Prevalence, feeding practices, and factors associated with undernutrition among HIV-exposed uninfected children aged 6 to 18 months in Bushenyi district, western Uganda: A cross-sectional study

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Abstract

Background

HIV-exposed children are vulnerable to undernutrition. Understanding the prevalence and factors with undernutrition remains essential for developing effective strategies to reduce the impact of malnutrition among this vulnerable population.

Methods

This was a cross sectional, descriptive and analytical study to determine the prevalence, feeding practices, and factors associated with undernutrition among HIV-exposed uninfected children aged 6 to 18 months in Bushenyi District. The study involved 245 mother-child pairs attending four highly active antiretroviral treatment (HAART) clinics. Data was collected from April to June 2021. Questionnaire interviews were used to obtain factors associated with undernutrition. A digital weighing scale, stadiometer and mid-upper-arm circumference (MUAC) tape were used for anthropometry. Undernutrition was defined by either a length-for-age or a weight-for-length or a weight-for-age below − 2 SD based on the 2006 World Health Organization growth standards. Data were entered and analysed using IBM SPSS 27.0 statistics for windows. The prevalence of undernutrition and indicators for feeding practices were determined as proportion, whereas binary logistic regression was used to determine factors associated with undernutrition. A p-value < 0.05 was considered for statistical significance at multivariable level.

Results

Of the 245 participants, 48(19.6%) had undernutrition. The prevalence of stunting, wasting and underweight was 11%, 5.3% and 6.5% respectively. Most study participants 176(71.8%) were initiated on breastfeeding during their first hour of life, and 185(75.5%) were exclusively breastfed for 6 months. However, 93(38%) of them did not receive an acceptable meal frequency and 188 (76.7%) did not have an acceptable dietary diversity score during the last 24 hours. Only 15(6.1%) continued breastfeeding after 1 year of age. The majority of mothers 162(66.1%) were advised on feeding practices. Low birthweight [p = 0,03; aOR 2.94(1.23–7.03)], history of illness in the past two weeks [p = 0,02; aOR 2.35(1.13–4.91)], maternal viral load of ≥ 1000 copies/μL [p = 0,03; aOR 3.12(1.10–8.89)], maternal undernutrition [p = 0,003; aOR 4.05(1.61–10.20)], and mixed feeding [p = 0,04; aOR 1.35(0.06–2.73)] were factors significantly associated with undernutrition.

Conclusion

The prevalence of undernutrition among HIV-exposed uninfected children was relatively high in this study. It demonstrates the need for routine nutritional assessment of HIV-exposed uninfected children.

1. Background

Globally, approximately 1.4 million HIV infected pregnant women give birth each year. In 2018, it was estimated that 82% of HIV infected pregnant women have access to antiretroviral medicines to prevent maternal to child transmission of HIV [1], [2]. As a result, most infants escape HIV infection leading to an increased population of HIV-exposed uninfected children [3]. Approximately 14.8 million children are exposed to HIV during intrauterine life or via breastfeeding and 13.2 million of them reside in sub-Saharan Africa. Uganda accounts about 1.1 million HIV-exposed uninfected children. It is the second-largest country worldwide with the biggest population of HIV-exposed uninfected children after South Africa which accounts about 3.5 million [4].

Undernutrition is a common problem among HIV-exposed children and it is associated with an increased risk of morbidity and mortality [5], [6]. Several factors contribute to undernutrition among HIV-exposed children; these include early mixed feeding, recurrent infections, poor care by HIV positive mothers with advanced stages of disease, and household food insecurity, to mention but a few [7]–[9]. HIV-exposed infants are also vulnerable to other factors that contribute to undernutrition in childhood such as, early weaning, diarrhea, poor sanitation, inappropriate complementary feeding practices and poverty [10]–[12].

