Maternal and Child Health Journal (2019) 23:1308–1316
https://doi.org/10.1007/s10995-019-02760-1

ORIGINAL RESEARCH

Breastfeeding Support Offered at Delivery is Associated with Higher Prevalence of Exclusive Breastfeeding at 6 Weeks Postpartum Among HIV Exposed Infants: A Cross-Sectional Analysis

Christian Mpody[1] · Travis Reline[2] · Noro Lantoniaina Rosa Ravelomanana[3] · Bienvenu Kawende[3] · Emile W. Okitolonda[3] · Frieda Behets[4] · Marcel Yotebieng[1]

Published online: 18 June 2019

Abstract

Objective HIV-exposed uninfected infants are almost twice as likely to die compared to infants born to HIV-uninfected women. HIV-exposed uninfected children whose mothers are on ART and who are breastfed have the lowest risk of dying by 24 months of age. Interventions to improve breastfeeding among HIV-infected mothers are needed. We aimed to assess the association between support/counseling provided by healthcare workers following delivery and the rate of exclusive breastfeeding (EBF) at 6-week postpartum. *Methods* This is a secondary analysis of data collected as part of a trial to evaluate the effect of conditional cash transfers on retention in and uptake of PMTCT services. Between April 2013 and August 2014, newly diagnosed HIV-infected women, ≤ 32 weeks pregnant, registering for antenatal care (ANC), in 89 clinics in Kinshasa, Democratic Republic of Congo, were recruited and followed through 6 weeks postpartum. At 6-week, participants were asked if they had given anything other than breastmilk to their infant in the 24 h preceding the interview (No = EBF) and whether a nurse or a doctor talked to them about breastfeeding after they gave birth (YES = received breastfeeding support/counseling). Logistic regression was used to estimate the odds ratios (OR) and 95% confidence intervals (CI) measuring the strength of the association between EBF and receiving breastfeeding support/counseling by a healthcare provider following delivery. *Results* Of 433 women enrolled, 328 attended a 6-week postpartum visit including 320 (97%) with complete information on EBF. Of those 320, 202 (63%) reported giving nothing other than breastmilk to their infant in the previous 24 h; 252 (79%) reported that a healthcare provider came to talk to them about breastfeeding following delivery. Mothers who reported receiveing breastfeeding support/counseling from a healthcare provider were more likely to exclusively breastfeed compared to those who did not (69% vs. 38%, OR 3.74; 95% CI 2.14–6.54). Adjustment for baseline sociodemographic characteristics did not change the association substantially, (adjusted OR 3.72; 95% CI 2.06–6.71). *Conclusion for Practice* Receipt of breastfeeding support/counseling from a healthcare provider after delivery among HIV-infected mothers in care at 6-weeks postpartum in Kinshasa almost quadrupled the odds of EBF.

Keywords Breastfeeding counseling · 6 weeks postpartum · Exclusive breastfeeding · Healthcare worker

✉ Christian Mpody
mpody.1@osu.edu

Travis Reline
relinetg@gmail.com

Noro Lantoniaina Rosa Ravelomanana
norolantoniaina@gmail.com

Bienvenu Kawende
bienvenukawende@yahoo.fr

Emile W. Okitolonda
okitow@yahoo.fr

Frieda Behets
frieda_behets@unc.edu

Marcel Yotebieng
yotebieng.2@osu.edu

[1] Division of Epidemiology, College of Public Health, The Ohio State University, Columbus, OH, USA

[2] Carter Center, Atlanta, GA, USA

[3] School of Public Health, University of Kinshasa, Kinshasa, Democratic Republic of the Congo

[4] Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Significance

Children born to HIV positive mothers have the lowest risk of dying by 24 months of age when they are exclusively breastfed and their mother are taking antiretroviral therapy (Arikawa et al. 2017). Exclusive breastfeeding also reduces the risk of vertical transmission of HIV from mother to the infant, compared to mixed feeding. In addition, the long-term benefits of exclusive breastfeeding include the reduction of 5 years mortality and morbidity (Black et al. 2008; Edmond et al. 2006; Jones et al. 2003), optimal growth and development (Kramer et al. 2008; Victora et al. 2015). These findings reveal that women who received breastfeeding from a healthcare worker after delivery had almost four times the odds of exclusively breastfeeding by six-week post-partum.

Introduction

HIV exposed uninfected (HEU) infants are almost twice as likely to die compared to infants born to HIV-uninfected women (Brahmbhatt et al. 2006; Newell et al. 2004; Zaba et al. 2005). Optimal breastfeeding practices, including breastfeeding initiation within 1 h of birth, exclusive breastfeeding (EBF) with no additional fluid or food for 6 months, and continuation of breastfeeding thereafter up to 24 months and beyond with age-appropriate complementary feeding (WHO 2001), reduce under 5 years mortality rate (Black et al. 2008; Edmond et al. 2006; Jones et al. 2003). A recent pooled analysis showed that HEU children whose mothers were breastfeeding and on antiretroviral therapy (ART) had the lowest risk of dying by 24 months of age (Arikawa et al. 2017). In addition, EBF is associated with lower risk of vertical transmission compared to mixed-feeding (giving other liquids and/or foods together with breast milk) (Iliff et al. 2005). Since 2010, the World Health Organization (WHO) has recommended that mothers living with HIV should exclusively breastfeed for at least 12 months and may continue breastfeeding for up to 24 months or longer (similar to the general population) while being fully supported for ART adherence (Hsu et al. 2015).

