## RESEARCH

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# Comparison of infant feeding practices by maternal HIV status, and associated factors, in a rural district, South Africa 2019



Victoria Temwanani Mukhula<sup>1</sup>, Moleen Zunza<sup>1</sup>, Thandiwe Elsie Mbira<sup>2</sup>, Vundli Ramokolo<sup>2</sup>, Andrew J. Prendergast<sup>3,4</sup>, Thorkild Tylleskär<sup>5</sup>, Phillippe Van de Perre<sup>6</sup>, Ameena Ebrahim Goga<sup>2,7</sup> and Nobubelo K. Ngandu<sup>2\*</sup>

### Abstract

**Background** The prevalence of exclusive breastfeeding (EBF) during the first 6 months and breastfeeding up to 24 months in all mothers, regardless of HIV status, in high HIV prevalence settings of South Africa is not frequently evaluated. This study aimed to describe practices of EBF and breastfeeding beyond 12 months, compare these between HIV exposed (HE(s)) and unexposed infants (HU(s)), and determine associated factors.

**Methods** A secondary objective analysis of data from a cross-sectional study conducted during September-December-2019 in a rural South African district, was performed. Mothers living with HIV (MLHIV) paired with their infants in the following age groups: 0 to 3, > 3 to 6, > 6 to 12, and > 12 to 24 months; and mother-infant pairs without HIV with infants aged > 3 to 6 months and > 12 to 24 months, were enrolled. Descriptive statistics and bivariate and multivariable binomial regression were used for analyses.

**Results** A total of 771 mother-infant pairs, 62% being MLHIV, were enrolled. Among HEs (including 10 living with HIV), the prevalence of EBF was 41.0% and 16.7% in 0–3, and, 3–6 months age-groups, respectively, and breastfeeding prevalence was 19% in 12–24 months age-group. Among HUs, the prevalence of EBF was 7.9% among 3–6 months old and breastfeeding prevalence was 38.0% among > 12–24 months old. Overall, 79.8% and 45.5% HUs and HEs aged 3–6 months were still breastfeeding, respectively. HEs were more likely to exclusively breastfeed at 3–6 months age compared to HUs (adjusted prevalence ratio [aPR] 3.84; 95% confidence interval (CI) 1.55, 9.53). Breastfeeding practice at 12–24 months age was significantly less likely among HEs (versus HUs) and in infants with unmarried/ non-cohabiting mothers (versus married/co-habiting) (aPR 0.42; 95% CI 0.27, 0.63 and aPR 0.66; 95% CI 0.47, 0.92), respectively). Among HEs, breastfeeding beyond 6 months was more likely among MLHIV with known HIV-negative male partners (versus known HIV concordant relationships).

**Conclusion** In this study population, EBF was comparably more likely among HEs while breastfeeding beyond 12 months was more likely among HUs. Maternal marital status, frequency of antenatal care attendance and male partner's HIV status also influenced breastfeeding practice. Overall, there is still room for improvement regardless of

\*Correspondence: Nobubelo K. Ngandu Nobubelo.Ngandu@mrc.ac.za

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



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infant HIV status, requiring continued client-sensitive strengthening of the implementation of the recommended breastfeeding practices.

**Keywords** Exclusive breastfeeding, Breastfeeding beyond 12 months, HIV exposed infants, Infant feeding practice, Vertical HIV transmission

#### Background

Globally, 39 million people were estimated to be living with HIV in 2022, of whom 1.5 million were children aged 0-14 years, mostly in sub-Saharan Africa [1]. According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), South Africa has one of the highest HIV burdens among children in the world, with 260,000 and 230,000 children aged 0 to 14 years estimated to be living with HIV in 2018 and 2022, respectively [2]. HIV prevalence in pregnancy has also remained static since 2004, with nearly a third of pregnant women living with HIV [3–5]. Pregnancy and postpartum states are a particularly vulnerable period for new HIV infections [6-8], which is associated with a high risk of vertical transmission [9]. The Thembisa model (version 4.1), estimates that postnatal HIV acquisition in South Africa accounted for 75% of total vertical HIV transmissions (VHTs) in 2017-18, an increase from 40% in 2004 [10, 11]. Even though the benefits of breastfeeding in the context of HIV exposure are unquestionable, the reduction of VHT during the breastfeeding period has occurred at a slower rate compared to transmissions during antenatal and/or delivery period [12–14]. This slower progress poses a challenge for South Africa to sustain the World Health Organization (WHO) cumulative VHT target of 5% or less in a breastfeeding population and achieve less than 50 new pediatric HIV infections per 100 000 live births [15]. The challenges to attain and sustain viral suppression among pregnant and postpartum women contributes to the challenge of VHT in South Africa, where only 66% pregnant women had attained adequate viral suppression in 2019 [16–19].