Previous studies have reported a high prevalence of undernutrition among HIV-exposed children in Sub-Saharan Africa [13], [14]. In Uganda, a study conducted in Entebbe reported a high prevalence of undernutrition among HIV-exposed children with stunting, underweight and wasting being 14.2%, 8.0% and 3.9%, respectively. However, this study was conducted during a time when highly active antiretroviral therapy (HAART) was not widely available in Uganda and most HIV-exposed infants enrolled in this study were breastfed for a duration not exceeding six months [15]. Currently, the WHO recommends the provision of antiretroviral therapy for all HIV-positive persons irrespective of clinical or immunological staging of the diseases including HIV-positive women during pregnancy and lactation period[16]. This change in the protocol of HIV management may influence the prevalence of undernutrition among HIV-exposed children. Updated data is lacking.

Bushenyi is known as one of the districts most affected by HIV in Uganda [17]. It has persistently registered high levels of under-five undernutrition despite being referred to as “the food basket” of Uganda [18]. However, there is no data regarding the nutritional status of HIV-exposed and uninfected children. This study aims to determine the prevalence, feeding practices, and factors associated with undernutrition among HIV-exposed uninfected children aged 6 to 18 months in Bushenyi district.

2. Methodology

2.1. Study area, study design, and study period

This was a health facility-based cross sectional, descriptive and analytical study conducted from April to June 2021. The study involved four HAART centers in Bushenyi district, Uganda. Bushenyi is located in Western Uganda. It lies between 0°N and 0°46’ S of the equator and 29°41’ East and 30°30’ East of

Greenwich. It is bordered by Rubirizi District to the northwest, Buhweju District to the northeast, Sheema District to the east, Mitooma District to the south and Rukungiri District to the west. The District has a land area of 841 square kilometres and is 910–2500 metres above sea level[19].

At the time of the survey, 15 HAART clinics were providing care to 1219 HIV-exposed children within Bushenyi district. The research was conducted in four HAART centers including Kampala International University-Teaching Hospital(KIU-TH), Ishaka Adventist Hospital, St. Daniel Comboni Hospital, and Kyabugimbi Health centre (HC) IV. These four HAART clinics were selected using a randomization sequence of OpenEpi[20].

2.2. Study population

The study included all HIV-exposed uninfected children aged 6 to 18 months attending the four selected HAART centers in Bushenyi district. Children with congenital anomalies or other disabilities (cerebral palsy, amputations, etc.) that would have interfered with study procedures such as anthropometry measurement or interpretation were excluded. Furthermore, since the HIV status of children were determined by the last polymerase chain reaction (PCR), all children with no PCR result reports during the period of data collection were also excluded.

2.3. Sample size determination and sampling technique

The sample size of 245 HIV-exposed uninfected children was determined using Kish Leslie formula [21] based on the assumptions of a prevalence of undernutrition of 20% from a cross-sectional study conducted in Tororo District, Hospital, Uganda by Osterbauer et al., [22] with 95% level of confidence and 5% margin of error. It was anticipated that no study participant would withdraw from the study.

The number of participants to be recruited from each HAART clinic was determined using proportionate sampling in accordance with the total population of HIV-exposed uninfected children registered at the very HAART clinic. A month prior to the survey, 702 HIV-exposed uninfected children were registered in four HAART clinics and were distributed as the following KIU-TH (83), Ishaka Adventist Hospital (229), St. Daniel Comboni Hospital (212), and Kyabugimbi HC IV (178). After a proportionate sampling, 29, 80, 74, and 62 study subjects were recruited at KIU-TH, Ishaka Adventist Hospital, St. Daniel Comboni Hospital, and Kyabugimbi HC IV respectively. Participants were enrolled consecutively until the required sample size in each HAART clinic was achieved.

2.4. Data collection and variable measurement

Sociodemographic data, medical data, feeding information as well as anthropometric measurements were obtained from all study participants.

Socio-demographic characteristics were collected using a questionnaire and included variables such as age and sex of the HIV-exposed uninfected child. The age, address, education level, occupation, family size, marital status, and monthly income were collected for HIV-positive mothers. Mothers were grouped in two age categories: less than 25 years old representing adolescent and young mothers, and more than

25 years old. Based on their marital status, mothers were grouped as single (single mother, divorced or widower) or married (legally or cohabiting), which helped to assess the impact of single parenthood on the nutritional status of children. Formal occupation referred to mothers who earned monthly salaries while working in either private or public sectors. Non-formal occupation referred to self-employed mothers with no monthly salaries. These included peasants, small business holders, among others. According to the Uganda Bureau of Statistics (UBOS), the average household size in Uganda is 4.5 members [23]. Therefore, in this study, a large family referred to a family of five or more members. The caretaker's monthly income was categorized using the international poverty line. A monthly income less 57 US dollars (1.9 US dollars daily), which is approximately 200,000 Ugandan Shillings (UGX) was considered for cut-off of poverty [24].

