (6.0)	574 (37.7)	948 (62.3)	

Abbreviations

ANC – Antenatal Care

SD-Standard deviation

FP – Family planning

Percentages shown in brackets

household size (aOR 0.9, 95% CI 0.8–0.9, $p=0.001$), 10% among mothers residing in rural areas (aOR 0.9, 95% CI 0.8–1.0, $p=0.065$), and 20% for mothers whose children had received vitamin A supplementation (aOR 0.8, 95% CI 0.7–0.9, $p<0.001$).

Discussion

The study findings revealed that about one in five mothers with children under 2 years old ceased breastfeeding before the child reached 2 years of age. Half of the

Table 3 Factors associated with breastfeeding cessation of children under 24 months

Variables	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
ANC attendance in 1st trimester				
No	1			
Yes	0.9 (0.9–1.0)	0.043*		
Months at 1st ANC				
1	1			
2	1.0 (0.9–1.2)	0.781		
3	1.1 (1.0–1.3)	0.114		
4	1.2 (1.0–1.4)	0.024		
5	1.1 (1.0–1.3)	0.144		
ANC attendance times				
Mean (SD)	0.9 (0.9–1)	< 0.001*		
Child age				
6–11 months	1		1	
12–17 months	7.5 (6.4–8.8)	< 0.001*	6.9 (5.8–8.1)	< 0.001*
18–23 months	30.2 (25.9–35.3)	< 0.001*	28.3 (24.0–33.5)	< 0.001*
Mother marital status				
Never married	1		1	
Married	0.6 (0.5–0.8)	< 0.001*	0.6 (0.4–0.7)	< 0.001*
Divorced/separated/widowed	1.0 (0.8–1.3)	0.918	1.0 (0.8–1.4)	0.902
Mother age				
10–19	1		1	
20–24	1.7 (1.5–2.0)	< 0.001*	1.3 (1.1–1.5)	0.004*
25–29	1.9 (1.6–2.2)	< 0.001*	1.4 (1.1–1.6)	0.001*
30+	2.1 (1.8–2.4)	< 0.001*	1.5 (1.2–1.8)	< 0.001*
Mother education level				
None	1		1	
Primary	0.9 (0.8–1.0)	0.064	0.9 (0.8–1.1)	0.369
Secondary	1.0 (0.9–1.2)	0.752	1.1 (0.9–1.3)	0.303
Above secondary	0.9 (0.7–1.0)	0.081	0.8 (0.6–1.0)	0.128
Household size (hhs)				
<=mean hhs	1		1	
>mean hhs	0.9 (0.9–1.0)	0.046*	0.9 (0.8–0.9)	0.001*
Residence				
Urban	1		1	
Rural	0.9 (0.8–1.0)	0.011*	0.9 (0.8–1.0)	0.065
ANC Attendance				
No	1		1	
Yes	0.5 (0.4–0.6)	< 0.001*	0.6 (0.4–0.7)	< 0.001*
Delivery place				
Home/other	1		1	
Health facility	0.9 (0.8–1.0)	0.014	1.0 (0.9–1.1)	0.559
Vitamin A supplementation				
No	1		1	
Don't know	1.7 (1.4–2.1)	< 0.001*	1.1 (0.8–1.4)	0.660
Yes	1.7 (1.5–1.8)	< 0.001*	0.8 (0.7–0.9)	< 0.001*
Mother diet				
No	1		1	
Yes	1.2 (1.1–1.2)	< 0.001*	1.0 (0.9–1.1)	0.610
Modern FP use				
No	1		1	
Yes	2.4 (2.3–2.6)	< 0.001*	1.2 (1.1–1.3)	< 0.001*
Currently pregnant				
No	1		1	

Table 3 (continued)