Recent reports on breastfeeding practices among women living with HIV showed very low prevalence of exclusive breastfeeding across countries in sub-Saharan Africa. A hospital based survey in Tanzania found that only 34.2% and 13.3% of HIV-positive mothers exclusively breastfed at 4 and 6 months, respectively (Young et al. 2010). In Zambia, a survey of HIV positive mothers of infants aged 3–9 months found that 37% were exclusively breastfeeding (Hampanda, 2016). In a hospital based survey of 600 HIV-positive mothers of infants aged 6 weeks to 12 months in Nigeria, the prevalence of EBF and formula feeding were 61% and 26%, respectively (Aishat et al. 2015). A similar study in Cameroon reported that 25% and 75% of HIV-positive mothers practiced EBF and formula feeding respectively at 2-months post-partum (Nlend and Ekani 2014).

HIV positive mothers are more likely to choose recommended feeding (EBF) if they received prenatal or postnatal infant feeding support and counseling (Genetu et al. 2017; Ikeako et al. 2015; Mekuria and Edris 2015), disclosed their HIV status (Ikeako et al. 2015; Muluye et al. 2012), or are married (Muluye et al. 2012). In addition, mother's perception of inadequacy of breastmilk for child's growth (Maonga et al. 2016), having a male infant (Okanda et al. 2014), or experiencing emotional and sexual violence (Hampanda 2016) are known predictors of sub-optimal feeding practices. Other predictors of infant feeding choices include lack of resource (Chisenga et al. 2011; Muluye et al. 2012), partner's involvement in HIV counseling (Farquhar et al. 2001), and partner's attitudes towards infant feeding (Mataya et al. 2013). Findings from randomized trials showed that training health-care professionals to provide breastfeeding support increases the proportion of exclusive breastfeeding (McFadden et al. 2017; Yotebieng et al. 2015).

Most of these studies included a very heterogeneous group of infants with ages varying from 6 weeks to 12 months, making results difficult to interpret. In addition, the immediate period following delivery is critical to establish optimal feeding practices in that concerns about breastfeeding that arise in the first weeks after hospital discharge are the strongest predictors of cessation of exclusive, or all, breastfeeding (Wagner et al. 2013). Yet, there are few studies, and none in Kinshasa, that have assessed the effect of counseling provided by healthcare worker to HIV-infected women in the first week following delivery on proportion of exclusive breastfeeding. Therefore, the aims of this manuscript were to: (1) assess infant feeding practices and (2) determine the effect of breastfeeding support provided by healthcare workers after delivery on the proportion of exclusive breastfeeding at 6 weeks postpartum among HIV-infected women receiving PMTCT services in Kinshasa, Democratic Republic of Congo (DRC).

Methods

Study Design, Study Population and Data Collection

We performed a cross-sectional analysis of data obtained from a randomized controlled trial that was conducted across 89 maternal and child health care facilities in Kinshasa, DRC

(NCT01838005). Details of the randomized controlled trial procedures are reported elsewhere (Yotebieng et al. 2016). Briefly, it was designed to assess the effect of small and increasing cash incentives, conditioned on attending scheduled clinic visits and receiving the available PMTCT services, on retention at 6 weeks post-partum. Between April 2013 and August 2014, all newly diagnosed HIV-infected women, irrespective of parity, ≤ 32 weeks pregnant, attending ANC at one of the 89 clinics were eligible to participate. Potential participants were excluded if they were severely ill, did not intend to remain in Kinshasa through at least 6 weeks postpartum, refused to participate, or did not speak French or Lingala (the common languages in Kinshasa) (Yotebieng et al. 2016). This study was approved by the Institutional Review Board at the Ohio State University and the Kinshasa School of Public Health Ethical Committee.

During their first follow-up visit after ANC registration (generally between 2 weeks and 1 month after ANC registration), eligible women provided informed consent to a study nurse who was not part of the health facility's care-providing team. Women who agreed to be part of the study were interviewed to collect information on socio-demographic characteristics and obstetrical history among other information. Women were followed up to 6 weeks post-partum at which point they were also interviewed on information about infant feeding practices, breastfeeding counseling and other educational information received during antenatal care visits or after delivery. Only women with available information at 6-weeks postpartum were included in this analysis.