Medical information including the result of the birthweight, child's history of illness during the two previous weeks, child's history of hospitalization, and maternal viral load, and maternal nutritional status. Low birth weight was defined as a birth weight below 2,500 g independent of the gestational age. Child's history of illness was assessed by asking about any history of the following symptoms in the past two weeks: fever, convulsions, loss of consciousness, nasal discharge, cough, difficulty in breathing, loss of appetite, vomiting, diarrhoea, crying during micturition, to mention but a few. The latest maternal viral load was obtained from the medical record, and classified as less than 1,000 copies/μL or more than 1,000 copies/μL.

Feeding practices were assessed using the core indicators including early initiation of breastfeeding initiation of breastfeeding within one hour after birth, exclusive breastfeeding under 6 months, continued breastfeeding at 1 year, minimum dietary diversity, minimum meal frequency and history of nutritional counselling [25]. Early initiation of breastfeeding indicator was presented as the proportion of HIV-exposed uninfected children aged 6 to 18 months who were put to the breast within one hour of birth. Exclusive breastfeeding under 6 months' indicator was defined as the proportion of participants who were exclusively breastfed under 6 months of age. Continued breastfeeding at 1 year was defined as the proportion of children 12–15 months of age who were still breastfed. Minimum dietary diversity was defined as the proportion of children 6–18 months of age who received foods from four or more food groups. Seven food groups were considered including grains, roots and tubers, legumes and nuts, dairy products, flesh foods, eggs, vitamin-A rich fruits and vegetables, other fruits and vegetables as established by the World Health Organization[25]. Breast milk was not considered. A list of commonly eaten local foods was established and foods were grouped into the seven WHO foods categories[25]. The mother was requested to list all food items that she provided to the child during the last 24 hours; the food items were then grouped matched to the seven WHO categories. Children who received foods from four or more categories were classified as having a minimum dietary diversity score; and those who received foods from less than four categories were classified as not having a minimum dietary diversity score[25]. Minimum meal frequency was reported as the proportion of breastfed and non-breastfed children 6–18 months of age who received solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more during the last 24-hours. The minimum number of times was defined as two times for breastfed infants 6–8 months, three times for breastfed

children 9–18 months and 4 times for non-breastfed children 6–18 months[25]. Each Mother was requested to recall the number of meals that she provided to her child during the last 24 hours. The number of meals was then compared to the age-appropriate number of meals taking into consideration the fact that the child was either still breastfeeding or not.

In order to assess the nutritional status of the child, the weight and the length were taken. The weight was measured using a digital scale. This was placed on a hard, flat surface and turned on. Before each measurement, the weighing scale was calibrated to zero. The child was weighed with minimum clothing and no jewellery. Those who were not able to stand were measured together with their caregiver and an automatic two-in-one adjustment button allowed the mother's stored weight to be deducted and the child's weight to be displayed on the scale. The weight was recorded to the nearest 0.1kg. The length was measured to the nearest 1 millimetre using a measuring board while the child was lying supine and was recorded to the nearest 0.1 cm. Undernutrition was defined by the presence of either a length-for-age(stunting) or a weight-for-length(wasting) or a weight-for-age(underweight) below − 2 SD of the WHO growth standards [26].

