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Exploring the Determinants of Infant Feeding Practice among Mothers Living with HIV in Addis Ababa, Ethiopia

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Abstract

Exploring the Determinants of Infant Feeding Practice among Mothers Living with HIV in Addis Ababa, Ethiopia

By Meridith R. Mikulich

Background: Mother-to-child transmission (MTCT) of HIV remains a critical public health issue in Ethiopia, particularly in urban areas like Addis Ababa. The World Health Organization (WHO) and Ethiopian national guidelines recommend exclusive breastfeeding (EBF) for the first six months of life, combined with maternal antiretroviral therapy (ART), to minimize the risk of HIV transmission while promoting infant health. However, adherence to these guidelines is influenced by complex sociocultural and behavioral factors, and many women struggle to EBF for 6 months. This mixed methods study, guided by the Theory of Planned Behavior (TPB), aimed to assess the factors influencing EBF intentions and practices among HIV-positive mothers in Addis Ababa between birth and four months postpartum.

Methods: First, qualitative elicitation interviews with HIV-positive mothers were conducted to identify salient behavioral, normative, and control beliefs regarding EBF. The results then informed the development of a quantitative, theory-driven instrument, which was then validated through pre-testing, and demonstrated adequate reliability and construct validity, effectively measuring key TPB constructs of attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC). Next, a prospective cohort study was conducted with 161 HIV-positive pregnant women, enrolled from 29 health facilities in Addis Ababa. The questionnaire was administered between 36 weeks gestational age and time of birth, and follow-up data was collected at four months postpartum.

Results: At baseline, 96.9% of participants intended to EBF, while 2.5% intended to mixed feed, and 0.6% were undecided. However, follow-up data revealed that only 71.4% adhered to EBF at four months. Bivariate and multivariate analysis identified religion, early antenatal care initiation, and the number of antenatal care visits as factors significantly associated with EBF. Longitudinal analyses revealed that several indirect TPB measures evolved over the postpartum period and were associated with infant feeding practice, notably beliefs about EBF convenience, spousal support for EBF, breastmilk adequacy, and dependency on other caregivers.

Conclusions: These findings highlight the need for targeted and individualized interventions that address barriers to EBF. The validated TPB-based instrument offers a valuable tool for future research and intervention design aimed at improving infant feeding practices among HIV-positive mothers in Ethiopia and similar settings.

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Chapter 1: Introduction

Background & Statement of the Problem

Mother-to-child Transmission of HIV

Mother-to-child transmission (MTCT) or vertical transmission of HIV remains a critical issue in the ongoing HIV/AIDS epidemic, accounting for over 90% of new HIV infections in children (Elizabeth Glaser Pediatric AIDS Foundation, 2025). An HIV-infected woman can transmit the virus to her child during pregnancy, labor and delivery, and through breastfeeding. Without intervention, risk of transmission is 5-10% during the intrauterine period, 10-20% during the intrapartum period, and 15-20% through breastfeeding, resulting in a total transmission rate of 20-45% (Belachew et al., 2020). In regions where breastfeeding is prolonged and common, postnatal transmission via breastfeeding can account for up to 50% of HIV infections in children (John-Stewart, 2008; Njom Nlend, 2022).

The global burden of pediatric HIV has significantly declined over the past two decades due to large-scale interventions. Since 2000, 3.4 million infections in children (aged 0–14 years) have been averted due to programs preventing vertical transmission of HIV during pregnancy, birth, and breastfeeding (Joint United Nations Programme on HIV/AIDS, 2023). Despite this, an estimated 1.4 million children under 15 were still living with HIV in 2023, with approximately 120,000 new infections and 76,000 HIV-related deaths in the same year (UNAIDS, 2024; World Health Organization, 2024). Sub-Saharan Africa remains the region most affected by pediatric HIV, with over 85% of HIV-infected children living in this region (UNAIDS, 2024).

PMTCT interventions, including the use of antiretroviral therapy (ART) for pregnant and breastfeeding women, elective caesarean section delivery, antiretroviral (ARV) prophylaxis for infants, and the promotion of safe infant feeding practices, have nearly eliminated MTCT in

high-income countries. For example, in the United States, the MTCT rate has been reduced to less than 1% (CDC, 2025; NIH Office of AIDS Research, 2024). However, in low- and middle-income countries (LMICs), particularly in sub-Saharan Africa, challenges such as limited healthcare infrastructure, inadequate access to ART, suboptimal infant feeding practices, and persistent stigma continue to prevent similar progress (Cardenas et al., 2023).

Despite earlier gains, the decline in new pediatric infections has stalled since the early 2010s, as ART coverage among pregnant women has plateaued. This is particularly pronounced in western and central Africa, where only 53% of pregnant or breastfeeding women living with HIV had access to ART (Joint United Nations Programme on HIV/AIDS, 2023; Njom Nlend, 2022). While improving access to ART continues to be a challenge in these settings, the complex issue of HIV and infant feeding has been one of the largest public health challenges since the discovery of HIV transmission through breastfeeding in 1985 (Kuhn & Aldrovandi, 2010).

HIV and Infant Feeding in the Global Context

The World Health Organization (WHO) currently recommends that HIV-positive mothers should exclusively breastfeed their infants for the first six months, introducing appropriate complementary foods thereafter, while continuing breastfeeding up to 1 year. During this period, it is highly recommended that mothers adhere to ART to minimize the risk of HIV transmission through breast milk (World Health Organization, 2016b).