Variables	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Don't know	2.2 (1.8–2.7)	< 0.001*	1.5 (1.2–2.0)	< 0.001*
Yes	9.7 (8.7–10.9)	< 0.001*	8.0 (6.9–9.3)	< 0.001*
Region				
Kampala	1		1	
Acholi	0.5 (0.4–0.6)	< 0.001*	0.4 (0.3–0.6)	< 0.001*
Ankole	0.9 (0.8–1.1)	< 0.181	0.7 (0.5–1.0)	0.053
Bugisu	0.7 (0.6–0.9)	< 0.001*	0.5 (0.4–0.7)	< 0.001*
Bukedi	0.8 (0.7–1.0)	< 0.037*	0.7 (0.5–1.0)	0.034*
Bunyoro	0.7 (0.6–0.9)	0.006*	0.7 (0.5–1.0)	0.027*
Busoga	0.9 (0.7–1.1)	0.185	0.8 (0.6–1.1)	< 0.157
Kigezi	0.6 (0.5–0.7)	< 0.001*	0.4 (0.3–0.6)	< 0.001*
Lango	0.5 (0.4–0.6)	< 0.001*	0.4 (0.3–0.5)	< 0.001*
North Central	1.3 (1.0–1.7)	< 0.021*	1.4 (0.9–2.1)	0.272
South Central	1.2 (1.0–1.5)	0.046*	1.2 (0.9–1.7)	0.272
Tooro	0.8 (0.6–0.9)	< 0.009*	0.6 (0.4–0.9)	0.006*
Karamoja	0.5 (0.3–0.7)	< 0.001*	0.3 (0.2–0.6)	< 0.001*
Teso	0.9 (0.7–1.1)	< 0.175	0.8 (0.6–1.2)	0.272

* denotes statistical significance at $p=0.05$; 0–5 months group omitted; □ variable omitted from adjusted model due to collinearity

Abbreviations

ANC – Antenatal Care

hhs – Household size

SD – Standard deviation

FP – Family planning

SD – Standard deviation

mothers of children aged 18–23 years had ceased breastfeeding. The supplementary analysis also revealed an 80% higher the odds of cessation at the 6-month age mark. Moreover, the odds of cessation were higher among mothers who utilized modern FP methods, those who were pregnant or unaware of their pregnancy status and older maternal age. Conversely, the odds of cessation were lower among married mothers, those in households larger than the mean household size, mothers residing in rural areas or regions other than Kampala and those whose children had received vitamin A supplementation.

Close to 20% of the children were ceased from breastfeeding before attaining the age of 2 years. Notably, the likelihood of cessation escalated progressively by child's age group. These observations mirror the findings of the 2016 Uganda Demographic and Health Survey (UDHS), which indicated that approximately 50% of mothers ceased breastfeeding by their children's 20-month mark [9]. Hence, there possibly hasn't been a discernible change in the practices regarding breastfeeding cessation in Uganda. The study highlighted an increased risk of breastfeeding cessation by mothers with children in older child age groups. This could be for multiple reasons, the end of maternity leave and the need to return to work [27–29], the introduction of complementary feeding [3] or the desire/practice to end breastfeeding early. This may potentially lead to improper assumptions about complementary food sufficiency. However, the high early

breastfeeding cessation rate is exacerbated by the reality that merely around 15% of children the age group receive an adequate diet [9]. In tandem, these increase vulnerabilities to infections, malnutrition, and various health complications among children in Uganda [1–3]. The findings advocate for interventions aimed improving nutrition for non-breastfed infants [30] and routine monitoring of breastfeeding cessation by the health management information system [31]. Currently it can only be established through surveys such as the LQAS [17, 18] and UDHS [9].

An elevated likelihood of breastfeeding cessation was evident in mothers employing modern FP methods. Some studies found that the reliance on hormonal components potentially hindered breastfeeding by affecting milk production [32–34]. For the present study, the possible reason for this observation requires further investigation. Moreover, a recent study in Uganda found a puzzling connection between breastfeeding and postpartum FP: the odds of FP use were more among breastfeeding mothers, yet among non-FP users, most cited breastfeeding as their reason for not using FP [19]. Also, that the present study found higher odds of breastfeeding cessation with being pregnant mirrors the findings in Lebanon. For the Lebanon study, well-planned pregnancies were linked to higher odds of breastfeeding [35]. Modern FP methods play a pivotal role in effective pregnancy planning, so the study's findings that FP use and

pregnancy were associated with more odds of breastfeeding cessation warrant further investigation.