Maternal nutritional status was defined by the mid-upper arm circumference (MUAC). This was taken on the less active arm. Both the tip of the shoulder (acromion) and elbow (olecranon) were located on the left flexed (90°) arm. A non-stretchable MUAC tape specifically designed by UNICEF was placed around the mid-point of the arm. Two measurements were taken to ensure accuracy. A third measurement was taken whenever the two were different to assure accuracy. The measurement was read to the nearest 0.1 cm (after extending the arm) and recorded. The result was interpreted as normal, moderate acute undernutrition, or severe acute undernutrition if it was above 22.0 cm, between 19–22.0 cm, or less than 19 cm respectively. For adolescent mothers, a MUAC cut off less than 21 cm and less than 18.5 cm was considered for moderate and severe undernutrition respectively [27].

2.6. Data analysis

The data was entered and cleaned using Microsoft Excel 2016 database and was exported to IBM SPSS 27.0 statistics for windows (Armonk. NY: IBM Corp) for further analysis. The prevalence of undernutrition was calculated as a fraction of participants with undernutrition against all participants enrolled in the study and expressed as a frequency and percentage. Feeding practices were expressed as frequencies and percentages. The factors (sociodemographic factors, medical factors and feeding practices) associated with undernutrition were analyzed using binary logistic regression (bivariable and multivariable). Both unadjusted (crude) odds ratios with their corresponding 95% confidence interval (CI) and adjusted OR with their corresponding 95% CI were reported. Variables that were statistically significant at bivariable level or had a p-value ≤ 0.2 were moved to multivariable level. A p-value ≤ 0.05 was considered statistically significant at multivariable level.

3. Results

3.1. Baseline characteristics of the study participants

Table 1
Baseline characteristics of study population

Variable	Frequency	Percent
Sex		
Male	124	50.6
Female	121	49.4
Age of the child (months)		
6–11	145	59.2
12–18	100	40.8
Age of the mother		
< 25	158	64.5
> 25	87	35.5
Marital status of the mother		
Single	101	41.2
Married	144	58.8
Family size		
< 5	159	64.9
≥ 5	86	35.1
Education level of the mother		
At most Primary	171	69.8
Secondary	50	20.4
Tertiary	24	9.8
Occupation of the mother		
Non formal	233	95.1
Formal	12	4.9
Montlhy income(Uganda shillings)		

The study sample included 245 HIV-exposed children aged 6 to 18 months attending HAART clinic in Bushenyi district. There was no significant difference among male and female HIV-exposed children enrolled in the study (50.6% versus 49.4%). Children aged from 6 to 11 months comprised the bulk of the sample (59.2%). The mean age of 10.5 ± 3.7 months. Most study participants had a normal birthweight (85.7%) and did not have a positive history of illness during the two weeks preceding data collection (92.2%). Other sociodemographic and medical characteristics of study participants are presented in the Table 1.

Variable	Frequency	Percent
< 200K	193	78.8
> 200K	52	21.2
Low birthweight		
Yes	35	14.3
No	210	85.7
History of illness		
Yes	74	30.2
No	171	69.8
History of hospital admission		
Yes	19	7.8
No	226	92.2
Maternal viral load (> 1000copies/μL)		
Yes	21	8.6
No	224	91.4
Maternal undernutrition		
Yes	28	11.4
No	217	88.6

The study sample included 245 HIV-exposed children aged 6 to 18 months attending HAART clinic in Bushenyi district. There was no significant difference among male and female HIV-exposed children enrolled in the study (50.6% versus 49.4%). Children aged from 6 to 11 months comprised the bulk of the sample (59.2%). The mean age of 10.5 ± 3.7 months. Most study participants had a normal birthweight (85.7%) and did not have a positive history of illness during the two weeks preceding data collection (92.2%). Other sociodemographic and medical characteristics of study participants are presented in the Table 1.

3.2. Prevalence of undernutrition among HIV-exposed uninfected children

Table 2
Prevalence of undernutrition among HIV-exposed uninfected children

Variables	Undernutrition (n = 245)	Stunting (n = 245)	Wasting (n = 241)	Underweight (n = 241)
Overall	48(19.6)	31(12.7)	15(6.1)	18(7.3%)

The overall prevalence of undernutrition among study participants was (48) 19.6% [95%CI: 16.8–19.8]. Among children with undernutrition, 4(8.3%) had oedematous severe acute malnutrition and were not assessed for wasting and underweight. The prevalence of stunting, wasting, and underweight was 12.7%, 6.1%, and 7.3% respectively. The mean z-score of length-for-age, weight-for-length and height-for-age was − 0.4 ± 1.4, 0.2 ± 1.4, − 0.06 ± 1.2 respectively. Some HIV-exposed children had more than one form of undernutrition. Results are reported in Table 2 above.