Variables

The primary outcome considered in this analysis was infant feeding practices at 6 weeks postpartum categorized as exclusive breastfeeding (EBF) or not. At the 6-week postpartum visit, participants were asked the following question: "Was (name the infant) given anything to drink other than breast milk yesterday or last night?". Women who responded "no" were classified as exclusively breastfeeding. Women who responded "yes" were asked a follow-up question: "What was (name the infant) given to drink?". Response options included: milk (other than breast milk), plain water, sugar or glucose water, anti-colic, sugar-salt-water solution, fruit juice, tea/infusion, honey, formula, and other (specify). Women who reported feeding non-breastmilk to their infant were also asked the following question: "Why did you decide to give (name of the drink) to the baby?". The main exposure was receipt of breastfeeding support and/or education from a healthcare provider following delivery. The variable was elicited at 6 weeks postpartum from the following question: "After delivery did a nurse or doctor come to discuss with you how to do exclusive breastfeeding (Yes or No)?".

Covariates considered in our analysis included factors that may affect both the exposure and the outcome of interest. All non-continuous variables were categorized in conformity with a previous manuscript (Yotebieng et al. 2016). These covariates include: maternal age categorized as < 25, 25–29, 30–34, and 35 + years; completed years of education (≤ 10 and > 10 years); marital status (married/cohabiting or never married/separated/divorced); primiparity (Yes or No), disclosed HIV status to partner (Yes or No), experienced any intimate partner violence (sexual, emotional or physical) within the past 12 months prior to enrollment into the study (Yes or No), social support index (low, high), and wealth index.

Intimate partner violence (IPV) was measured at the enrollment survey with the following three questions: "Have you ever been insulted, humiliated, or made to feel afraid by an intimate partner?" (emotional IPV), "Have you ever been hit, punched, kicked, slapped, choked, or otherwise physically hurt by an intimate partner?" (physical IPV), and "Have you ever been forced to have sex or do something sexual you didn't want to do? (sexual IPV). The social support index was created from a 10-item questionnaire which elicited information including the type and extent of perceived social support from family and friends. Response categories included "strongly disagree", "disagree", "not sure", "agree" and "strongly agree". The score 0 was assigned to "disagree", "strongly disagree" or "not sure", and 1 was assigned to "agree" or "strongly agree". The social support index was then calculated by summing the scores obtained from each of the 10 items (range 0–10, Cronbach alpha = 0.75) and categorized in two groups: < 50th Percentile, and ≥ 50th Percentile. Wealth index score was calculated using principal component analysis and 11 variables: home ownership, the average number of household members per room, water source, toilet facility type, cooking fuel type, maternal education, and ownership status of durable assets (radio, television, mobile telephone, and refrigerator). The score was categorized in three groups: the lower first two quintiles, the middle quintile, and the last two quintiles.

Statistical Analysis

Infant feeding modalities reported by participants were summarized using proportions. Bivariate and multivariable logistic regression were used to estimate the unadjusted and adjusted odds ratios and 95% confidence intervals (CI) measuring the strength of the association between receipt of breastfeeding support/education from a healthcare worker following delivery and exclusive breastfeeding at 6 weeks postpartum. Adjusted models controlled for age, marital status, year of education, wealth index, primiparity, HIV disclosure, and experience of any intimate partner violence. We checked and did not find

evidence of multicollinearity by computing the variance inflation factor. All analyses were performed using SAS 9.4 software (SAS Institute Inc., Cary, NC, USA).

Results

Study Population Characteristics

Of the 433 women enrolled in the parent study, 328 returned for the 6-week postpartum visit of whom 320 completed the 6-week interview and were included in this analysis. At enrollment, 21.6% (69/320) of the women were between 16 and 24 years of age; 32% (102/320), 24.1% (77/320), and 22.3% (71/320), were between 25–29, 30–34, and 35 years or older, respectively (Table 1). Over half of them (53.4%; 171/320) had 10 or less years of education; 58% (185/320) were married or cohabitating; and 12.9% (41/320) were primiparous. Most women (57.1%, 182/320) reported being unemployed. Over 87% (280/320) had not disclosed their HIV status to their partner and 57.7% (184/320) reported having experienced at least one type of intimate partner violence.

Infant Feeding Practice

At 6-weeks postpartum, 63.1% (202/320) of mothers reported solely providing breastmilk to their infants (EBF) in the 24 h preceding the interview. In addition, 14.4% (46/320) were formula feeding, and 22.5% (72/320) were mixing breastmilk with other liquids (Fig. 1). Of the 72 mothers who were mixing breastmilk with other liquids, 80.6% (58/72) gave plain water, 5.6% (4/72) gave sugar or honey, and 34.7% (25/72) gave other fluids such as juice or tea/infusion.

Reasons for Giving Something Other Than Breastmilk to Infant at 6 weeks

Among the 46 women who reported giving formula to their infants, only 3 (6.5%) reported doing so to prevent the child from getting HIV and 9 (19.6%) because the mother was not well (Table 2). We received 85 reasons from mothers who gave other liquids (water, sugar water, tea and/or juice) but not formula to their infants. The main reasons for doing so were: (1) hot weather ("it was hot in the hospital", "it was hot in the neonatology unit", "it was hot"), 30.6% (n = 26); (2) baby crying a lot, 25.9% (n = 22), and (3) baby constipation/sickness, 20.0% (n = 17).