Exclusive breastfeeding offers numerous benefits to an infant (compared with predominant breastfeeding, partial breastfeeding, and no breastfeeding), including a decrease in mortality, as it provides optimal nutrition and protects against infections. However, it is also associated with the risk of MTCT of HIV (Eccles et al., 2022; Kinshella et al., 2021). Conversely, exclusive replacement feeding (ERF) prevents the risk of MTCT of HIV, however in

low-resource settings, it is associated with an up to a six-fold increase in child mortality due to factors including unsustainable access to infant formula and clean water, sanitation challenges, and poor access to health services (Kuhn & Aldrovandi, 2012). Consequently, WHO guidelines on infant feeding practices among HIV-positive mothers have evolved significantly over the years in response to advancements in research, improved understanding of HIV transmission risks and the changing landscape of HIV treatment and prevention (Njom Nlend, 2022).

In 1985, when HIV was first reported in breastmilk, the U.S. Centers for Disease Control (CDC) issued guidelines that recommended avoidance of all breastfeeding by HIV-infected women (CDC, 2006). Early recommendations from the WHO were vague, though publications generally supported breastfeeding in the resource-poor settings (World Health Organization, 1992). However, the landmark Nairobi study in 2000 quantified the risk of HIV transmission through breastfeeding at 16% and first introduced the indicator of *6-month HIV-free survival* (a combination of two equally prioritized endpoints) (Nduati et al., 2000). The study results reported increased HIV-free survival among formula feeding, compared to breastfeeding, which triggered a major change in global thinking, recommendations, and policy regarding infant feeding (Kuhn & Aldrovandi, 2012).

In 2001, the WHO published its first guidelines on HIV and infant feeding. These guidelines recommended that HIV- positive mothers should avoid all breastfeeding and use replacement feeding, with the large caveat that this should only be practiced if replacement feeding is “acceptable, feasible, affordable, sustainable and safe” (AFASS) (World Health Organization, 2001, 2003). Consequently, many new research studies and public health programs were initiated to assess AFASS criteria and/or determine how to make replacement feeding AFASS in developing countries (Kuhn & Aldrovandi, 2012).

Notably, in an attempt to reduce MTCT of HIV through breastfeeding by reducing the barriers to successful replacement feeding, UNICEF implemented a program of providing free infant formula to eight African countries. However, within three years, this program was discontinued because rather than improving health outcomes among those that benefitted from the formula distribution, this program actually led to increased child morbidity and mortality in the entire population. Yet similar programs continued in this direction for years, with similar outcomes, demonstrating little to no success. Stigma related to HIV compromised acceptability, stock outs and rationing impeded feasibility and affordability, and population mobility presented challenges to sustainability. Despite an abundance of "safe preparation of formula" training programs (teaching boiling of water, hand washing, and general hygiene) throughout the developing world, the goal of safe clean water proved unreachable. Studies found that up to 80% of formula samples provided by mothers who received these trainings were contaminated with fecal material; moreover, about 20% of samples from instructor-led demonstrations were also contaminated. Another surprising outcome was the spillover effect of infant formula. Reports of free formula being sold in the communities and HIV-negative mothers choosing to feed their children formula further contributed to the negative impacts of these campaigns on child mortality (Kuhn & Aldrovandi, 2012).

With a large body of new evidence, a new WHO Consensus Statement on HIV and Infant Feeding was released in 2006 (World Health Organization, 2008). It highlighted new evidence that: (1) exclusive breastfeeding for up to 6 months was associated with a three to four-fold decreased risk of HIV transmission compared to non-exclusive breastfeeding; (2) HIV-free survival rates were similar whether infants were formula fed or breastfed; and (3) early breastfeeding cessation was associated with reduced HIV transmission but also with increased

risks of child mortality. This shifted the focus on infant feeding from the need to make the best choice between breastfeeding and replacement feeding to the need to have a sustainable ("exclusive") feeding method and ensure avoidance of mixed feeding.

New ART regimens for pregnant and breastfeeding women also began to transform the landscape of HIV prevention, as studies showed that maternal ART significantly reduced the risk of MTCT during breastfeeding. In 2010, the WHO introduced the "Option B" strategy, recommending lifelong ART for all HIV-positive pregnant and breastfeeding women, regardless of CD4 count, to reduce MTCT and improve maternal health (World Health Organization, 2010). This was further expanded in 2013 with the "Option B+" approach, which advocated for lifelong ART for all HIV-positive individuals, including pregnant and breastfeeding women (World Health Organization, 2015). These changes were supported by evidence that maternal ART drastically reduced HIV transmission through breastfeeding to less than 1%. The most recent WHO guidelines, updated in 2016 and reaffirmed in 2020, recommend that HIV-positive mothers breastfeed for at least 12 months while adhering to ART, as the benefits of breastfeeding in reducing infant morbidity and mortality outweigh the minimal risk of HIV transmission (World Health Organization, 2016b). Mothers are encouraged to continue breastfeeding for up to 24 months or longer, provided they maintain viral suppression through ART. These guidelines emphasize the importance of integrating infant feeding counseling with ART services to ensure optimal outcomes for both mothers and infants.

MTCT of HIV and Infant Feeding in Ethiopia

According to Federal Ministry of Health 2010 estimates, 43,000 pregnant women were HIV-positive; of these HIV-positive pregnant women, 7,300 gave birth to an HIV-positive newborn (17%) and an additional 5,700 (13%) transmitted HIV to their newborns through

breastfeeding for a total 13,000 (30%) newly infected children. Infant feeding practices contribute largely to new HIV infections in children. However, this high incidence rate could be drastically reduced with appropriate health behaviors.