3.3. Feeding practices among HIV-exposed uninfected children

Table 3
Feeding practices among HIV-exposed uninfected children

Variables	Frequency	percentage
Early initiation of breastfeeding (n = 245)		
Yes	176	71.8
No	69	28.2
Exclusive breastfeeding (n = 245)		
Yes	185	75.5
No	60	24.5
Continued breastfeeding (n = 100)		
Yes	15	6.1
No	85	34.7
Minimal meal frequency (n = 245)		
Yes	93	38.0
No	152	62.0
Minimal dietary diversity (n = 245)		
Yes	57	23.3
No	188	76.7
Nutritional counselling (n = 245)		
Yes	162	66.1
No	83	33.9

The majority of study participants (71.8%) were initiated on breastfeeding within the first hour following delivery and about 75% of them were exclusively breastfed during the first 6 months of life. However, the

majority of participants didn’t achieve the minimal meal frequency (62.0%) and minimal dietary diversity (76.7%) during the preceding 24 hours. Results are reported in Table 3 above.

3.4. Factors associated with undernutrition among HIV-exposed uninfected children

Table 4
Bivariable and multivariable analysis of sociodemographic and medical factors associated with undernutrition

Variable	Undernutrition		Bivariable analysis		Multivariable analysis	
	Yes	No	cOR(95% CI)	p-value	aOR(95% CI)	p-value
Sex						
Male	24(19.4)	100(80.6)	1.03(0.54–1.93)	0.92	-	-
Female	24(19.8)	97(80.2)	1			
Age of the child						
6–11	29(20.0)	116(80.0)	0.93(0.49–1.78)	0.84	-	-
12–18	19(19.0)	81(81.0)	1			
Age of the mother						
< 25	24(15.2)	134(84.8)	2.12(1.12–4.03)	0.02	0.49(0.23–1.03)	0.06
> 25	24(27.6)	63(72.4)	1		1	
Marital status						
Single	17(16.8)	84(83.2)	1.35(0.70–2.61)	0.36	-	-
Married	31(21.5)	113(78.5)	1			
Family size						
< 5	32(20.1)	127(79.9)	1			
> 5	16(18.6)	70(81.4)	0.90(0.46–1.76)	0.77	-	-
Education level						
At most Primary	35(20.5)	136(79.5)	0.55(0.15–1.96)	0.36	-	-
Secondary	10(20.0)	40(80.0)	0.57(0.14–2.30)	0.43	-	-
Tertiary	3(12.5)	21(87.5)	1			
Occupation						

Variable	Undernutrition		Bivariable analysis		Multivariable analysis	
Non formal	47(20.2)	186(79.8)	0.36(0.04–2.85)	0.33	-	-
Formal	1(8.3)	11(91.7)	1			
Monthly income						
< 200K	42(21.8)	151(78.2)	0.46(0.18–1.17)	0.10	-	-
> 200K	6(11.5)	46(88.5)	1			
Low birthweight						
Yes	16(45.7)	19(54.3)	0.21(0.09–0.45)	0.001	2.94(1.23–7.03)	0.01
No	32(15.2)	178(84.8)	1		1	
History of illness						
Yes	22(29.7)	52(70.3)	0.42(0.22–0.81)	0.01	2.35(1.13–4.91)	0.02
No	26(15.2)	145(84.8)	1		1	
History of admission						
Yes	5(26.3)	14(73.7)	0.65(0.22–1.92)	0.44	-	-
No	43(19.0)	183(81.0)	1			
Maternal viral load (> 1000c/µL)						
Yes	8(38.1)	13(61.9)	2.83(1.10–7.28)	0.03	3.12(1.10–8.89)	0.03
No	40(17.9)	184(82.1)	1		1	
Maternal undernutrition						
Yes	16(57.1)	12(42.9)	7.70(3.33–17.80)	0.001	4.05(1.61–10.20)	0.003
No	32(14.7)	185(85.3)	1		1	