Table 1 Characteristics of mothers living with HIV measured at 6 weeks post-partum

	Frequency (N = 320)	Percent %[a]
Maternal support on EBF at delivery[b]		
Not received	68	(21.3)
Received	252	(78.8)
Age (in years)		
16–24	69	(21.6)
25–29	102	(32.0)
30–34	77	(24.1)
35+	71	(22.3)
HIV disclosure to partner		
No	280	(87.8)
Yes	39	(12.2)
Any IPV[c]		
Yes	184	(57.7)
No	135	(42.3)
Employment		
No	182	(57.1)
Yes	137	(43.0)
Marital status		
Divorced/separated/widow/never married	134	(42.0)
Married/cohabitating	185	(58.0)
Wealth index[d]		
Lower (poorest)	129	(40.4)
Middle	125	(39.2)
Upper (richest)	65	(20.4)
Maternal years of education		
≤ 10 years	171	(53.4)
> 10 years	149	(46.6)
Primiparity		
No	278	(87.2)
Yes	41	(12.9)
Social support[e]		
Low	63	(42.3)
High	86	(57.7)

All data were derived from the conditional cash transfer (CCT), a randomized controlled trial by Yotebieng et al. conducted in 2013 in Kinshasa, the Democratic Republic of Congo. Our analytic sample included CCT participants that were retained in care at 6 weeks post-partum

MF mixed feeding, *FF* formula feeding, *EBF* exclusive breastfeeding, *IPV* intimate partner violence

[a]Column percents

[b]Receipt of breastfeeding support and/or education from a healthcare provider following delivery

[c]Self-report of emotional or physical or sexual partner violence

[d]Calculated using principal component analysis and categorized in three groups: the lower first two quintiles, the middle quintile, and the last two quintiles

[e]Elicited information including the type and extent of perceived social support from family and friends

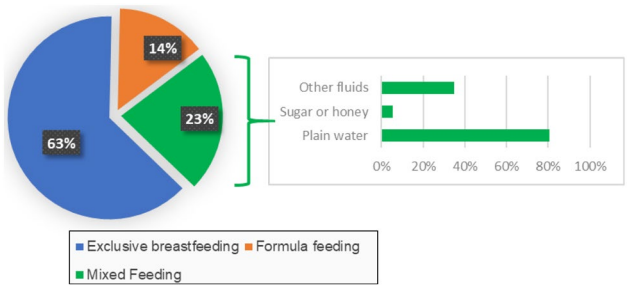

Fig. 1 Feeding practices at 6 weeks (Color figure online)

Receiving Exclusive Breastfeeding Support/ Education from a Healthcare Worker After Delivery and Exclusive Breastfeeding

At 6-week postpartum interview, 79.7% (255/320) of participants reported to have received breastfeeding support after delivery. In bivariate analysis, mothers who received breastfeeding counseling were more likely to exclusively breastfeeding at 6 weeks postpartum compared to mothers who were not counseled (69.5% vs. 47.9%; OR 3.74, 95% CI 2.14–6.54) (Table 3). Adjustment for age, marital status, year of education, wealth index, primiparity, HIV disclosure, and experience of any intimate partner violence did not change the result (aOR 3.72, 95% CI 2.06–6.71).

Discussion

The aims of this study were to assess: (1) infant feeding practices at 6-weeks postpartum in a cohort of women living with HIV and (2) whether the receipt of breastfeeding counseling/support from a healthcare provider following delivery was associated with improved proportion of EBF. Our results showed that less than two-third of mothers were exclusively breastfeeding at 6 weeks postpartum and of the remaining only three reported giving formula to avoid vertical transmission (possibly indicating exclusive formula feeding). In multivariable analysis, the strongest predictor of EBF was receiving counseling on how to exclusively breastfeed after delivery (aOR 3.72, 95% CI 2.06–6.71).

The prevalence of EBF at 6 weeks (63%) in this population was greater than the prevalence we recently reported (51%) in the same setting among HIV-uninfected women (Zivich et al. 2018), probably due to PMTCT education that is part of routine services for these women during antenatal care. Contrary to what has been generally reported (Gatti 2008; Li et al. 2008; Maonga et al. 2016), the main reason for supplementation in this setting was not women's perception of inssuficient milk supply or inadequacy of breastmilk. A quarter of mothers supplemented breastmilk because their infants were "crying a

Table 2 Reasons for feeding practices reported at 6 weeks post-partum by HIV positive mothers in Kinshasa 2013