Sixteen quantitative studies were identified that assessed infant feeding practices among HIV-positive mothers across regions in Ethiopia. While methodologies and measures vary notably across studies, vast variations in infant feeding practices are noted. Studies report EBF rates ranging from 56.0% up to 96.4%, and mixed feeding rates are reported from 8.3% up to 62.6% (Bultum et al., 2022; Ejara et al., 2018; Moges et al., 2017; Negash et al., 2019). While with study findings highlight regional differences in determinants of behavior, some common themes and trends emerge. Regarding demographic and socioeconomic characteristics, 3 studies report that increased maternal education increased EBF practice, and another 3 report that employment, occupation or income are predictive of EBF (Dagnew et al., 2019; Gebremariam et al., 2024; Muhammed & Seid, 2019; Muluye et al., 2012; Wakwoya et al., 2016). Seven studies demonstrate that disclose of HIV status to family and friends increased EBF practice (Berhan et al., 2014; Bultum et al., 2022; Ejara et al., 2018; Mebratu et al., 2020; Muluye et al., 2012, 2012; Wakwoya et al., 2016). Regarding health seeking behaviors, two studies report that facility delivery is associated with increased EBF rates compared to home deliveries (Mihret et al., 2020; Muhammed & Seid, 2019). Additionally, six studies reported higher EBF rates among those with increased antenatal and postnatal care visits and four with infant feeding counseling (Berhan et al., 2014; Bultum et al., 2022; Dagnew et al., 2019; Ejara et al., 2018; Gejo et al., 2019; Genetu et al., 2016; Mebratu et al., 2020; Mihret et al., 2020; Wakwoya et al., 2016). Finally, EBF practice was reported to be associated with increased maternal knowledge of HIV and infant

feeding guidance in five studies and with positive attitudes towards in three studies (Berhan et al., 2014; Gebremariam et al., 2024; Gejo et al., 2019; Mebratu et al., 2020; Negash et al., 2019).

Despite the existing body of research on infant feeding among HIV-positive mothers in Ethiopia, significant gaps in knowledge and practice remain. No studies measure or discuss fluctuations in these prevalence rates over time (e.g. from birth to 6 months of age), and very few are based in theory with the potential in influence future programming. Further, the evidence is unclear as to how and to what extent identified predictors impact infant feeding practice and how this knowledge could be used to inform intervention design to promote EBF over the course of six months. Thus, this study aims to address this gap in the literature by exploring determinants of infant feeding decision-making and behavior. By applying a health behavior theory, the research provides a deeper, theory-driven understanding of these causal relationships through both qualitative and quantitative approaches.

Theoretical Framework

The Theory of Planned Behavior (TPB) provides a framework for understanding the determinants of intentional human behavior. The TPB is a prominent behavioral model that focuses on individual motivational factors as key predictors of health behaviors. As one of the most widely applied theoretical frameworks, TPB plays a crucial role in understanding and predicting human behavior. Its applicability spans diverse fields, including advertising, technology, psychology, and various health issues, including exclusive breastfeeding (EBF) among HIV-positive women in Malawi. The extensive influence of TPB is evidenced by its citation in over 4,500 scholarly articles, positioning it among the most frequently referenced behavioral theories in academic research and intervention design (Bosnjak et al., 2020). Meta-analyses have demonstrated its robust predictive power, explaining significant variance in

intentions and behaviors. For instance, Armitage and Conner (2001) reported that the TPB explains approximately 39% of the variance in intention and 27% in behavior (Armitage & Conner, 2001).

The Theory of Planned Behavior (TPB) was developed by Icek Ajzen in 1985 as an extension of the Theory of Reasoned Action (TRA), originally formulated by Martin Fishbein and Ajzen in 1975 (Ajzen, 1991; Glanz et al., 2015). The TRA aimed to explain the relationship between attitudes, intentions, and behaviors. It emerged in response to debates in the 1960s and 1970s, where evidence showed a weak link between attitudes and behaviors. Fishbein advanced the theory by distinguishing between attitudes toward an object and attitudes toward a behavior, demonstrating that attitudes toward behaviors (e.g., mammography) are stronger predictors of actions than attitudes toward objects (e.g., cancer) (Conner, 2009). The TRA also integrated a "value-expectancy" conceptualization in the model, meaning that attitude is not solely determined by expectations or beliefs concerning an object (e.g., cancer) or action (e.g., mammography) and but an evaluation of those attributes. However, the TRA was limited to predicting volitional behaviors, those under a person's direct control. Ajzen addressed this in his TPB, by adding the concept of perceived behavioral control. This allowed the model to account for situations where the ability to perform a behavior depends not only on motivation or intention but also on perceived control over the behavior (Fishbein & Ajzen, 2011). A comparison of the TRA and TPB (shaded boxes) can be seen in Figure 1.1.

TPB assumes that individuals are rational and make decisions systematically based on available information. Additionally, it recognizes that although volitional actions are controlled by intentions, not all intentions are carried out. The theory explains this phenomenon with two factors: volition and time. Few behaviors are entirely under volitional control, and several

internal personal factors (e.g., knowledge, skills, physical ability, emotions) and external factors (e.g., resources, dependence on others, time, opportunity) often limit actual behavioral control. This TPB model is also contingent upon the stability of intention over time and the individual's volitional control. Time lags between intention and behavior can weaken the relationship, as the likelihood that unforeseen events will alter intention also increases over time (Ajzen, 2011).

The TPB posits that behavioral intention (BI) is the most proximal and important determinant of behavior. Intentions, in turn, are the product of three direct determinants (1) attitude toward a behavior (ATT), defined as "the degree to which performance of a behavior is positively or negatively valued"; (2) subjective norm (SN), defined as "the perceived social pressure to engage or not to engage in a behavior"; and (3) perceived behavioral control (PBC), defined as the individual's "perceptions of ability to perform a given behavior" (similar to self-efficacy).