One surprising finding of this study was that older maternal age was a risk factor for breastfeeding cessation as this is contrary to other research [36–38]. In the present study, teenage mothers were more likely to breastfeed longer. A possible explanation is the high unemployment rates among teenage mothers which can reduce the possibility of employment-related breastfeeding cessation [39–41]. Unemployment can also lead to financial constraints which could limit the ability of teenage mothers to provide alternative comprehensive foods [42]. This could make prolonged breastfeeding one of the ways to ensure that the nutrition needs of their children are met. Also, this study observed regional and district disparities in the cessation of breastfeeding like what has been observed elsewhere [3]. This could be partly attributed to socioeconomic differences as much as cultural diversity [43, 44]. Notably, lower odds of cessation of breastfeeding were observed among mothers not living in Kampala (the country's capital city). Moreover, overall, lower odds were observed among mothers living in rural areas. These observations are the same and are like those made in Ethiopia [35]. Women in the city or urban areas have more work demands or access to breastfeeding substitutes among other reasons which may compromise the duration of breastfeeding [39, 45]. Many workplaces lack essential breastfeeding support structures which hinders successful breastfeeding experiences [39–41].

Moreover, the odds of cessation were lower among married mothers and mothers in households larger than the mean household size. Marriage provides an opportunity for financial, social, and emotional support from spouses or relatives [46]. This can create part of the social support structures necessary to ensure proper childhood nutrition [4]. Although larger households may provide a risk for food insecurity [47], they can provide an opportunity for additional social support structures as the mother may be afforded time for childcare while other household members support with extra household duties. Therefore, households with higher sizes could leverage this opportunity to promote prolonged breastfeeding. Also, the study found that mothers whose children had received Vitamin A supplementation were less likely to cease breastfeeding. Vitamin A supplementation is given by community health workers or health workers at the facility. This may mean that such mothers had an opportunity to receive additional information on breastfeeding, unlike their counterparts [48]. Without Vitamin A supplementation among children who have stopped breastfeeding, both the benefits of prolonged breastfeeding [1, 4, 5] and Vitamin A supplementation [49–51] are missed. This is further exacerbated by an inadequate diet

in this age group where the majority do not receive the minimum acceptable diet [9].

The present study examines breastfeeding cessation in Uganda using the LQAS datasets which, although not conventionally used for such investigations, offers a unique and current perspective. Remarkably, the study's robustness lies in its expansive sample size, which ensures comprehensive representation from diverse districts and regions, thus bolstering the study's applicability to a wider context. Nonetheless, the study does encounter certain limitations that warrant consideration while interpreting or employing its outcomes. A notable constraint resides in the study's foundation upon self-reported data garnered from the LQAS survey. This reliance introduces a potential for bias, as respondents may not consistently convey their experiences with precision [52, 53]. To its benefit, the interval was only two years which could have increased the probability of accurate recall. Moreover, the LQAS data upon which the study is based covered 77 of the 135 districts in Uganda, representing about 57% of the country, which although localized, may raise pertinent questions regarding the extrapolation of findings to the entire country. However, similar studies in the country used much smaller sample sizes or were limited in scope being health facility-based or focused on the cessation of breastfeeding in the context of HIV [10, 11, 43, 44]. Consequently, this study's findings provide a holistic and complementary understanding of breastfeeding practices beyond the constraints of previous research methodologies.

Conclusion

The study examined the prevalence, patterns, and determinants of breastfeeding cessation among mothers of children under 24 months in Uganda. The findings show that one in five mothers ceased breastfeeding before their child reached 2 years of age, however, half of mothers with children 18 - 23 months had ceased breastfeeding. This implies that prolonged breastfeeding remains low in Uganda. The use of modern FP methods, pregnancy, older maternal age, and urban residence were associated with higher cessation odds, while marriage, larger household size, rural residence, and Vitamin A supplementation for children were linked to lower odds. While echoing findings from the 2016 UDHS [9], the study emphasizes the need for interventions on breastfeeding duration, particularly given the limited access to sufficiently nutritious diets for children in Uganda. Moreover, the findings call for more strategies for adequate nutrition for non-breastfed infants, particularly in regions with higher cessation rates.

Abbreviations

ANC	Antenatal care
aOR	Adjusted odds ratios

FP	Family planning
Hhs	Household size
HIV	Human immunodeficiency virus
LQAS	Lot quality assurance sampling survey
PPFP	Postpartum family planning
QGIS	Quantum Geographic Information System
SSA	Sub-Saharan Africa
SD	Standard deviation
uOR	Unadjusted odds ratios
UDHS	Uganda Demographic and Health Survey
UNICEF	The United Nations Children's Fund
WHO	World Health Organization

Acknowledgements

The authors are grateful to Social & Scientific Systems Inc., a DLH Holdings Company for creating an enabling environment that made it possible to carry on this study. The authors are also grateful for the contributions of the district teams upon whose leadership and support the LQAS surveys are conducted.