Type of non-breastmilk liquid and main reasons[a]	Frequency
Formula feeding	46
Breastmilk insufficient: *"no milk secretion", " I do not have enough breastmilk"*	12
Baby crying a lot	7
Mother was unwell	9
Baby's perceived illness: *"the baby was constipated", " the baby was sick"*	4
Mother's employment: *"because I had go get back to work"*	2
To prevent the baby from catching HIV	3
Other	9
Other liquids (water, sugar water, tea, juice)	85
Hot weather: *"it was hot in the hospital" " it was hot in the neonatology unit" " it was hot"*	26
Baby crying a lot	22
Baby's perceived illness: *"the baby was constipated", " the baby was sick"*	17
Family pressure: *"because of my mother in law", " following the demand of the baby's father"*	6
Breastmilk insufficient: *"no milk secretion", " I do not have enough breastmilk"*	5
Cultural belief: *"the breastmilk is hot"*	2
Mother was unwell	1
Other	6

All data were derived from the conditional cash transfer (CCT), a randomized controlled trial by Yotebieng et al. conducted 2013 in Kinshasa, the Democratic Republic of Congo. Our analytic sample included CCT participants that were retained in care at 6 weeks post-partum

[a]Responses were ascertained by the following open-ended question: Why did you decide to give (name of the drink) to the baby? (report the reason for each drink given to the baby)

Table 3 Maternal support on EBF post-delivery and exclusive breastfeeding at 6 weeks post partum among HIV positve mothers in Kinshasa[a]

Variables	Total[b]	Exclusive breast-feeding (N = 202)		Bivariate analysis		Multivariable analysis[d]	
		n	%[c]	OR	95% CI	OR	95% CI
Maternal support on EBF post-delivery[f]							
Not received	94	45	(47.9)	1.00		1.00	
Received	226	157	(69.5)	3.74	(2.14, 6.54)	3.72	(2.06, 6.71)
Age in years							
16–24	69	44	(63.8)	1.00		1.00	
25–29	102	58	(56.9)	0.75	(0.40, 1.40)	0.73	(0.36, 1.46)
30–34	77	52	(67.5)	1.18	(0.60, 2.34)	1.00	(0.46, 2.19)
35+	71	47	(66.2)	1.11	(0.56, 2.23)	1.02	(0.46, 2.26)
HIV disclosure to partner							
No	280	174	(62.1)	1.00		1.00	
Yes	39	27	(69.2)	1.37	(0.67, 2.82)	1.26	(0.58, 2.73)
Any IPV[e]							
Yes	184	115	(62.5)	1.00		1.00	
No	135	86	(63.7)	0.95	(0.82, 2.36)	0.92	(0.56, 1.51)
Employment							
No	182	116	(63.7)	1.00		1.00	
Yes	137	85	(62.0)	0.93	(0.59, 1.47)	0.98	(0.59, 1.63)
Marital status							
Other[g]	134	76	(56.7)	1.00		1.00	
Married/cohabitating	185	125	(67.6)	1.59	(1.00, 2.52)	1.81	(1.06, 3.08)
Wealth tertile							
Lower (poorest)	129	78	(60.5)	1.00		1.00	
Middle	125	89	(71.2)	1.65	(0.96, 2.73)	1.38	(0.75, 2.62)
Upper (richest)	65	34	(52.3)	0.72	(0.39, 1.31)	0.62	(0.29, 1.33)
Years of education							
≤ 10 years	171	112	(65.5)	1.00		1.00	
> 10 years	149	90	(60.4)	0.80	(0.51, 1.27)	0.75	(0.41, 1.35)
Primiparity							
No	278	176	(63.3)	1.00		1.00	
Yes	41	25	(61.0)	0.83	(0.50, 1.37)	1.08	(0.40, 2.87)

OR odds ratio, *CI* confidence interval, *IPV* intimate partner violence

[a]Odds ratios and their 95% confidence intervals were obtained using logistic regression models. All data were derived from the conditional cash transfer (CCT), a randomized controlled trial by Yotebieng et al. conducted in 2013 in Kinshasa, the Democratic Republic of Congo. Our analytic sample included CCT participants that were retained in care at 6 weeks post-partum

[b]Only participants with available data on feeding patterns were considered in the models, and stratified frequencies may not add to N because of missing data

[c]Row percents

[d]Adjusted for all covariates in the table

[e]Receipt of breastfeeding support and/or education from a healthcare provider following delivery

[f]Calculated using principal component analysis and categorized in three groups: the lower first two quintiles, the middle quintile, and the last two quintiles

[g]Self report of emotional or physical or sexual partner violence

lot" and over 80% were doing so because it was hot. Our group identified similar reasons among non HIV-infected women from the same settings (Yotebieng et al. 2013). Our group also found that adequate feeding counseling and support modified these practices of supplementing breastmilk with water and other liquids (Yotebieng et al. 2013, 2015). Therefore, it is not surprising that mothers who were supported on breastfeeding practices by healthcare

workers were less likely to engage in sub-optimal feeding practices. The effect size of receiving breastfeeding support (relative to not receiving breastfeeding support) on exclusive breastfeeding was similar to the one we observed in the same setting, in a trial evaluating the effect of training healthcare workers to provide antenatal breastfeeding support (Yotebieng et al. 2015).