PBC, a construct similar to self-efficacy, is also hypothesized to have a direct influence on behavior due to its ability to predict actual behavioral control. Ajzen explains that "as a general rule, the more favorable the attitude and subjective norm with respect to a behavior, and the greater the perceived behavioral control, the stronger should be an individual's intention to perform the behavior under consideration". The theory assumes that factors external to the individual that could impact the behavior, are inherently accounted for as they will shape an individual's ATT, SN and PBC. However, PBC has a specific secondary function, as a proxy for measuring actual behavioral control due to external factors.

Based on the expectancy-value model used by the TPB, the theory further posits that each of these direct determinants of BI (ATT, SN and PBC) are derived from a set of antecedent beliefs (an expectancy weighted by a value). Ajzen explains that "at the most basic level of

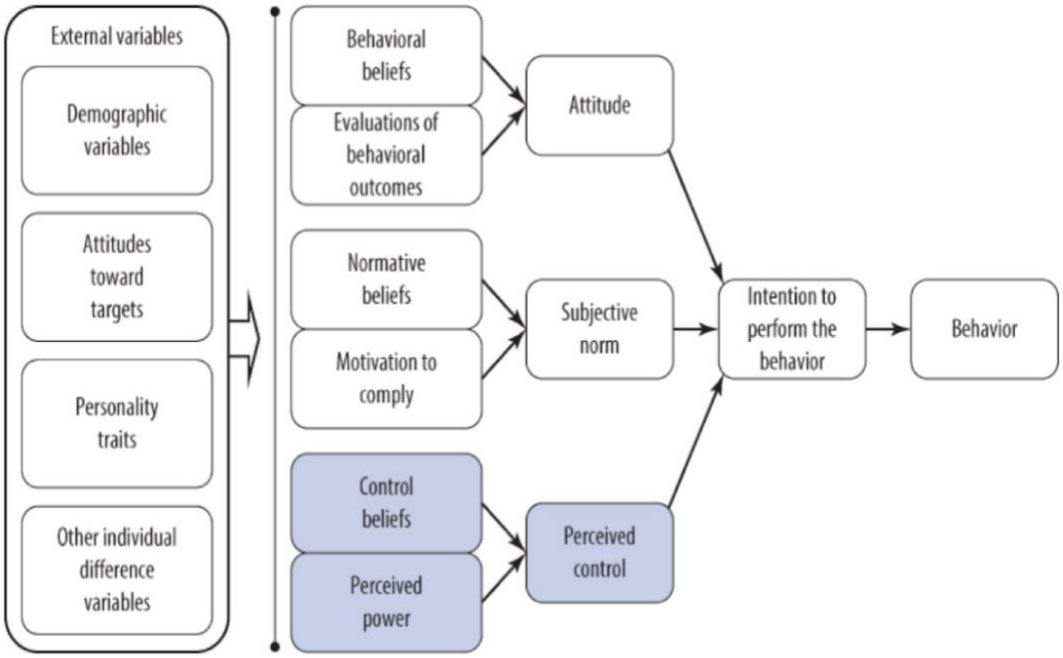
explanation, the theory postulates that behavior is a function of salient information, or beliefs, relevant to the behavior". In the TPB model, these salient beliefs are distinguished as behavioral beliefs, normative beliefs, or control beliefs. ATT can be determined when the strength of each salient belief about the behavioral outcome is combined in a multiplicative fashion with the subjective evaluation of the beliefs attribute, and the resulting products are summed over the number of salient beliefs. Similarly, SN is determined by normative beliefs about the expectations of important referents and the individual's motivation to comply with the referents. PBC is determined by control beliefs about the presence of facilitators and barriers to the behavior and the perceived power of that particular facilitator or barrier.

Thus, a causal chain of 1) antecedent beliefs, 2) direct determinants (ATT, SN and PBC), and 3) intentions drive behavior. Finally, while not explicitly defined in the TPB model, the theory recognizes that factors (such as demographic characteristics, socioeconomic status, and personal habits) will influence intention and behavior by shaping beliefs and evaluations. Using the TPB framework, explicit, measurable and temporal relationships between specific beliefs, intentions and behaviors can be identified and serve as a guide for intervention design to ultimately improve health outcomes.

Well-established guidelines for the development, administration and analysis of TPB based questionnaires have been published both by the author of the theory, Icek Ajzen, and the Centre for Health Services Research in the United Kingdom. This application of the TPB has been validated for a variety of languages, settings (both developed and developing countries, including Ethiopia), and health topics. The reliability and validity of questionnaires based on this model have also been acknowledged for decades, primarily because of its repeated ability to accurately predict behavior. TPB constructs (ATT, SN and PBC) have two sets of measures,

direct and indirect, to estimate the values of the constructs. Both direct measures and indirect measures are based on 3 to 5 items, using 5-point semantic differential scales that are bidirectional (-2 to +2) or unidirectional (1to 5), depending on the construct. Indirect measures, based on the expectancy-value model, are scored by multiplying antecedent expectancy beliefs (e.g. behavioral beliefs, normative beliefs, or control beliefs) by antecedent value beliefs (e.g. evaluation of beliefs, motivation to comply, perceived power). The use of both direct and indirect measures is strongly advised because direct measures are generally not reliable (they assume individuals have a standardized method of giving a summary evaluation of a cognitive structure). Indirect measures are theoretically more reliable, although they also make other assumptions (e.g. the breadth of all content beliefs are included). Using both direct and indirect measures in TPB-based studies provides more comprehensives insights and strengthens construct validity. Direct measures offer a concise assessment of the overall evaluative stance an individual holds toward the behavior, while indirect measures delve into the specific underlying beliefs that form these evaluations. This dual approach not only enables researchers to validate the internal consistency of TPB constructs but also facilitates the identification of modifiable beliefs for targeted interventions (Ajzen, 2011; Conner, 2009).