The WHO recommendations on breastfeeding have evolved over time as the knowledge on VHT and access to antiretroviral therapy (ART) has improved. The WHO initially encouraged giving mothers living with HIV (MLHIV) feeding options, including the use of breastmilk substitutes if they can be provided sustainably, safely prepared and are nutritionally-adequate [20, 21]. However, considerations had to be made in low-income settings where the risk of death from malnutrition and infections was higher than the benefit of not breastfeeding as HIV prevention strategy. Currently, the WHO recommends similar breastfeeding practices regardless of maternal HIV status [22]. This is on the condition that MLHIV are supported to achieve and maintain optimal adherence to ART and HIV viral suppression. A few years after a pledge to promote, protect and support breastfeeding through the 'Tshwane Declaration of Support of breastfeeding (2011)', South Africa adopted the current WHO recommendations by revising and updating the Infant and Young Child Feeding policy in 2017 [23, 24]. The recommendations were substantiated by a study in South African HIV exposed infant cohort, which demonstrated that breastfeeding was not a risk factor for VHT or death due to wider access to ART [14]. Additionally, exclusive breastfeeding (EBF) for the first six months remains important especially in low-resource settings due to its associated reduced risk of diarrhea, pneumonia, and malnutrition, which are the leading causes of mortality in children under five years [25, 26]. The WHO and UNICEF recommend optimal feeding as it could save 820,000 lives in children under five years of age every year [27]. Optimal feeding includes early initiation of breastfeeding within one hour of birth, EBF for the first six months of life, and introduction of nutritionally adequate and safe complementary foods at six months together with continued breastfeeding up to 2 years of age or beyond.

The 2019 South African guideline for the prevention of mother to child transmission of communicable infections continued to encourage MLHIV to breastfeed their infants for longer, while maintaining HIV viral suppression [28]. Therefore, providing care and support for women living with HIV during pregnancy, delivery, and the postpartum period is an opportunity for the prevention of VHT (PVHT) [29]. We sought to describe breastfeeding practices among MLHIV and associated factors, to understand the extent to which the current WHO infant feeding recommendations have been adopted. The main objective of the study was to compare EBF at more than (>)3 to 6 months and breastfeeding at >12 to 24 months postpartum between HIV exposed infants (HE(s)) and HIV-unexposed infants (HU(s)). The study also sought to describe among HEs the prevalence of EBF during the first six months postpartum and breastfeeding beyond 6 months.

#### Methods

We performed analysis of data for a secondary objective from a facility-based cross-sectional study conducted during September-December 2019. The overall goal of the study was to assess risk factors for peripartum and postpartum VHT in a rural district in South Africa. Details of the primary objective and sample have been described elsewhere [19].

#### Study setting

The study was conducted in the eight largest community healthcare centers (CHC) of fifteen across Ehlanzeni district, in Mpumalanga province, a predominantly rural province in North-East of South Africa. According to the National Department of Health, Mpumalanga province had an overall antenatal HIV prevalence of 34% in 2019, which was among the highest in the country [3].

#### Participants

The study, mainly designed for the primary objective, included postpartum women attending the study facilities for infant postnatal care. MLHIV were recruited along with their biological infants according to the following infant age categories: a) 0 to 3 months, b) > 3 to 6 months, c) > 6 to 12 months, and d) > 12 to 24 months. Mother-infant pairs without HIV were purposively recruited from two groups at > 3 to 6 months and > 12 to 24 months for the secondary objective to compare breast-feeding practices at these milestones. Mother-infant pairs recruited postpartum were included in the current analysis of the secondary objective.

#### Study measurements and procedures

Data were collected electronically using a 20-30-minute questionnaire administered face-to-face by paired data collectors during the participants' routine visits to the CHC. Infant feeding practices were collected using 24-hour recall. Overall feeding practices since the birth of the infant were assessed as lifetime measures by asking if the infants had ever been exposed to a particular practice.

#### Socio-demographic factors

The following variables were collected and explored as risk/protective factors: maternal age, maternal education status, maternal and partner's HIV status, marital status, monthly income, source of income and timing of first antenatal visit. Maternal age was categorized to compare the HIV high risk age group of adolescents and young mothers 15-24 years with >24 years. Marital status was whether someone was living with a partner, married or cohabiting, or not. The primary source of income included employment or dependence on partner, other family members or government grants. Maternal education was the highest level of education completed and presented as a binary variable of tertiary education versus secondary or lower education. Monthly household income was used as binary variable according to the recommended minimum wage. Partner's HIV status was the HIV status of the child's biological father as reported by the mother, presented as a categorical variable of known positive, known negative and unknown. Maternal HIV status was as per their clinic records at the time of study

#### **Outcome variables**

The main outcomes assessed in this secondary analysis were EBF and breastfeeding practices beyond 12 months. Mothers' 24-hour recall were used to collect feeding practices to minimize recall bias. EBF was defined as an infant aged 0-6 months who received no other food or drink, not even water, except breastmilk (including milk expressed or from a wet nurse), while allowing for ingestion of prescribed medicines and vitamins [30]. Breastfeeding beyond 6 months was described for HEs aged>6 months and breastfeeding beyond 12 months was described for all infants aged>12 months. Ever breastfed was another outcome variable which assessed all infants>12-24 months old who were ever breastfed from birth to the time of data collection. Mixed feeding was also described and defined as infants aged 0-6 months who were given any liquid except vitamin syrup, in addition to the breast milk (31). Other feeding in this age-group was defined as any feeding other than EBF or mixed feeding. Comparisons between HEs and HUs were done for age-groups > 3-6 months and >12-24 months, as per study design.