To our knowledge, this study is the first to quantitatively assess whether receipt of breastfeeding support/counseling following delivery in a context of high breastfeeding initiation is associated with improved frequency of exclusive breastfeeding in a population of HIV-infected women in Kinshasa. Concerns about breastfeeding that arise in the first weeks after hospital discharge are the strongest predictors of cessation of exclusive or all, breastfeeding (Wagner et al. 2013). While breastfeeding support is generally effective, its systematic provision in the postpartum period is still challenging (Hoddinott et al. 2009; Yonemoto et al. 2013). In low-resource settings, the first follow-up visit after delivery occurs at 6 weeks, which might be quite late to prevent sub-optimal practices like water supplementation. At this point, any pressure to change such practice might not work or even backfire (Yotebieng et al. 2015).

Interpreting the results of our study should take into account some limitations. First, both exposure and outcome were self-reported. Possibly, women who were exclusively breastfeeding were better at recalling or reporting their interaction with healthcare workers following delivery. Similarly, we cannot rule out the role of social desirability that may result in overreporting of exclusive breastfeeding among women who received counseling. Furthermore, assessment of feeding practices was based on 24-h recall and may be vulnerable to over-reporting (Yotebieng et al. 2015; Zivich et al. 2018). Second, only women seen at 6 weeks postpartum were eligible for this study. About 10% of the original sample were lost to follow-up between delivery and the 6-week visit. Possibly, women who received breastfeeding counseling after delivery may have been more likely to be retained in care. Third, our data did not contain information on the content and quality of breastfeeding counseling received by participants. However, it has been documented that not all of the participating clinics meet or is attempting to meet the standards for baby friendly hospital (Yotebieng et al. 2013, 2015). Finally, the exposure was not randomly assigned and despite the availability of data for hypothesized potential confounders, residual confounding cannot be excluded. Despite these limitations, the strong effect size observed and its consistency with findings from a previous cluster randomized controlled trial among women attending some of the same clinics suggest that bias alone cannot fully explain the observed association.

In conclusion, we found a strong association between receipt of breastfeeding counseling/support from a healthcare provider following delivery and continuation of exclusive breastfeeding at 6-weeks postpartum among HIV-infected women in Kinshasa. However, our results need to be confirmed in a prospective, preferably randomized controlled study.

Acknowledgements We are grateful to the women and infants who participated in the study. We are also grateful the personnel of the participating clinics for their time and effort. We are thankfull for the technical support of Dr. Landry Kiketa and Mrs. Martine Tabala, the data collection and data entry contributions of Josée Nlandu Babela, Valerie B. Chalachala, Fanny Matadi, Espérance Mindia, and Georges Kihuma Nganguli, and the support of the Ohio State University's, University of North Carolina's, and Kinshasa School of Public Health's administrative teams.

Funding This study was supported by a grant from the President's Emergency Plan for AIDS Relief (PEPFAR) and the National Institute of Health and Child Development: NIHCD 1R01 HD075171. MY and CM are partially supported by the National Institute of Health (NIAID U01AI096299). The funders had no role in study design, data collection, data collection, data analysis and interpretation, preparation of the manuscript, or decision to submit.

References

Aishat, U., David, D., & Olufunmilayo, F. (2015). Exclusive breastfeeding and HIV/AIDS: A crossectional survey of mothers attending prevention of mother-to-child transmission of HIV clinics in southwestern Nigeria. *Pan African Medical Journal*. https://doi.org/10.11604/pamj.2015.21.309.6498.

Arikawa, S., Rollins, N., Jourdain, G., Humphrey, J., Kourtis, A. P., Hoffman, I.,… Becquet, R. (2017). Contribution of maternal ART and breastfeeding to 24-month survival in HIV-exposed uninfected children: An individual pooled analysis of African and Asian studies. *Clinical Infectious Diseases*. https://doi.org/10.1093/cid/cix1102

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., de Onis, M., Ezzati, M., et al. (2008). Maternal and child undernutrition: Global and regional exposures and health consequences. *Lancet, 371*(9608), 243–260. https://doi.org/10.1016/S0140-6736(07)61690-0.

Brahmbhatt, H., Kigozi, G., Wabwire-Mangen, F., Serwadda, D., Lutalo, T., Nalugoda, F., et al. (2006). Mortality in HIV-infected and uninfected children of HIV-infected and uninfected mothers in rural Uganda. *Journal of Acquired Immune Deficiency Syndromes, 41*(4), 504–508. https://doi.org/10.1097/01.qai.0000188122.15493.0a.

Chisenga, M., Siame, J., Baisley, K., Kasonka, L., & Filteau, S. (2011). Determinants of infant feeding choices by Zambian mothers: A mixed quantitative and qualitative study. *Maternal and Child Nutrition, 7*(2), 148–159. https://doi.org/10.1111/j.1740-8709.2010.00264.x.