Figure 1.1. The Theory of Planned Behavior



Chapter 2: Infant feeding intention and practices among women living with HIV in Sub-Saharan Africa: A Systematic Review

Background

Despite decades of global health successes, in 2023, 2.4 million children under 19 years of age still live with HIV, nearly 86% of whom live in sub-Saharan Africa (UNICEF, 2023). The primary route of infection in children is via mother-to-child transmission (MTCT). MTCT of HIV can occur during pregnancy, labor, delivery, or breastfeeding. In the absence of interventions, HIV transmission occurs in 15% to 45% of pregnancies, but can be reduced to below 1-2% when clinical guidelines are followed (Cardenas et al., 2023; Maingi et al., 2022).

The World Health Organization (WHO) issued recommendations for the prevention of mother-to-child transmission (PMTCT) of HIV since 2000, and with continual updates in response to emerging evidence. Most recently, guidelines have evolved from Option A and Option B in 2010 (treatment guidelines for pregnant and breastfeeding women based on CD4 cell count), to option B+ between 2013 (lifelong antiretroviral therapy (ART) to all pregnant and breastfeeding women with HIV), and then to ART for all (regardless of pregnancy and breastfeeding status) in 2016 (Maingi et al., 2022; World Health Organization, 2016a).

Recommendations on infant feeding also evolved as part of these PMTCT guidelines, as the role of infant feeding on HIV transmission has been of concern since the onset of the epidemic. While exclusive breastfeeding for the first 6-months of life provides optimal nutrition, protects against infection, and promotes infant growth and development, the risk of HIV transmission complicates this practice. Between 2006 and 2007, the WHO first highlighted new evidence that: (1) exclusive breastfeeding for up to 6 months was associated with a three- to four-fold decreased risk of HIV transmission compared to non-exclusive breastfeeding; (2) HIV-

free survival rates were similar whether infants were formula fed or breastfed; and (3) early breastfeeding cessation was associated with reduced HIV transmission, but also with increased risks of child mortality. Since then, the WHO recommends exclusive breastfeeding for the first 6 months of life to maximize HIV-free survival (World Health Organization, 2008, 2010).

Since 2000, programs for preventing vertical HIV transmission averted over three million HIV infections in children, however progress stalled over the past eight years. This is particularly true in regions of Africa where efforts to eliminate MTCT reach only 53% (range: 42–64%) of pregnant or breastfeeding women living with HIV (Joint United Nations Programme on HIV/AIDS, 2023). Globally, an estimated 1.3 million women and girls living with HIV become pregnant each year, and these pregnancies result in 160,000 new HIV infections in children (UNAIDS, 2024). Approximately half of these children acquire HIV due to suboptimal infant feeding practices (Njom Nlend, 2022).

Infant feeding practices play a crucial role in mother-to-child transmission (MTCT) of HIV. Thus, to ultimately eliminate pediatric HIV infections, understanding infant feeding practices among mothers living with HIV in sub-Saharan Africa is imperative. Further, it is also crucial to understand how mothers make infant feeding decisions, as well as identifying facilitators and barriers in adherence to intended infant feeding practice, in order to tailor healthcare intentions.

Purpose

Despite the importance of exclusive breastfeeding for the health of HIV-exposed infants, no systematic reviews exist that identify patterns in infant feeding practices and the determinants of these practices. Thus, this systematic review explores the current literature on infant feeding practices among women living with HIV in sub-Saharan Africa. Specifically, the objective is to

evaluate data on infant feeding decision-making and the actual practices of mothers living with HIV in sub-Saharan Africa, with a specific focus on exclusive breastfeeding within 6-months of childbirth. Secondarily, the review also collects data on predictive or associated determinants of infant feeding decision and practice.

Research Questions

This systematic review answers the following questions:

1. What proportion of mothers living with HIV in sub-Saharan Africa make the decision to exclusively breastfeed for 6 months, as opposed to replacement feeding (e.g. formula feeding) or mixed feeding?
2. What proportion of mothers living with HIV in sub-Saharan Africa who choose to exclusively breastfeed for 6 months are successful in accomplishing this behavior?
3. Among those who do not continue breastfeeding until 6 months, at what time point do they discontinue this behavior?
4. What personal and/or environmental factors significantly predict or are associated with exclusive breastfeeding decision-making and/or practice?
5. What gaps and/or challenges towards understanding infant feeding practices among mothers living with HIV currently exist in the literature?

Methods

A systematic search (in January of 2023) of multiple databases identified quantitative, observational studies assessing infant feeding practices among mothers living with HIV in sub-Saharan Africa between birth and 6 months postpartum between 2007 and 2022, which the researcher evaluated for inclusion in this study.

Inclusion and Exclusion Criteria

Types of studies. Only quantitative, observational studies were included. Studies that included interventions potentially impacting infant feeding decision-making or practice outside of national or international PMTCT program guidelines and standard practice for their time and setting were excluded from this analysis.

Population. Included studies focused on mothers living with HIV and HIV-exposed newborn pairs in sub-Saharan Africa from birth to 6 months postpartum. Studies including both HIV-positive and HIV-negative samples were included, if the data from the HIV-positive sample could be extracted from the larger study results.

Outcomes. Studies were included if they assessed exclusive breastfeeding decision-making and/or practice from birth through 6 months postpartum. Studies that did not define the type of breastfeeding (e.g., "any breastfeeding", "all breastfeeding" or "breastfeeding of unknown exclusivity") were excluded. Studies that only assessed mixed feeding or replacement/formula feeding were excluded. Studies were also excluded if the time frame of infant feeding practice assessed was unclear (e.g., if assessment may have included breastfeeding beyond 6 months).

Language. Only studies published or available in English were included.