#### Sample size

The study used data from an existing database with 771 mother-infant pairs. A minimum sample size of 504 with 252 in each group was needed to detect at least 11% difference in EBF between HEs and HUs, using a previous South African study [31], and sample power of 80% with 5% precision. The estimates were based on the national EBF prevalence of 32% [32].

#### Statistical analysis

Categorical variables were summarized as proportions. The prevalence of EBF was measured as the proportion of HEs 0 to 6 months old who were exclusively breastfed in the previous 24 h, out of the total number of HEs 0 to 6 months old. Due to the pre-defined recruitment design of HUs, the comparison of EBF between HEs and HUs was measured only for infants aged > 3 to 6 months old out of the total number of infants in the same age-group. Breastfeeding prevalence was estimated as the proportion of infants at > 12 to 24 months of age who were fed breast milk in the previous 24 h, out of the total number of infants in the same age group. This was also measured for the >6 to 24 months old HEs separately. Lifetime measure of breastfeeding was also measured as ever breastfeed.

Chi-squared test statistic was used to compare the distribution of socio-demographic variables and breastfeeding practice variables between MLHIV and mothers without HIV, using a P-value < 0.05 to indicate a significant difference. Given the overall prevalence > 20% of the EBF and breastfeeding outcome variables in this cross-sectional data, we fitted a generalized linear model using log binomial regression to calculate prevalence ratios (instead of odds ratios) to estimate the association between the outcome and independent variables. Due to differing levels of sample size realization between the MLHIV and HIV-negative women relative to the targeted (Additional file 1), differences in key baseline demographic characteristics were first assessed to determine variables to be adjusted for in multivariable regression analysis for comparing feeding practices between MLHIV and mothers without HIV. Additional analyses were done for HEs alone: Bivariate analyses were used to assess factors associated with EBF (0-6 months) and breastfeeding beyond 6 months for HEs. Adjusted models were not used for the HEs sub-group analysis due to limited data for model convergence. Prevalence ratios with corresponding 95% confidence interval (CI) were reported. Non-overlapping 95% CI were taken to represent significant prevalence ratios.

#### Results

### **Baseline characteristics**

A total of 771 mother-infant pairs were consecutively included in the analysis, of whom 62% (480) were MLHIV. There were 306 mother-infant pairs with 0-6 months old infants, which is smaller than the needed sample size. The results are therefore exploratory and for internal sample validity. The participant demographic characteristics are presented in Table 1. There were more young mothers without HIV aged 15-24 years old (45.4%) compared to MLHIV (16.9%), while education level and employment status were comparable. Overall, more than four fifths of the women had achieved secondary education or higher, with almost half (48.1%) dependent on their family or partner for income. Most mothers had attended antenatal care at least five times (71.1%). Nearly three-quarters (74.1%) of MLHIV had started ART treatment before pregnancy and were on first line regimen. Many of the recruited infants (43.2%) were within the >12 to 24 months age group.

2% (*n*=10) of HEs had confirmed HIV infection and all had initiated ART, while 31.6% of the uninfected HEs were still on postnatal prophylaxis. Among HEs without HIV, postnatal prophylaxis was highest among the youngest age-group (0–3 months old, 69.6%) and decreased with increasing age-group to, 32.5%, 14.7% and 6.5% among >3–6, >6–12 and >12–24 months old groups, respectively. Of the 10 HEs with HIV, four were

between 0 and 6 months old, one under one year and five were between > 12 to 24 months old (Table 2).

#### **Description of infant feeding practices**

#### **HIV** exposed infants

The 24-hour recall feeding practices are presented in Fig. 1. Table 3 shows infant feeding practices among HEs and HUs at specific age milestones. The prevalence of EBF among 0–6 months old HEs was 32.3% and higher among the 0–3 months old sub-group (41.0%). The prevalences of EBF and mixed feeding among > 3 to 6 months old HEs were comparable, at 16.7% and 14.3%, respectively, while any breastfeeding was 45.5%. The remainder of the infants were on other feeds, including solids and water. Most infants on other feeds were fed formula milk (~70.0%). The prevalence of breastfeeding was 28.9% in HEs older than 6 months. Less than a fifth (19.1%) of HEs aged > 12 to 24 months were breastfeeding and 70.0% had ever been breastfeed since birth.