Author contributions

D.K., F.N., and H.N. conceived the idea. D.K. and F.N. designed the study procedures. F.N., D.K., K.K., H.N., L.K., and I.B., conducted quality control and prepared the data used for the analysis. F.N. and D.K. led the analysis, interpretation of the results and preparation of figures. F.N., and D.K. led the manuscript development. N.N., R.N.N., K.K., H.N., L.K., I.B., S.S., N.M., B.A., and D.B. reviewed the manuscript. F.N., and D.K. refined the final version of the manuscript. F.N., and D.K. also responded to editorial and reviewer comments. All authors received and approved the final manuscript.

Funding

The United States Agency for International Development (USAID) supported the implementation of the LQAS survey through the USAID/ Strategic Information Technical Support (SITES) Activity that was awarded to Social & Scientific Systems Inc., (SSS), a DLH Holdings Company under USAID Contract Number: AID-617-C-17-00001. However, no funding was received for this study. The content of the article is the responsibility of the authors alone and does not necessarily reflect the views of USAID, the United States government, Social & Scientific Systems Inc. (SSS), or the DLH Holdings Company.

Data availability

The data that support the findings of this study are available upon request from Social & Scientific Systems, Inc., a DLH Holdings Company. In compliance with our institutional data-sharing policy and due to the sensitive nature of the data, we are unable to publicly provide the data as part of the manuscript submission. To obtain the data from Social & Scientific Systems, Inc., a DLH Holdings Company, interested researchers should contact Daraus Bukenya (Dr.) at Daraus.Bukenya@dlhcorp.com, Barbara Amuron (Dr.) at Barbara.Amuron@dlhcorp.com or the DLH Institutional Review Board at IRBHelp@dlhcorp.com. If researchers prefer to request data from specific districts, they may reach out to the corresponding district offices through the Ministry of Local Government at ps@molg.go.ug. Requests for data from both Social & Scientific Systems, Inc., A DLH Holdings Company will be subject to review by the IRB Review Team, ensuring adherence to ethical and legal considerations.

Declarations

Disclaimer

The views and contents of this article are the responsibility of the authors alone and do not necessarily reflect the views of Social & Scientific Systems Inc., the DLH Holdings Company, the United States Agency for International Development, and/or the United States Government.

Ethical approval

The study involved a secondary analysis of the LQAS survey data, which is publicly available upon reasonable request at the participating districts or projects without any usage restrictions. Due to this data's availability, ethical review consideration or informed consent was not required for the study. However, the study obtained permission from the United States Agency for International Development Strategic Information Technical Support Activity to use the survey datasets. The LQAS surveys may contain some confidential variables, but for the analysis, the study used an anonymized dataset that

did not require any such variables. For more information on the LQAS study's procedures, one can refer to the LQAS reports [16–18]. To ensure adherence to appropriate reporting guidelines, the study results were reported following acceptable standards and guidelines for observational studies in epidemiology [54].

Consent to participate

Not applicable.

Consent to publish

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹United States Agency for International Development, Strategic Information Technical Support (SITES) Activity, Social & Scientific Systems, Inc, DLH Holdings company, Kampala, Uganda

²The United States Agency for International Development Uganda, US Mission Compound-South Wing, Kampala, Uganda