Time Frame. Only studies that were conducted and published between 2007 and 2022 were included. The year 2007 represents the first time the WHO published recommendations stating that exclusive breastfeeding reduced HIV transmission, compared to non-exclusive breastfeeding.

Search Strategy

The following search terms were used in PubMed, Embase, Medline and APA PsychInfo: (HIV OR AIDS) AND (Africa) AND ((“mother-to-child transmission”) OR (“vertical transmission”)) AND ((breastfeeding) OR ("breast feeding") OR ("mixed feeding")). The results were then limited by date (2007-2022), species (human), and language (English).

Screening and Data Extraction

Citations and abstracts of articles were organized in Microsoft Excel. Studies were then assessed and categorized as “full article review” or “excluded” based on the criteria discussed previously. Full articles were then reviewed to verify that the study met all inclusion criteria. Data was extracted from included articles and organized by outcome to answer the specific aims listed above. In some cases, raw data from a study was used to re-calculate outcomes of interest to standardize reported variables for analysis across all studies.

Results

Study Selection

The search strategy originally returned 2,427 articles. After applying limits based on date (2007-2022), species (human), and language (English), the number of eligible studies was reduced to 1,759. Removing duplicate articles (770) reduced the number of abstracts to 989.

As illustrated in Figure 1, a total of 739 of these articles were excluded from the review after assessing the abstracts (461 for type of study, 238 for the outcomes/study variables, and 40 for the population). Full articles for the remaining 250 studies were sought, and 241 were retrieved and reviewed. An additional 178 studies were excluded (62 for studies that took place prior to 2007, 42 for type of study, 64 for the outcomes/study variables and 10 for the study

population). A total of 63 studies met all inclusion criteria and were included in this analysis. Figure 1 schematizes the various steps and stages of the search process.

Table 2.1 summarizes the study characteristics of the 63 included studies, beginning with the year(s) and country of research. It also notes the study design (prospective, cross-sectional, or retrospective), how data were reported (prospective or cross-sectional), and the data source (primary or secondary). Additionally, Table 2.1 notes the measures reported in the study, whether the measures relate to infant feeding intention or practice, and the time period of reporting. Finally, Table 2.1 notes in which results category the study was included and if it contained any predictors/correlates of infant feeding practice.

Geographic Representation

A total of 16 sub-Saharan African countries are represented in this review, as geographically depicted in Figure 2 and numerically depicted in Table 2.2. It is important to note the inclusion of South Africa in this systematic review. Between 2002 and 2011, South Africa had a national policy of providing free formula for HIV-exposed infants. In 2011, the Tshwane Declaration ended this policy in response to rising infant and child mortality rates. Thus, while the provision of free formula differentiates four South Africa studies in this review, they were included as there remained no intervention that could influence infant feeding practice outside of national policy. There were no included studies that took place in multiple countries.

Research Question 1: What proportion of mothers living with HIV in sub-Saharan Africa make the decision to exclusively breastfeed for 6 months, as opposed to replacement feeding (e.g. formula feeding) or mixed feeding?

Table 2.3 demonstrates data from nine studies reporting on infant feeding intentions of mothers living with HIV, collected late in pregnancy or at time of birth, with sample sizes ranging from 30 to 810 participants (Afolabi et al., 2018; Aguti et al., 2020; Iloh et al., 2015;

Kafulafula et al., 2013; Mussa et al., 2021; Onubogu et al., 2015; Opotamutale Ashipala et al., 2021; Thomas et al., 2017; Ukpe et al., 2009). In most (7/9) of these studies, the variables were reported "EBF" and "not EBF", which included both mixed feeding (MF) and exclusive replacement feeding (ERF). For consistency, the two studies not differentiating between these practices were re-calculated into one variable ("No EBF"). Only two studies included the category of "undecided". These nine studies took place in six countries (South Africa, Malawi, Nigeria, Uganda, Namibia and Botswana). Overall, intention to EBF ranged widely, from 23.95% to 96.67%.

Research Question 2: What proportion of mothers living with HIV in sub-Saharan Africa who choose to exclusively breastfeed for 6 months are successful in accomplishing this behavior?

Two analyses were conducted to address this research question. First, prospective data was extracted from studies that followed cohorts of breastfeeding mothers from birth through 6 months postpartum. Second, cross-sectional data was collected from studies that reported infant feeding practice between 0-6 months postpartum and at the end of the 6-month postpartum period.

Prospective Results. These studies reported data on the number of mothers initiating exclusive breastfeeding at time of birth, and at least one other data point between 2-24 weeks (1-6 months) after delivery. As in the previous analysis, in some cases, study data had to be re-calculated to standardize the results. For example, denominators had to be re-calculated in several studies to account for participant loss to follow-up.

Table 2.4 summarizes the data from 12 studies report prospective results demonstrating infant feeding practice over the course of 6 months, representing 6 countries (Nigeria, Rwanda, South Africa, Tanzania, Uganda, Zambia), with an average sample size at time of birth of 367 (range: 39-1,450 participants) (Aguti et al., 2020; Anígilájé et al., 2015; Decker et al., 2017; Gill

et al., 2017; A. E. Goga et al., 2020; Goon et al., 2021; Maonga et al., 2016; Napyo et al., 2020; Ngoma et al., 2015; Onubogu et al., 2015; Pellowski et al., 2019; Young et al., 2010). For this analysis, all breastfeeding women were assumed to have started exclusively (thus 100% of the breastfeeding sample was exclusive at birth). Studies documented various follow-up points from study-to-study. The most frequently reported follow-up data collection times were 6 weeks postpartum (a time recommended for routine postpartum visits, HIV testing of exposed infants, and several infant immunizations) and 24 weeks (6 months) postpartum (the recommended duration of EBF).