#### HIV unexposed infants

Despite 79.8% of HUs at >3 to 6 months age group breastfeeding (Fig. 1A), EBF in this group was lower, at 7.9% than among HE (16.7%). The prevalence of mixed feeding in the same age group of HUs was 4.5% (Table 3) and was significantly lower compared to that of HEs (chisquared p = 0.028). 58% of the HUs aged >3 to 6 months had been given water (Fig. 1B). More than a third (38.1%) of HUs in the >12 to 24 months age group were breastfeeding and 93.0%. had ever been breastfed since birth.

### Factors associated with infant feeding practices Factors associated with exclusive breastfeeding at > 3 to 6 months and with breastfeeding at > 12 to 24 months

The potential role of maternal HIV status on breastfeeding practices was investigated in a multivariable model adjusting for socio-demographic factors found to have heterogenous distribution in the realized samples of MLHIV and mothers without HIV. The variables found to be different between the two maternal HIV status samples were: maternal age, education, marital status, source of income, and partner's HIV status (Table 4).

HEs were at least three times more likely to exclusively breastfeed at > 3 to 6 months compared to HUs (adjusted prevalence ratio [aPR] 3.84; 95% CI 1.55, 9.53), after adjusting for income source, partner HIV status, maternal education, maternal age and marital status (Table 5).

HEs were 0.42 times as likely to breastfeed at > 12 to 24 months compared to HUs (aPR 0.42; 95% CI 0.27, 0.63). Mothers who were not married/cohabiting were less likely to be breastfeeding infants of the same age group

#### **Baseline Characteristics** Overall (N = 771) MLHIV (N = 480) n (%) HIV Negative mothers (N = 291) n (%) n (%) Maternal age, years 15-24 213 (27.6) 81 (16.9) 132 (45.4) 25-34 386 (50.1) 274 (57.1) 112 (38.5) 35–49 172 (22.3) 125(26.0) 47 (16.2) Infant age, months -3 139 (18.0) 139 (29) Not recruited >3-6 167 (21.7) 78 (16.3) 89 (30.6) >6-12 132 (17.1) 132 (27.5) Not recruited >12-24 333 (43.2) 131 (27.3) 202 (69.4) Gestational age, weeks Pre-term 84 (10.9) 49 (10.2) 35 (12.0) 687 (89.1) 431 (88.0) 256 (88.0) Term Infant birth weight, kg < 2.5 70 (9.1) 45 (9.1) 25 (8.6) ≥2.5 701 (90.9) 435 (90.6) 266 (91.4) Maternal BMI Underweight 42 (5.5) 23 (4.8) 19 (6.5) Normal 298 (38.7) 183 (38.1) 115 (39.5) Overweight 81 (27.8) 219 (28.4) 138 (28.8) Obesity 212 (27.5) 136 (28.3) 76 (26.1) Education 8 (2.8) None/primary 53 (7.0) 45 (9.5) Secondary 624 (82.3) 385 (81.2) 239 (84.2) Tertiary 81 (10.7) 44 (9.3) 37 (13.0) Marital status Married/living with partner 300 (39.0) 203 (42.4) 97 (33.3) Not married 470 (61.0) 276 (57.6) 194 (66.7) Income source 67 (23.0) Employed 199 (25.9) 132 (27.7) Dependent 369 (48.1) 208 (43.2) 161 (55.3) Government grant 200 (26.0) 137 (28.7) 63 (21.7) Household gross income > R3200 454 (59.0) 272 (56.8) 182 (62.5) < R3200/none 316 (41.0) 207 (43.2) 112 (37.5) Partner's HIV status Positive 237 (30.8) 231 (48.2) 6 (2.1) Negative 298 (38.7) 89 (18.6) 209 (71.8) Unknown 235 (30.5) 159 (33.2) 76 (26.1) Gestation at ANC-1 visit ≤12 weeks 518 (67.7) 330 (68.9) 188 (65.7) 13-20 weeks 197 (25.8) 114 (23.8) 83 (29.0) >20 weeks 50 (6.5) 35 (7.3) 15 (5.2) Number of ANC visits 0–4 visits 179 (28.9) 128 (32.5) 51 (22.7) 5-12 visits 440 (71.1) 266 (67.5) 174 (77.3)

 Table 1
 Demographic characteristics of mothers living with HIV and HIV negative mothers

MLHIV- mothers living with HIV, ANC- antenatal care, BMI-body mass index

Infant age in months	Total HE, N	With HIV, <i>n</i> (%)	Without HIV, n (%)
0–3	81	3 (3.7)	78 (96.3)
>3-6	62	1 (1.6)	61 (98.4)
>6-12	122	1 (0.8)	121 (199.2)
>12-24	121	5 (4.1)	116 (95.9)

Table 2 HIV status of HIV exposed infants by age-group milestones

compared to mothers who were married (aPR 0.66; 95% CI 0.47, 0.92) (Table 5).

# Factors associated with exclusive breastfeeding in HIV exposed infants

None of the investigated factors was associated with EBF among at 0–6 months old HEs, except for the number of antenatal visits (Table 6). HEs whose mothers attended at least five antenatal visits were less likely (prevalence ratio [PR] 0.62; 95% CI 0.41, 0.93) to be exclusively breastfed, compared to those whose mothers attended less than five visits.