Table 5
Bivariable and multivariable analysis of nutritional factors associated with undernutrition

Variable	Undernutrition		Bivariable analysis		Multivariable analysis	
	Yes	No	aOR(95% CI)	p-value	aOR(95% CI)	p-value
Early initiation of breastfeeding						
Yes	34(19.3)	142(80.7)	1			
No	14(20.3)	55(79.7)	1.06(0.53–2.13)	0.86	-	-
Exclusive breastfeeding						
Yes	34(18.4)	151(81.6)	1		1	
No	14(23.3)	46(76.7)	4.71(2.76–8.05)	0.01	1.35(0.66–2.73)	0.16
Continued breastfeeding						
Yes	2(13.3)	13(86.7)	1			
No	17(20.0)	68(80.0)	1.62(0.33–7.89)	0.54	-	-
Minimal meal frequency						
Yes	23(24.7)	70(75.3)	1			
No	25(16.4)	127(83.6)	0.59(0.31–1.13)	0.11	-	-
Minimal dietary diversity						
Yes	7(12.3)	50(87.7)	1			
No	41(21.8)	147(78.2)	1.99(0.84–4.72)	0.11	-	-
Nutritional counselling						
Yes	29(17.9)	133(82.1)	1			
No	19(22.9)	64(77.1)	1.36(0.71–2.61)	0.35	-	-

The Table 4 and 5 below present biviarable and multivariable analysis of factors associated with undernutrition among HV-exposed uninfected children in Bushenyi district.

At bivariable analysis, factors associated with undernutrition young maternal age [p = 0,02; cOR 2.12(1.12–4.03)], low birthweight age [p = 0,001; cOR 0.21(0.09–0.45)], positive history of illness during the past two weeks [p = 0,01; cOR 0.42(0.22–0.81)], high maternal viral load age [p = 0,03; cOR 2.83(1.10–7.28)], maternal undernutrition age [p = 0,001; cOR 7.70(3.33–17.80)], and mixed feeding [p = 0,01; cOR 4.71(2.76–8.05)].

At multivariable level, children born with a low birthweight were 2.9 times more likely to present undernutrition when compared to their counterparts with normal birthweight [p = 0,03; aOR 2.94(1.23–7.03)]. Other variables significantly associated with undernutrition at multivariable analysis included positive history of illness during the past two weeks [p = 0,02; aOR 2.35(1.13–4.91)], high maternal viral load age [p = 0,03; aOR 3.12(1.10–8.89)], maternal undernutrition age [p = 0,003; aOR 4.05(1.61–10.20)], and mixed feeding [p = 0,04; aOR 1.35(0.06–2.73)].

4. Discussion

4.1. Prevalence of undernutrition among HIV-exposed uninfected children

In this study, the prevalence of undernutrition was 19.6%. Overall, the prevalence of stunting, wasting, and underweight was 12.7%, 6.1%, and 7.3% respectively. Some HIV-exposed uninfected children had more than one form of undernutrition.

The overall prevalence of undernutrition was lower compared to the findings of most previous studies. In central Uganda, studies at St Francis hospital-Nsambya [28] and in Entebbe municipality[15] reported an overall prevalence of 20.2% and 26.1% respectively. Similarly, a cross-sectional study conducted at Tororo District Hospital in Eastern Uganda reported a prevalence of 20%[22]. Through a follow-up study of 2387 HIV-exposed infants, Mcdonald and colleagues[14] reported a prevalence of 22.9% in Tanzania. The most plausible explanation for the lower prevalence of undernutrition in the current study is the general improvement in child health due to improved access to HAART and widespread utilization of other child survival strategies including feeding practices and immunization coverage. For example, the recommended duration of breastfeeding for HIV-exposed uninfected children changed from a duration not exceeding 6 months, to 12 months[29]. In addition, the proportion of children aged 12–23 months fully vaccinated by 12 months of age has increased over time from 40% in 2011 to 55% in 2016, and Rotavirus vaccine against diarrheal diseases was recently introduced in Uganda [30], [31]. Furthermore, this study focused on children aged 6–18 months compared to previous studies that involved a wider age range of under-fives [22]. In addition, there was a high exclusive breastfeeding rate in the first 6 months of life when compared to previous studies. This could have conferred some protection against undernutrition [32].