11 of the 12 studies followed participants to 6 months postpartum (22-24 weeks postpartum), and these data are illustrated in Figure 3. Overall, successful EBF from time of birth to 6 months postpartum ranged widely, from 13.98% to 94.90%.

Cross-sectional Results. Most studies did not report prospective data but instead reported infant feeding practice at one time point between 0 and 6 months postpartum. Some studies reported practice at a specific time point (e.g. 6 weeks postpartum) or time range (e.g. 3-4 months postpartum), while others only indicated that the behavior was measured sometime before 6 months postpartum. Two studies included cross-sectional data at multiple time points within the 6 month period. However, the sample of participants differed at each time point; thus they were reported as multiple discreet data points, rather than as prospective data.

Table 2.5 shows data from 40 studies reported cross-sectional results on infant feeding practice sometime between 0-6 months postpartum, representing 11 countries (Cameroon, Ethiopia, Kenya, Lesotho, Liberia, Malawi, Nigeria, South Africa, Tanzania, Uganda, Zambia, Zimbabwe), with an average sample size of 952 (range: 20-7,989 participants). The average proportion of mothers practicing exclusive breastfeeding is 65.0% (range: 20- 99.1%). The

average proportion of mixed feeding practice was 12.4% (range: 0-43.2%), and the average proportion of exclusive replacement feeding was 22.6% (range: 0-71.4%.) The large variation over the 6-month time period aligns with results from the prospective analysis (Afolabi et al., 2018; Ahmadu-Ali & Couper, 2013; Aishat et al., 2015; Andare et al., 2019; Ashiono et al., 2017; Berhan et al., 2014; Chi et al., 2014; Desta et al., 2019; Dinh et al., 2018; Flax et al., 2016; A. E. Goga et al., 2015, 2016, 2020; Hampanda, 2016; Itiola et al., 2019; Kassaw et al., 2020; Ladzani et al., 2011; Lanktree et al., 2011; Mama et al., 2017; Mebratu et al., 2020; Moges et al., 2017; Muluye et al., 2012, 2012; Mutawulira et al., 2022; Mwendo et al., 2014; Napyo et al., 2020; Negash et al., 2019; Njom Nlend et al., 2018; Noubiap et al., 2013; Obsa et al., 2018; Okong et al., 2010; Oleribe et al., 2018; Remmert et al., 2020; Saounde Temgoua et al., 2015; Tchendjou et al., 2020; Torpey et al., 2012; Tsehay, 2019; Tukei et al., 2020; Tuthill et al., 2017; Ukpe et al., 2009; Umar et al., 2022; Yapa et al., 2020).

Finally, Table 2.6 organizes the information from 14 studies reporting infant feeding practice at the end of the 6-month postpartum period, which represent nine countries (Ethiopia, Malawi, Mozambique, Nigeria, South Africa, Tanzania, Uganda, Zambia, Zimbabwe), with an average sample size of 746 (range:10-2,965 participants) (Adelekan et al., 2022; Bultum et al., 2022; Chi et al., 2014; Dinh et al., 2018; Flax et al., 2016; A. E. Goga et al., 2020; Haile et al., 2014; Hampanda, 2016; Iliyasu et al., 2019; Lawani et al., 2014; Mihret et al., 2020; Moiane et al., 2020; Okong et al., 2010; Young et al., 2010). The average proportion of mothers practicing exclusive breastfeeding until the end of the 6-month period is 61.5% (range: 13.3-93.8%). The average proportion of mixed feeding practice at 6-month postpartum was 24.7% (range:1.9-53.1%), and the average proportion of exclusive replacement feeding was 14.1% (range: 0-65.8%). Compared to the prospective and cross-sectional analyses between 0-6 months, this

analysis demonstrates a much higher proportion of mothers continuing EBF until the end of 6 months.

Research Question 3: Among those who do not continue breastfeeding until 6 months, at what time point do they discontinue this behavior?

The analyses presented for the previous research question also address the third research question. The prospective analysis demonstrates multiple time points at which mothers practicing EBF no longer maintain exclusivity in breastfeeding. One study demonstrates decreases in EBF as early as 1-week postpartum, while another shows 100% adherence to EBF until after the 6-week time period.

Eight studies reported follow-up data between 4-8 weeks postpartum. At this point, an average of 12% (range: 0%-19%) of exclusively breastfeeding mothers already began practicing mixed feeding or switched to exclusive replacement feeding. Six studies reported follow-up data between 12-16 weeks postpartum. By this time, an average of 28% (range: 5%-64%) of exclusively breastfeeding mothers began practicing mixed feeding or switched to exclusive replacement feeding. 10 studies reported follow-up data at the end of 6 months (22-24 weeks) postpartum. By then, an average of 50% (range: 5%-86%) of mothers who initiated EBF were no longer breastfeeding exclusively.

Research Question 4: What personal and/or environmental factors significantly predict or are associated with exclusive breastfeeding decision-making and/or practice?

Data from studies that assessed predictors or other associated factors of exclusive breastfeeding intention were extracted to assess the fourth research question (Figure 4). 18 studies included a quantitative assessment of potential predictors of EBF intention or practice, representing 11 countries (Botswana, Cameroon, Ethiopia, Kenya, Malawi, Namibia, Nigeria, South Africa, Tanzania, Uganda, Zambia). Predictors of EBF intention were included in four

studies, and predictors of EBF practice were included in 15 studies (one study included separate analyses of both intention and practice). Nine studies included both bivariate and multivariate analyses, while two studies reported only bivariate results and seven studies reported only multivariate results. Appendix A lists the 62 different variables assessed across all 18 studies, and indicates whether the study found the variable to be a statistically significant associate of EBF intention or practice, using the following legend depicted in Figure 4.