### Factors associated with breastfeeding > 6 months in HIV exposed infants

None of the investigated factors was associated with breastfeeding at >6 to 24 months among HEs except for the HIV discordance status between mothers and their partners. HEs with HIV discordant parents were 1.70 times more likely to be breastfed at >6 to 24 months of age compared to infants whose mothers had partners living with HIV (PR 1.70; 95% CI 1.06, 2.71) (Table 7).

#### Discussion

In this study, the prevalence of EBF and breastfeeding beyond 12 months, of infants recruited in a largely rural district in South Africa (Ehlanzeni district, Mpumalanga province), was low ( $\leq 41\%$  and  $\leq 38\%$ , respectively) and similar to the overall national breastfeeding practices [32]. The EBF prevalence of a third (this appearing to be higher than in HUs) and the low breastfeeding prevalence of 28.9% beyond 6 months among HEs were also comparable to the national estimates. Breastfeeding beyond 12 months still differs by infant HIV exposure status, contrary to WHO feeding recommendations. In this sample, twice as many HUs were breastfed compared to HEs at >12 to 24 months age. This difference remained similar when comparing the lifetime measure of breastfeeding since birth. Of good note is that mixed feeding was very low, and breastfeeding was very high among HUs around 6 months, although room for improvement was observed among HEs.

The prevalence of EBF in HEs is consistent with the national prevalence of 32% [32] and comparable to 30% prevalence in HEs in Kwa-Zulu Natal [33]. However, there has been a wide range of prevalence reported among HEs in South Africa. A systematic review which

assessed evidence on breastfeeding after WHO's 2010 recommendation of breastfeeding regardless of HIV status, showed the prevalence in South Africa to range from as low as 26% to as high as 99% between 2011 and 2020 [34]. The wide difference is likely due to discrepancies in sampling, heterogeneity in the duration of breastfeeding and definitions of the outcome where others included non-prescribed medications. Regardless, South Africa is one of the countries with low EBF rates compared to other countries in the region, which have EBF rates above 50% [35, 36]. These differences have been attributed to factors including weak or inadequate legislative implementation of the international code of marketing milk substitutes which results in easy marketing and access to infant formula, or relatively lesser hospital initiatives which have shown to improve the rates in other countries [37]. The findings in the current study shows a gap in the WHO's target of 1.2% annual increase in exclusive breastfeeding to attain at least 50% prevalence by 2025 [38].

Despite an overall low breastfeeding prevalence after 12 months in this population, the higher breastfeeding beyond 12 months in HU at > 12 to 24 months compared to HEs was consistent with a study in Johannesburg, even though the proportions were different (48% and 24.7% vs. 38% and 19%). The differences may have been due to a smaller sample size in the study done in Johannesburg (n = 181) [39]. Another study in Mozambique also found a similar gap where the risk of discontinuing breastfeeding was 2-fold higher in HEs than HUs [40].

The low rates of prolonged breastfeeding may be due to mixed messages, in part due to that South Africa in its previous policies adopted earlier WHO considerations to use breast-milk substitutes if they can be provided sustainably, safely prepared and are nutritionally adequate. The subsequent PVHT and feeding policies sought to clarify and streamline the feeding messaging for all women irrespective of HIV status. The negative association between the number of antenatal visits and breastfeeding among MLHIV could reflect messaging inconsistences during antenatal care visits. A study conducted previously in the same province reported that miscommunication on breastfeeding from the health care workers negatively influenced their breastfeeding practices [41]. Alternatively, women who attended more antenatal care visits could be those who were often sickly and hence had low confidence in the safety of breast feeding in the context of high risk of VHT. Nonetheless,

# The prevalence (%) of feeding practices in the previous 24 hours in HIV-exposed and unexposed infants by age group

В

D





С





E

G

100

80

60

40

20

0

7.4

0-6

4.3

0-3



Other liquids 24 hour recall

28.1

13

>3-6

35.9

>6-12

F

100

80



86.6

>12-24

Traditional medicines 24 hour recall

Η



Fig. 1 24-hour recall of different feeding practices in HIV exposed- (black bars) and unexposed (blue bars) infants by infant age-groups. Infant age in months is shown in the X-axis. The proportions (%) are shown in the Y-axis