Stunting was the most common form of undernutrition most likely because of the high rate of intrauterine growth restriction among HIV-exposed children [33]. Wasting was the least common form of

undernutrition in this study. Studies have reported that HIV-exposed children tends to be smaller in both length and weight than uninfected children, making them to have a normal weight-for-length [34].

4.2. Feeding practices among HIV-exposed uninfected children

The findings of this study show that majority (71.8%) of study participants were initiated on breastfeeding within the first hour of life. This is similar to the findings of Chepkorir and colleagues who reported that 95.3% of HIV-exposed uninfected children were initiated on breastfeeding within the first hour of life[32]. In contrast, Rossouw et al. in a cross-sectional study conducted in South Africa, reported a lower proportion of 55%[35].

In the present study, 75.5% of HIV-exposed uninfected children were exclusively breastfed for 6 months, whereas 24.5% were on mixed fed. This is a high exclusive breastfeeding rate compared to the national average of two-thirds (66%) [31]. Emphasis on exclusive breastfeeding and nutritional counselling in HAART clinics in Uganda may explain this finding.

The proportion of HIV-exposed uninfected children who continued breastfeeding after their first birthday was 6.1%. This is congruent with the findings of other studies [15], [36]. In Uganda, current clinical guidelines for the prevention and treatment of HIV/AIDS recommend exclusive breastfeeding for the first 6 months after birth, followed by the introduction of appropriate complementary foods and continued breastfeeding up to the first 12 months of life for HIV-exposed uninfected children. Breastfeeding may continue for HIV-exposed who turn positive [29]. A low proportion of breastfed children above one year of age was observed in this study because it only included HIV-exposed uninfected children.

The present study found that 38% of participants did not receive the appropriate meal frequency for age, and 76.7% did not have an acceptable dietary diversity score during the last 24 hours. Similar results were reported by Haile et al. in Ethiopia, where 65.6% and 53.3% of HIV exposed infants did not receive the recommended number of food groups and frequency of complementary feeding in the last 24 hours respectively[37]. According to the Uganda Bureau of Statistics and the International Classification of Functioning, 70% of children under 24 months living in Uganda are not fed according to minimum dietary diversity, and 58% do not reach a minimum meal frequency[31]. The minimum dietary diversity and minimum meal frequency are poor for both HIV-exposed children and their HIV-unexposed counterparts in Uganda. However, they tended to be worse among HIV-exposed uninfected children. This may be linked to the fact that food insecurity is more common and more severe among families affected by HIV [9].

In the current study, 78.4% of HIV-positive mothers benefited from counselling on infant feeding practices during antenatal care. Buonomo et al.[38] reported a significant difference in dietary diversity score among HIV-exposed children from 5.3 ± 1.9 on admission to 6.5 ± 1.3 after nutritional counselling. Counselling on feeding improves the nutrition of children born to HIV-positive mothers by helping them to adhere to infant-feeding recommendations.

4.3. Factors associated with undernutrition among HIV-exposed uninfected children

Factors that were significantly associated with undernutrition in the present study included lack of exclusive breastfeeding during the first 6 months of life, low birth weight, a positive child's history of illness, maternal viral load of ≥ 1000 copies/μL and maternal undernutrition.

In this study, children who were not exclusively breastfed during the first six month of life were prone to undernutrition when compared to their counterparts who were exclusively breastfed. Similar findings were reported by [13] in a retrospective chart review conducted in Kenya. Lang'at et al., found a statistically significant association between mixed feeding and stunting and underweight among HIV-exposed uninfected children[32]. Mixed feeding is associated with increased diarrhoea morbidity such as undernutrition, and mortality in developing countries [39], [40].