Edmond, K. M., Zandoh, C., Quigley, M. A., Amenga-Etego, S., Owusu-Agyei, S., & Kirkwood, B. R. (2006). Delayed breast-feeding initiation increases risk of neonatal mortality. *Pediatrics, 117*(3), e380–e386. https://doi.org/10.1542/peds.2005-1496.

Farquhar, C., Mbori-Ngacha, D. A., Bosire, R. K., Nduati, R. W., Kreiss, J. K., & John, G. C. (2001). Partner notification by HIV-1 seropositive pregnant women: Association with infant feeding decisions. *AIDS, 15*(6), 815–817. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/11371706, https://www.ncbi.nlm.nih.

gov/pmc/articles/PMC3358138/pdf/nihms-359815.pdf. Accessed 21 Dec 2017.

Gatti, L. (2008). Maternal perceptions of insufficient milk supply in breastfeeding. *Journal of Nursing Scholarship, 40*(4), 355–363. https://doi.org/10.1111/j.1547-5069.2008.00234.x.

Genetu, H., Yenit, M. K., & Tariku, A. (2017). Breastfeeding counseling and support are associated with continuous exclusive breastfeeding from one week to six months of age among HIV exposed infants in north Gondar zone, Ethiopia: A cross-sectional study. *International Breastfeeding Journal*. https://doi.org/10.1186/s13006-017-0113-1.

Hampanda, K. (2016). Intimate partner violence against HIV-positive women is associated with sub-optimal infant feeding practices in Lusaka, Zambia. *Maternal and Child Health Journal, 20*(12), 2599–2606. https://doi.org/10.1007/s10995-016-2087-9.

Hoddinott, P., Britten, J., Prescott, G. J., Tappin, D., Ludbrook, A., & Godden, D. J. (2009). Effectiveness of policy to provide breastfeeding groups (BIG) for pregnant and breastfeeding mothers in primary care: Cluster randomised controlled trial. *BMJ, 338,* a3026. https://doi.org/10.1136/bmj.a3026.

Hsu, Y. H., Liu, Y., Hannan, M. T., Maixner, W., Smith, S. B., Diatchenko, L.,… Jordan, J. M. (2015). Genome-wide association meta-analyses to identify common genetic variants associated with hallux valgus in Caucasian and African Americans. *Journal of Medical Genetics, 52*(11), 762-769. https://doi.org/10.1136/jmedgenet-2015-103142

Ikeako, L. C., Ezegwui, H. U., Nwafor, M. I., Nwogu-Ikojo, E., & Okeke, T. C. (2015). Infant feeding practices among HIV-positive women in Enugu, Nigeria. *British Journal of Medicine and Medical Research, 8*(1), 61–68. https://doi.org/10.9734/BJMMR/2015/16980.

Iliff, P. J., Piwoz, E. G., Tavengwa, N. V., Zunguza, C. D., Marinda, E. T., Nathoo, K. J.,… group, t. Z. s. (2005). Early exclusive breastfeeding reduces the risk of postnatal HIV-1 transmission and increases HIV-free survival. *AIDS, 19*(7), 699-708. https://doi.org/10.1097/01.aids.0000166093.16446.c9

Jones, G., Steketee, R. W., Black, R. E., Bhutta, Z. A., & Morris, S. S. (2003). How many child deaths can we prevent this year? *Lancet, 362*(9377), 65–71. https://doi.org/10.1016/S0140-6736(03)13811-1.

Kramer, M. S., Aboud, F., Mironova, E., Vanilovich, I., Platt, R. W., Matush, L.,… Shapiro, S. (2008). Breastfeeding and child cognitive development: New evidence from a large randomized trial. *Archives Of General Psychiatry, 65*(5), 578–584. https://doi.org/10.1001/archpsyc.65.5.578.

Li, R., Fein, S. B., Chen, J., & Grummer-Strawn, L. M. (2008). Why mothers stop breastfeeding: Mothers' self-reported reasons for stopping during the first year. *Pediatrics, 122*(Suppl 2), S69–S76. https://doi.org/10.1542/peds.2008-1315i.

Maonga, A. R., Mahande, M. J., Damian, J., & Msuya, S. E. (2016). Factors affecting exclusive breastfeeding among women in Muheza District Tanga Northeastern Tanzania: A mixed method community based study. *Maternal and Child Health Journal, 20*(1), 77–87. https://doi.org/10.1007/s10995-015-1805-z.

Mataya, R., Mathanga, D., Chinkhumba, J., Chibwana, A., Chikaphupha, K., & Cardiello, J. (2013). A qualitative study exploring attitudes and perceptions of HIV positive women who stopped breastfeeding at six months to prevent transmission of HIV to their children. *Malawi Medical Journal*, *25*(1), 15–9. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/23717750, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3653193/pdf/MMJ2501-0015.pdf

McFadden, A., Gavine, A., Renfrew, M. J., Wade, A., Buchanan, P., Taylor, J. L.,… MacGillivray, S. (2017). Support for healthy breastfeeding mothers with healthy term babies. *Cochrane Database System Review*, *2*, Cd001141. https://doi.org/10.1002/14651858.cd001141.pub5

Mekuria, G., & Edris, M. (2015). Exclusive breastfeeding and associated factors among mothers in Debre Markos, Northwest Ethiopia: A cross-sectional study. *International Breastfeeding Journal*. https://doi.org/10.1186/s13006-014-0027-0.