Infant feeding practices	HIV Expo	sed	HIV Unexposed		P-value
	N	With Endpoints	N	With endpoints	
		n (%) [95% Cl]		n (%) [95% Cl]	
0–3 months	139				
Current feeding					
Exclusive breastfeeding		57 (41.0) [32.7, 49.7]		-	-
Mixed feeding		35 (25.2) [18.2, 33.2]		-	-
Other feeding		47 (33.8) [26.0, 42.3]		-	-
>3–6 months	78		89		
Current feeding					
Exclusive breastfeeding		13 (16.7) [9.2, 26.8]		7 (7.9) [3.2, 15.5]	0.081
Mixed feeding		11 (14.1) [7.4, 24.1]		4 (4.5) [1.2, 11.1]	0.028
Other feeding		54 (69.2) [57.8, 79.2]		78 (87.6) [79.0, 93.7]	0.004
>6–12 months	132				
Currently breastfeeding		51 (38.6) [30.3, 47.5]		-	-
>12-24 months	131		202		
Currently breastfeeding		25 (19.1) [12.8, 26.9]		77 (38.1) [31.4, 45.2]	< 0.001
Ever breastfed		92 (70.2) [61.6, 77.9]		187 (92.6) [88.6, 96.1]	< 0.001

Table 3 Infant breastfeeding practices by mother's HIV status

CI- confidence interval, chi-squared P-value is shown and P-values < 0.05 are in boldface font

the policy for breastfeeding counselling, including placing the baby on the breast during the first hour of birth, was emphasized in the follow-up revised 2019 guidelines [28]. Surprisingly, MLHIV in HIV discordant relationships were more likely to breastfeed beyond 6 months compared to concordant couples. Reasons for the differences may include the differences in the effort discordant couples may put in to understand the best breastfeeding practices for the child or a perceived high risk of VHT through breastfeeding among the HIV concordant couples. This association also emphasizes on the urgency of making sure all pregnant and breastfeeding women know their partner's HIV status and partner engagement in care is supported [42].

Having a quarter of HEs exposed to mixed feeding as early as the first 3-months of life is concerning and further investigations are required to ensure that it does not outweigh the benefits of breastfeeding [34]. Our study findings are yet another reminder of an extensively studied topic of EBF which is not easy to translate into practice. Several factors have contributed to challenges to implement EBF, especially among HEs. A review by Nieuwoudt S et al. highlighted the ripple effect of the changes in breastfeeding policy in the past two decades on low rates of EBF [43]. However, given the WHO recommendations in 2010, the mixed messaging should have been redressed by now. Improvement in indicator definitions when designing research studies is also needed, to better track changes over time. Some studies have reported breastfeeding for the first 3 months only, others for 4 to 6 months, whilst others have measured the first six months. Additionally, health care workers are among the main sources of information on breastfeeding among mothers, hence periodic knowledge surveys and training on guidelines and messages is needed [44]. The effectiveness of training health care workers to improve EBF was demonstrated in a Zimbabwean trial, where the prevalence of EBF was higher among mothers who were taught by trained healthcare workers [45]. An alternative and complementary source of information on breastfeed-ing are family members, especially grandmothers, whose cultural practices are deeply rooted in mixed feeding, hence their influence should be investigated [34].

#### Strengths and limitations

Our study details breastfeeding practices among HEs and HUs, cross-sectionally across different milestones of the first two years of life. It provides data on infant feeding practices after implementation of the WHO guidelines for continued breastfeeding as far as 24 months regardless of HIV status. However, the study had some limitations. Firstly, the study sample size was not designed around infant feeding as a primary outcome and was underpowered for the outcomes reported here. The final sample size used was smaller than that required for 80% power at district-level external validity. This made the results more exploratory than confirmatory and should be interpreted as related to the recruited sample and not the district setting at large. However, the purposive recruitment of HUs at >3 months to 6 months and >12 to 24 months of age allowed for descriptive comparisons of long-term EBF and breastfeeding beyond 12 months. The feeding practices in this study were based on selfreported data, which can be susceptible to response bias.

#### Recommendations

There is a need for periodic surveys on breastfeeding practices, policy knowledge among health service **Table 4** Distribution of baseline characteristics in MLHIV and HIV negative mothers with infants aged 4–6 months and with infants aged 12–24 months