Children with a history of low birth weight were more vulnerable to undernutrition. Previous studies linked small for gestational age with undernutrition among the HIV-exposed uninfected children [14], [41]. However, Nduta & Marnane did not find any relationship between history of low birth weight and undernutrition[42]. It is known that some infants who are born small (low birthweight or short length) experience significant growth recovery by the end of the first year of life [43]. In this current study, most participants were younger than one year of age, which may have influenced the outcome. Ideally, the anthropometric measurements should be adjusted for birth weight especially for study participants younger than one year [44].

A recent history of illness in an HIV-exposed uninfected child increases the likelihood of undernutrition. History of illness in HIV-exposed infants has been associated with undernutrition in several studies in Sub-Saharan Africa [36], [45]. Recent illness can be associated with reduced appetite, increased basal metabolic rate and energy expenditure especially if it is associated with fever. This may partly explain the poor nutritional status [46].

The current study showed that maternal viral load of ≥ 1000 copies/μL increases the likelihood of undernutrition among HIV-exposed uninfected children. High maternal viral load count was also associated with wasting in a study conducted in Tanzania by Mcdonald and colleagues that found that the risk of wasting was elevated among infants whose mothers had a more advanced HIV disease stage[14]. High maternal viral load count may be associated with an impairment of maternal health and therefore affect the infant feeding and care.

Maternal undernutrition was associated with child undernutrition in this study. Similar findings were reported by Mcdonald and colleagues in Tanzania where maternal wasting was associated with child undernutrition [14]. A mother with undernutrition may have more advanced HIV disease stage or more HIV co-infections, which could lower her nutritional status and overall health, consequently impairing her ability to properly care for her child. Furthermore, maternal undernutrition may also reflect household food

insecurity, which might adversely affect complementary feeding of the child, and consequently lead to undernutrition.

5. Study Limitations

Micronutrient deficiencies was beyond the scope of the study, therefore was not assessed during data collection. Based on historical recall, indicators of feeding practices could have been affected by recall bias. However, this was minimized by using a 24-hour dietary recall for meal frequency and dietary diversity. Lastly, this study relied on the last PCR test result of HIV-exposed uninfected children with a risk to enrol children who might have seroconverted between the last HIV screening and data collection period. Nonetheless, this risk was minimal.

6. Conclusions

The prevalence of undernutrition among HIV-exposed uninfected children (6–18 months) in Bushenyi district was relatively low. The study revealed a high exclusive breastfeeding rate in the first 6 months, which may have offered a protective effect. On the other hand, complementary feeding practices were poor with regards to frequency and diversity. Undernutrition in HIV-exposed children was multifactorial; Young age of mothers, low birth weight, child child's history of illness in the last two weeks, maternal viral load of ≥ 1000 copies/μL, maternal undernutrition, and mixed feeding practices during the first six months of life were significantly associated with undernutrition among HIV-exposed uninfected children.

Abbreviations

AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; HAART, highly active antiretroviral treatment; HC, health center; HIV, human immunodeficiency virus; IBM SPSS, international business machine statistical package for the social sciences; MUAC, mid-upper-arm circumference; PCR, polymerase chain reaction; SD, standard deviation; UBOS, Uganda bureau of statistics; UGX, Ugandan shillings; UNICEF, United Nations international children's emergency fund; WHO, World Health Organization.

Declarations

Ethics approval and consent to participate

Ethical approval was sought from the research ethics committee (REC) of Kampala International University, Western Campus (Ref: KIU-2021-13). The study was registered with Uganda National Council for Science and Technology. Permission to execute the study was obtained from Health District Office of Bushenyi district. Caregivers were requested to sign an informed consent form after being given full details of the study in the language that they were able to understand. A fingerprinter was obtained for

those who could not sign. They were free to withdraw from the study any time they wished. All study procedures were performed in accordance with relevant guidelines and regulations in the method section.

Consent for publication

Not applicable.

Availability of data and materials

The data and all supporting materials used in the preparation of this manuscript are freely available from the corresponding author at reasonable request.

Competing interests

The authors declare no conflict of interest.

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Authors' contributions

All authors made substantial contributions to the conception and design of the study, acquisition of data, or data analysis and interpretation, took part in drafting the article or revising it critically for important intellectual content, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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