Muluye, D., Woldeyohannes, D., Gizachew, M., & Tiruneh, M. (2012). Infant feeding practice and associated factors of HIV positive mothers attending prevention of mother to child transmission and antiretroviral therapy clinics in Gondar Town health institutions, Northwest Ethiopia. *BMC Public Health*. https://doi.org/10.1186/1471-2458-12-240.

Newell, M. L., Coovadia, H., Cortina-Borja, M., Rollins, N., Gaillard, P., & Dabis, F. (2004). Mortality of infected and uninfected infants born to HIV-infected mothers in Africa: A pooled analysis. *Lancet, 364*(9441), 1236–1243. https://doi.org/10.1016/s0140-6736(04)17140-7.

Nlend, A. E., & Ekani, B. B. (2014). Trends of early infant feedings practices after counseling in infant born to HIV positive women in Yaounde, Cameroon. *Pan African Medical Journal, 17,* 282. https://doi.org/10.11604/pamj.2014.17.282.3500.

Okanda, J. O., Borkowf, C. B., Girde, S., Thomas, T. K., & Lecher, S. L. (2014). Exclusive breastfeeding among women taking HAART for PMTCT of HIV-1 in the Kisumu breastfeeding study. *Bmc Pediatrics*. https://doi.org/10.1186/1471-2431-14-280.

Victora, C. G., Horta, B. L., Loret de Mola, C., Quevedo, L., Pinheiro, R. T., Gigante, D. P.,… Barros, F. C. (2015). Association between breastfeeding and intelligence, educational attainment, and income at 30 years of age: A prospective birth cohort study from Brazil. *Lancet Global Health, 3*(4), e199–e205. https://doi.org/10.1016/s2214-109x(15)70002-1.

Wagner, E. A., Chantry, C. J., Dewey, K. G., & Nommsen-Rivers, L. A. (2013). Breastfeeding concerns at 3 and 7 days postpartum and feeding status at 2 months. *Pediatrics, 132*(4), e865–e875. https://doi.org/10.1542/peds.2013-0724.

WHO. (2001). Global strategy for infant and young child feeding, the optimal duration of exclusive breastfeeding.

Yonemoto, N., Dowswell, T., Nagai, S., & Mori, R. (2013). Schedules for home visits in the early postpartum period. *Cochrane Database System Review, 7,* Cd009326. https://doi.org/10.1002/14651858.cd009326.pub2.

Yotebieng, M., Chalachala, J. L., Labbok, M., & Behets, F. (2013). Infant feeding practices and determinants of poor breastfeeding behavior in Kinshasa, Democratic Republic of Congo: A descriptive study. *International Breastfeeding Journal, 8*(1), 11. https://doi.org/10.1186/1746-4358-8-11.

Yotebieng, M., Labbok, M., Soeters, H. M., Chalachala, J. L., Lapika, B., Vitta, B. S., et al. (2015). Ten steps to successful breastfeeding programme to promote early initiation and exclusive breastfeeding in DR Congo: A cluster-randomised controlled trial. *Lancet Global Health, 3*(9), e546–e555. https://doi.org/10.1016/S2214-109X(15)00012-1.

Yotebieng, M., Thirumurthy, H., Moracco, K. E., Kawende, B., Chalachala, J. L., Wenzi, L. K.,… Behets, F. (2016). Conditional cash transfers and uptake of and retention in prevention of mother-to-child HIV transmission care: A randomised controlled trial. *Lancet HIV, 3*(2), E85-E93. Retrieved from < Go to ISI > :// WOS:000371834700008, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5485848/pdf/nihms866282.pdf

Young, S. L., Israel-Ballard, K. A., Dantzer, E. A., Ngonyani, M. M., Nyambo, M. T., Ash, D. M., et al. (2010). Infant feeding practices among HIV-positive women in Dar es Salaam, Tanzania, indicate a need for more intensive infant feeding counselling. *Public Health Nutrition, 13*(12), 2027–2033. https://doi.org/10.1017/s1368980010001539.

Zaba, B., Whitworth, J., Marston, M., Nakiyingi, J., Ruberantwari, A., Urassa, M., et al. (2005). HIV and mortality of mothers and children: Evidence from cohort studies in Uganda, Tanzania, and Malawi. *Epidemiology, 16*(3), 275–280.

Zivich, P., Lapika, B., Behets, F., & Yotebieng, M. (2018). Implementation of steps 1–9 to successful breastfeeding reduces the frequency of mild and severe episodes of Diarrhea and respiratory tract infection among 0–6 month infants in Democratic Republic of Congo. *Maternal and Child Health Journal*. https://doi.org/10.1007/s10995-018-2446-9.