Baseline Characteristics	Mothers with infants aged > 3 to 6 months			Mothers with infants aged > 12 to 24 months		
	MLHIV ( <i>N</i> =78)	HIV Negative mothers ( <i>N</i> = 89)	Chi-squared P value	MLHIV (N=131)	HIV Negative mothers (N=202)	Chi- squared
Maternal age years			< 0.001			
15–24	13 (16.67)	45 (50 56)		22 (16 79)	87 (43 07)	
25-34	49 (62 82)	31 (34.83)		68 (51 91)	81 (40 10)	
35-49	16 (20 51)	13 (14 61)		41 (31 30)	34 (16.83)	
Gestational age at birth, weeks	10 (2000 1)	10 (1 101)	0.630	(31.30)	51(10.05)	0.800
< 37 weeks	7 (8.97)	10 (11.24)		25 (12.38)	15 (11.45)	
≥ 37 weeks	71 (91.03)	79 (88.76)		177 (87.62)	116 (88.55)	
Infant birth weight, kg	(		0.230			0.398
<2.5	4 (5.13)	9 (10.11)		14 (10.69)	16 (7.92)	
≥2.5	74 (94.87)	80 (89.89)		117 (89.31)	186 (92.08)	
Maternal BMI			0.427			0.699
Underweight	3 (3.85)	9 (10.11)		8 (6.11)	10 (4.95)	
Normal	31 (39.74)	31 (34.83)		54 (41.22)	84 (41.58)	
Overweight	23 (29.49)	28 (31.46)		28 (21.37)	53 (26.24)	
Obesity	21 (26.92)	21 (23.60)		41 (31.30)	55 (27.23)	
Education*			0.861			0.037
≤ Secondary	65 (84.42)	76 (85.39)		123 (94.62)	171 (87.69)	
Tertiary	12 (15.58)	13 (14.61)		7 (5.38)	24 (12.31)	
Marital status			0.738			0.005
Married/living with partner	30 (38.46)	32 (35.96)		62 (47.69)	65 (32.18)	
Not married	48 (61.54)	57 (64.04)		68 (52.31)	137(67.82)	
Income source			0.030			0.361
Employed	25 (32.05)	19 (21.35)		32 (24.62)	48 (23.76)	
Dependent	27 (34.62)	49 (55.06)		63 (48.46)	112 (55.45)	
Government grant	26 (33.33)	21 (23.60)		35 (26.92)	42 (20.79)	
Household gross income			0.181			0.731
> R3200	42 (53.85)	57 (64.04)		78 (60.0)	125 (61.88)	
< R3200/none	36 (46.15)	32 (35.96)		52 (40.0)	77 (38.12)	
Partner's HIV status			< 0.001			< 0.001
Positive	39 (50.0)	1 (1.12)		66 (50.38)	5 (2.48)	
Negative	15 (19.23)	62 (69.66)		25 (19.08)	147 (72.77)	
Unknown	24 (30.77)	26 (29.21)		40 (30.53)	50 (24.75)	
Gestation at ANC-1 visit *			0.177			0.322
≤12 weeks	60 (76.92)	58 (67.44)		92 (70.23)	130 (65.0)	
>12 weeks	18 (23.08)	28 (32.56)		39 (29.77)	70 (35.0)	
Number of ANC visits*			0.090			0.057
0–4 visits	13 (21.67)	24(35.29)		51 (31.29)	51 (22.67)	
5–12 visits	47 (78.33)	44 (64.71)		112 (68.71)	174 (77.33)	

MLHIV- mothers living with HIV, ANC- antenatal care, BMI-body mass index, \*variables have missing data for  $n \le 3$ 

providers, re-training for consistent messaging on breastfeeding and extensive awareness campaigns on changes of guidelines. Future studies should focus on knowledge translation research in the field for all healthcare providers including community outreach teams and mothers regardless of HIV status, whilst still considering differences in barriers and/or facilitators due to HIV status and the role of male partners and influence of family and cultural feeding influences.

### Conclusions

Even though the odds of EBF and breastfeeding beyond 12 months differed significantly by infant HIV exposure, both feeding practices were generally low across all infants in this study population. In this study population, EBF was comparably more likely among HEs while breastfeeding beyond 12 months was more likely among HUs. Maternal marital status, frequency of antenatal care attendance and male partner's HIV status also influenced

Table 5	Factors associated with exclusive breastfeeding at > 3–6 months and breastfeeding at > 12–24	months, using log binomial
regressio	n	

Variable	EBF > 3–6 months	BF > 12–24 months
	Adjusted Prevalence Ratio (95% CI), $N = 167$	Adjusted Prevalence Ratio (95% CI), N=333
Maternal HIV status Negative Positive	Ref <b>3.84 (1.55, 9.53)</b>	Ref <b>0.42 (0.27</b> , <b>0.63)</b>
Income source Employed Dependent Government grant	1.41 (0.77, 2.59) Ref Not fitted	1.14 (0.88, 1.47) Ref <i>Not fitted</i>
Partner HIV status Positive Negative Don't know	1.18 (0.74, 1.89) Ref Not fitted	0.99 (0.77, 1.27) Ref Not fitted
Maternal education ≤ Secondary Tertiary education	Ref 0.98 (0.34, 2.78)	Ref 0.75 (0.41, 1.34)
Maternal age 15-24years > 24 years	Ref 1.00 (0.41, 2.45)	Ref 1.23 (0.83, 1.80)
Marital status Married/living with partner Not married	Ref 1.07 (0.42, 2.23)	Ref <b>0.66 (0.47</b> , <b>0.92)</b>

EBF- exclusive breastfeeding, BF- breastfeeding, CI- confidence interval, significant confidence intervals are in boldface font