Received: 4 September 2023 / Accepted: 31 May 2024

Published online: 05 June 2024

References

- Victora CG, Bahl R, Barros AJD, França GVA, Horton S, Krasevec J, et al. Breast-feeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *Lancet*. 2016;387:475–90. [https://doi.org/10.1016/S0140-6736\(15\)01024-7](https://doi.org/10.1016/S0140-6736(15)01024-7).
- Chowdhury R, Sinha B, Sankar MJ, Taneja S, Bhandari N, Rollins N, et al. Breastfeeding and maternal health outcomes: a systematic review and meta-analysis. *Acta Paediatr*. 2015;104:96–113. <https://doi.org/10.1111/apa.13102>.
- United Nations Children's Fund (UNICEF). BREASTFEEDING: A Mother's Gift, for Every Child. 2018. Available: https://www.unicef.org/media/48046/file/UNICEF_Breastfeeding_A_Mothers_Gift_for_Every_Child.pdf.
- Rollins NC, Bhandari N, Hajeerbhoy N, Horton S, Lutter CK, Martines JC, et al. Why invest, and what it will take to improve breastfeeding practices? *Lancet*. 2016;387:491–504. [https://doi.org/10.1016/S0140-6736\(15\)01044-2](https://doi.org/10.1016/S0140-6736(15)01044-2).
- Bener A, Hoffmann GF, Afify Z, Rasul K, Tewfik I. Does prolonged breastfeeding reduce the risk for childhood leukemia and lymphomas? *Minerva Pediatr*. 2008;60:155–61.
- Ministry of Law and Justice of India., The Maternity Benefit (Amendment) Act. 2017. 2017.
- Murtagh L, Moulton AD. Working Mothers, Breastfeeding, and the Law. *Am J Public Health*. 2011;101:217–23. <https://doi.org/10.2105/AJPH.2009.185280>.
- John-Joy Owolade A, Abdullateef RO, Adesola RO, Olaloye ED. Malnutrition: an underlying health condition faced in sub Saharan Africa: challenges and recommendations. *Annals Med Surg*. 2022;82:104769. <https://doi.org/10.1016/j.jamsu.2022.104769>.
- Uganda Bureau of Statistics (UBOS) and ICF. 2018. Uganda Demographic and Health Survey 2016. Kampala, Uganda and Rockville, Maryland, USA: UBOS and ICF.
- Ngbapai JG, Izudi J, Okoboi S. Cessation of breastfeeding and associated factors in the era of elimination of mother to child transmission of HIV at Ndejje health center, Uganda: a retrospective cohort study. *Int Breastfeed J*. 2020;15:78. <https://doi.org/10.1186/s13006-020-00323-7>.
- Marquez C, Okiring J, Chamie G, Ruel TD, Achan J, Kakuru A, et al. Increased morbidity in early Childhood among HIV-exposed uninfected children in Uganda is Associated with Breastfeeding Duration. *J Trop Pediatr*. 2014;60:434–41. <https://doi.org/10.1093/tropej/fmu045>.
- United Nations Children's Fund (UNICEF). UNICEF Conceptual Framework on Maternal and Child Nutrition. UNICEF Nutrition and Child Development Section, Programme Group 3 United Nations Plaza New York, NY 10017, USA. 2021. Available: <https://www.unicef.org/documents/conceptual-framework-nutrition>.
- NIPN - National Information Platforms for Nutrition. [cited 22 May 2024]. Available: <https://www.nipn-nutrition-platforms.org/>.
- Rath RS, Solanki HK. Review of Lot Quality Assurance Sampling, Methodology and its application in Public Health. *Nepal J Epidemiol*. 2019;9:781–7. <https://doi.org/10.3126/nje.v9i3.24507>.

15. Anoke SC, Mwai P, Jeffery C, Valadez JJ, Pagano M. Comparing two survey methods of measuring health-related indicators: Lot Quality Assurance Sampling and Demographic Health Surveys. *Trop Med Int Health*. 2015;20:1756–70. <https://doi.org/10.1111/tmi.12605>.
16. Kintu P, Elizabeth E, Denis B, Samson K, UPHOLD LQAS Survey Report. 2006: Household and Facility Survey on HIV/AIDS, Health and Education Interventions in 34 Ugandan Districts. 2006. Available: <http://library.health.go.ug/sites/default/files/resources/LQAS%20Survey%20Report%202006.pdf>.
17. MoLG & SSS M of LG and S&SS (SSS). Community surveys based on LQAS Methodology in Uganda. Uganda and Silver Spring. Maryland, US: USAID/ SITES Project; 2020.
18. Regional Health Integration to Enhance Services-North, Lango. LQAS Survey Report. 2020 Jul. Available: https://pdf.usaid.gov/pdf_docs/Pnadi228.pdf.
19. Nakaggwa F, Kimuli D, Kasule K, Katwesige JF, Kintu D, Ssempebwa R, et al. Postpartum family planning uptake in Uganda: findings from the lot quality assurance sampling survey. *Contracept Reproductive Med*. 2023;8:44. <https://doi.org/10.1186/s40834-023-00243-x>.
20. Kimuli D, Nakaggwa F, Namuwenge N, Nsubuga RN, Kasule K, Nyakwezi S, et al. Prevalence and determinants of minimum dietary diversity for women of reproductive age in Uganda. *BMC Nutr*. 2024;10:39. <https://doi.org/10.1186/s40795-024-00858-6>.
21. Kimuli D, Nakaggwa F, Namuwenge N, Nsubuga RN, Isabirye P, Kasule K, et al. Sociodemographic and health-related factors associated with exclusive breastfeeding in 77 districts of Uganda. *Int Breastfeed J*. 2023;18:66. <https://doi.org/10.1186/s13006-023-00604-x>.
22. Kimuli D, Nakaggwa F, Kasule K, Kiconco I, Nyakwezi S, Sevume S et al. S Kundu editor 2023 Level of minimum acceptable diet and its associated factors among children aged 12–23 months in Ugandan districts. *PLoS ONE* 18 e0293041 <https://doi.org/10.1371/journal.pone.0293041>.
23. McLachlan GJ. Cluster analysis and related techniques in medical research. *Stat Methods Med Res*. 1992;1:27–48. <https://doi.org/10.1177/096228029200100103>.
24. Walsh D. Occam's Razor: a Principle of Intellectual Elegance. *Am Philos Q*. 1979;16:241–4.
25. StataCorp CSTX. Stata Press. Stata 15 Base Reference Manual. 2017 [cited 8 Dec 2020]. Available: <https://www.stata.com/support/faqs/resources/citing-software-documentation-faqs/>.
26. QGIS (v3.32.1-Lima). QGIS Geographic Information System. 2023. Available: <https://www.qgis.org/en/site/>.
27. Olang B, Heidarzadeh A, Strandvik B, Yngve A. Reasons given by mothers for discontinuing breastfeeding in Iran. *Int Breastfeed J*. 2012;7:7. <https://doi.org/10.1186/1746-4358-7-7>.
28. Brown CRL, Dodds L, Legge A, Bryant J, Semenic S. Factors influencing the reasons why mothers stop breastfeeding. *Can J Public Health*. 2014;105:e179–85. <https://doi.org/10.17269/cjph.105.4244>.
29. Addati L, Cassirer N, Gilchrist K. Maternity and paternity at work: law and practice across the world. Geneva: International Labour Office; 2014.
30. WHO (World Health Organization). Guiding principles for feeding non-breastfed children 6–24 months of age. (2005). Guidelines for an Integrated Approach to the Nutritional Care of HIV-Infected Children (6 Months-14 Years). World Health Organization; 2009. Available: <https://www.ncbi.nlm.nih.gov/books/NBK143674/>.
31. Ministry of Health Resource Centre. The Health Management Information System; Health Unit Procedure Manual. 2020.
32. Goulding AN, Wouk K, Stuebe AM. Contraception and Breastfeeding at 4 months Postpartum among women intending to Breastfeed. *Breastfeed Med*. 2018;13:75–80. <https://doi.org/10.1089/bfm.2017.0064>.
33. Kelsey JJ. Hormonal contraception and lactation. *J Hum Lact*. 1996;12:315–8. <https://doi.org/10.1177/089033449601200419>.
34. Contraceptives, Oral. Combined. Drugs and Lactation Database (LactMed®). Bethesda (MD): National Institute of Child Health and Human Development; 2006. Available: <http://www.ncbi.nlm.nih.gov/books/NBK501295/>.
35. Hamade H, Chaaya M, Saliba M, Chaaban R, Osman H. Determinants of exclusive breastfeeding in an urban population of primiparas in Lebanon: a cross-sectional study. *BMC Public Health*. 2013;13:702. <https://doi.org/10.1186/1471-2458-13-702>.