**Table 6** Factors associated with exclusive breastfeeding in HIV

 exposed infants 0–6 months, using log binomial regression

Variable	EBF Prevalence	Variable Maternal age 15–24 years	
	Ratio (95% CI),		
	N=217		
Maternal age		>24 years	
15–24 years	Ref	Timing of first antenatal	
>24 years	1.27 (0.72, 2.25)	<12 weeks	
Timing of first antenatal visit		>12 weeks	
<12 weeks	Ref	Source of income	
>12 weeks	1.13 (0.74, 1.73)	Employed	
Source of income		Dependent	
Employed	Ref	Government grant	
Dependent	1.22 (0.74, 2.0)	Maternal education	
Government grant	1.56 (0.94, 2.58)	≤ secondary education	
Maternal education		Tertiary education	
≤ secondary education	Ref	Antenatal visits	
Tertiary education	0.77 (0.40, 1.51)	0–4	
Number of antenatal visits		5–12	
0–4	Ref	Monthly income	
5–12	0.62 (0.41, 0.93)	> R3.200	
Monthly income		< R3,200	
> R3,200	Ref	Partner HIV status	
< R3,200	0.99 (0.67, 1.45)	Positive	
Partner HIV status		Negative	
Positive	Ref	Don't know	
Negative	1.14 (0.65, 2.0)	Marital status	
Don't know	1.18 (0.77, 1.82)	Married/living with p	
Marital status		Not married	
Married/living with partner	Ref	CI- confidence interval, B	
Not married	0.99 (0.66, 1.49)	in boldface font	

**Table 7** Factors associated with breastfeeding in HIV exposed infants at > 6 to 24 months, using log binomial regression

Variable	BF Prevalence Ratio (95% CI), N = 263		
Maternal age			
15–24 years	Ref		
>24 years	1.66 (0.86, 3.20)		
Timing of first antenatal visit			
<12 weeks	Ref		
>12 weeks	1.26 (0.86, 1.86)		
Source of income			
Employed	Ref		
Dependent	1.53 (0.87, 2.71)		
Government grant	1.69 (0.93, 3.06)		
Maternal education			
≤ secondary education	Ref		
Tertiary education	1.01 (0.47, 2.17)		
Antenatal visits			
0–4	Ref		
5–12	0.83 (0.55, 1.24)		
Monthly income			
> R3,200	Ref		
< R3,200	0.71 (0.47, 1.07)		
Partner HIV status			
Positive	Ref		
Negative	1.70 (1.06, 2.71)		
Don't know	1.56 (1.00, 2.43)		
Marital status			
Married/living with partner	Ref		
Not married	0.74 (0.50, 1.08)		

CI- confidence interval, BF breastfeeding, significant confidence intervals are in boldface font

CI- confidence interval, significant confidence intervals are in boldface font

breastfeeding practice. Overall, there is still room for improvement regardless of infant HIV status. Periodic review of the implementation of policies for promoting EBF and breastfeeding beyond 12 months in the current context of extended coverage of infant postnatal prophylaxis should be considered. Initiatives to strengthen and sustain the recommended feeding practices, while being sensitive to differences in the barriers and/or facilitators associated with clients' HIV status, need to continue.

#### List of Abbreviations

ANC	Antenatal Care
ART	Antiretroviral Therapy
aRR	Adjusted Risk Ratio
BMI	Body Mass Index
CI	Confidence Interval
EBF	Exclusive breastfeeding
HEs	HIV exposed infants
HIV	Human Immunodeficiency Virus
HUs	HIV unexposed infants
MLHIV	Mothers living with HIV
PVHT	Prevention of VHT
UNAIDS	The Joint United Nations Programme on HIV/AIDS
VHT	Vertical HIV Transmission
WHO	World Health Organization

#### **Supplementary Information**

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Additional file 1

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#### Author contributions

Primary study design, conceptualization and implementation: AG, AJP, CW, NKN, PVP, TM, TT. Detailed analysis design and plan for the presented data VTM, NKN, MZ. Data analyses VTM, TEM, NKN and MZ. First draft VTM, NKN. All authors reviewed the subsequent drafts and gave approval of the final version.

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#### Data availability

The data are available upon request from the corresponding author.

#### Declarations

#### Ethics approval and consent to participate

Ethics Approval was obtained from the South African Medical Research Council ethics committee in 2019 for the baseline study (EC002-2/2019) and the Regional Committee for Medical and Health Research Ethics West, Norway (REK-Vest no 2019/773). Complete informed signed consent was obtained from eligible women before being interviewed, during the baseline study. The consent process included permission to contact participants for future studies and secondary data analysis.

#### **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

#### Author details

<sup>1</sup>Division of Epidemiology and Biostatistics, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa <sup>2</sup>HIV and other Infectious Diseases Research Unit, South African Medical Research Council, Cape Town, South Africa

<sup>3</sup>Blizard Institute, Queen Mary University of London, London, UK <sup>4</sup>Zvitambo Institute for Maternal and Child Health Research, Harare, Zimbabwe

<sup>5</sup>Centre for International Health, Dept of Global Public Health and Primary Care, University of Bergen, Bergen, Norway

<sup>6</sup>Pathogenesis and Control of Chronic and Emerging Infections, Montpellier University, INSERM, EFS, CHU Montpellier, Montpellier, France <sup>7</sup>Dept of Paediatrics and Child Health, University of Pretoria, Pretoria, South Africa

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