36. Ever-Hadani P, Seidman DS, Manor O, Harlap S. Breast feeding in Israel: maternal factors associated with choice and duration. *J Epidemiol Community Health*. 1994;48:281–5. <https://doi.org/10.1136/jech.48.3.281>.
37. Hromi-Fiedler AJ, Pérez-Escamilla R. Unintended pregnancies are associated with less likelihood of prolonged breast-feeding: an analysis of 18 demographic and health surveys. *Public Health Nutr*. 2006;9:306–12. <https://doi.org/10.1079/PHN2006856>.
38. Tarrant RC, Younger KM, Sheridan-Pereira M, White MJ, Kearney JM. The prevalence and determinants of breast-feeding initiation and duration in a sample of women in Ireland. *Public Health Nutr*. 2010;13:760–70. <https://doi.org/10.1017/S1368980009991522>.
39. Nabunya P, Mubeezi R, Awor P. Prevalence of exclusive breastfeeding among mothers in the informal sector, Kampala Uganda. *PLoS ONE*. 2020;15:e0239062. <https://doi.org/10.1371/journal.pone.0239062>.
40. Omute T, Kirungi G. Breast-feeding practices and maternal employment in health facilities of Lira District, Northern Uganda. *Bull Natl Res Centre*. 2022;46:124. <https://doi.org/10.1186/s42269-022-00810-3>.
41. Clara KB. 849 breast feeding practices among working mothers attending 'postnatal' clinics in two hospital in Kampala, Uganda. *Occup Environ Med*. 2018;75:A537–537. <https://doi.org/10.1136/oemed-2018-ICOHabstracts.1523>.
42. Ludvigsson JF, Ludvigsson J. Socio-economic determinants, maternal smoking and coffee consumption, and exclusive breastfeeding in 10 205 children: Socio-economic factors and exclusive breastfeeding. *Acta Paediatr*. 2007;94:1310–9. <https://doi.org/10.1111/j.1651-2227.2005.tb02093.x>.
43. Nankumbi J, Mulira JK. Barriers to infant and child-feeding practices: a qualitative study of primary caregivers in Rural Uganda. *J Health Popul Nutr*. 2015;33:106–16.
44. Akello R, Kimuli D, Okoboi S, Komuhangi A, Izudi J. Prelacteal feeding among infants within the first week of birth in eastern Uganda: evidence from a health facility-based cross-sectional study. *Int Breastfeed J*. 2021;16:77. <https://doi.org/10.1186/s13006-021-00425-w>.
45. Ahmad RS, Sulaiman Z, Nik Hussain NH, Mohd Noor N. Working mothers' breastfeeding experience: a phenomenology qualitative approach. *BMC Pregnancy Childbirth*. 2022;22:85. <https://doi.org/10.1186/s12884-021-04304-4>.
46. Papp LM. The longitudinal role of Breastfeeding in Mothers' and fathers' Relationship Quality trajectories. *Breastfeed Med*. 2012;7:241–7. <https://doi.org/10.1089/bfm.2011.0074>.
47. Tambe BA, Mabapa NS, Mbhatsani HV, Mandiwana TC, Mushaphi LF, Mohlala M, et al. Household socio-economic determinants of food security in Limpopo Province of South Africa: a cross sectional survey. *Agric Food Secur*. 2023;12:19. <https://doi.org/10.1186/s40066-023-00424-6>.
48. Nyundo L, Whittaker M, Eagle L, Low DR. Adaptation of community-based distribution of family planning services to context-specific social networks: a case of marriage counsellors in Lusaka district, Zambia. *BMC Health Serv Res*. 2021;21:437. <https://doi.org/10.1186/s12913-021-06422-3>.
49. Fawzi WW. The benefits and concerns related to vitamin A supplementation. *J Infect Dis*. 2006;193:756–9. <https://doi.org/10.1086/500369>.
50. Villamor E, Fawzi WW. Effects of vitamin A supplementation on Immune responses and correlation with clinical outcomes. *Clin Microbiol Rev*. 2005;18:446–64. <https://doi.org/10.1128/CMR.18.3.446-464.2005>.
51. Vitamin A. Supplementation: who, when and how. *Community Eye Health*. 2013;26:71.
52. van de Thea F. Faking it: Social Desirability Response Bias in Self-Report Research. *Australian J Adv Nurs*. 2012;25:40–8. <https://doi.org/10.3316/informit.210155003844269>.
53. Yin RK. Case Study Research Design and methods: Applied Social Research and methods Series. Second ed. Thousand Oaks, CA: Sage Publications Inc; 1994.
54. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The strengthening the reporting of Observational studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *Int J Surg*. 2014;12:1495–9. <https://doi.org/10.1016/j.ijsu.2014.07.013>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.