Demographic and Socioeconomic Variables. This analysis assessed several maternal characteristics as possible associates of infant feeding practice, including maternal age (N=15), marital status (N=15), maternal employment or occupation (N=13), maternal education (N=13), parity/living children (N=10), religion (N=6), residence (N=3), ethnicity (N=3), length of relationship with partner (N=1), and living with mother (N=1). In most cases, variables were not statistically significant or demonstrated variability in the direction of associations from study to study. For example, maternal employment, assessed in 13 studies, was non-significant in eight studies, negatively associated in three multivariate studies, and positively associated in two bivariate analyses. Maternal education was positively associated with EBF practice in four of 11 studies, and statistically insignificant in the remaining seven studies.

Some studies also considered paternal characteristics as predictors, including paternal education (N=4), paternal age (N=1), paternal employment (N=1). Both paternal age and employment were found to be statistically insignificant, and only one study found paternal education to be a positive predictor of EBF practice.

Several studies assessed various indicators of socioeconomic status (SES), such as an overall or composite measure of socioeconomic status (N=6), monthly income (N=5), running water in home (N=3), electricity in home (N=3), food security (N=2), refrigeration in home

(N=1), and radio/TV in home (N=1). Again, most studies reported no significant associations, with two studies reporting negative associations between higher SES and EBF, and five studies reporting positive associations between higher SES and EBF.

Mental Health and Substance Use. Six studies assessed mental health indicators as predictors of EBF intention and/or practice, including alcohol risk or use (N=4), postpartum depression (N=3), experience of intimate partner violence (N=3), psychological distress (N=2), trauma exposure or post-traumatic stress disorder (N=2), prenatal depression (N=2), and tobacco use (N=2). Of the 16 total analyses performed, 10 found mental health predictors statistically nonsignificant. However, of the six analyses that found mental health indicators significant, they were all negatively correlated with EBF intention or practice, indicating that mental health characteristics and behaviors may play a notable role in infant feeding practice.

Disclosure of HIV Status. Seven studies assessed the role of disclosing HIV status to husband/father (N=7), family (N=5) and friends (N=3). All seven assessed disclosure of HIV status to husband/father, and four of these studies found it to be a positive predictor of EBF intention and/or practice. Additionally, two of five studies found disclosure to family positively associated with EBF intention and/or practice, and the same pattern exists for disclosure to friends in two of three studies assessing this. While there is some variation across studies, it does appear that disclosure of HIV to family and friends broadly supports EBF.

HIV Experience & Care. Twelve studies tested five characteristics related to mothers' HIV experience and care, including previous experience with HIV in pregnancy and infant feeding (N=4), adherence to ART (N=4), time of HIV diagnosis (N=3), CD4 cell count (N=2), and couple HIV status discordance (N=1). All analyses of previous experience with HIV in pregnancy and infant feeding were not significant, and the majority of other characteristics were

also not significant. The results do not demonstrate any pattern related to HIV experience and care.

Maternal Health Characteristics. Thirteen studies assessed 10 variables related to maternal health (antenatal care, labor and delivery, postnatal care), including place of delivery (N=8), infant feeding counseling by health worker (N=7), type of delivery (N=6), ANC attendance (N=5), planned pregnancy (N=2), gestational age (N=2), postnatal care (N=2), skilled birth attendance (N=1), complications during delivery (N=1), and time of BF initiation (N=1). More than half of the studies (N=5/9) assessing place of delivery or skilled birth attendance found significant results, and all demonstrated that delivering in a facility and/or with a skilled birth attendant was positively associated with EBF. Almost all (N=6/7) studies found that infant feeding counseling by a health worker was positively associated with EBF; similarly two-thirds of studies found that increased ANC attendance was positively associated with EBF. This suggests that increased health-seeking behavior and engagement with the health system supports EBF intention and practice. The remaining variables were either non-significant or demonstrated inconclusive results.

Infant Characteristics. Eight studies assessed four different infant characteristics, including gender (N=6), birth weight (N=4), HIV prophylaxis (N=2), and HIV-status. The only significant variable was infant receipt of prophylaxis, and both studies assessing this variable found a positive association with EBF.

Health Theory Constructs. Ten studies included theoretical constructs that draw from well-known behavioral theories such as the Health Belief Model, the Theory of Planned Behavior, and the Social Cognitive Theory, to understand how knowledge, intention/decision-making, attitudes, social norms, and perceived behavioral control relate to infant feeding

practice. Six studied knowledge related to HIV and infant feeding, and almost all (N=5/6) found knowledge to be a significant positive predictor of EBF intention and practice. Three studies included variables of overall intention (N=1) and timing of infant feeding decision, but none found significant relationships among these variables. Five studies assessed indicators of attitudes towards EBF, either reporting a summary measure (N=3) or reporting on specific beliefs, including belief that infants will not acquire HIV through breastmilk (N=2) and belief that ART can prevent HIV transmission (N=1). Most studies demonstrated that attitude is positively associated with EBF (N=4/6), though one study produced a nonsignificant result, and another a negative association. Three studies included various indicators of social norms, such as an overall evaluation of social norms (N=1), spousal influence (N=2), family influence (N=2), and fear of stigmatization (N=1). Three studies suggested that socials norms are positively associated with EBF, while one demonstrated a negative association, and two found no significant associations. The wide variety in measures of social norms, despite the small number of studies, makes a generalization of these data difficult to identify. Finally, four studies assessed variables related to behavioral control, including overall perceived behavioral control (N=1), barriers related to insufficient milk or other breast health problems (N=2), and confidence in safe preparation of formula (N=1). Overall perceived behavioral control was positively associated with EBF and insufficient milk or other breast health problems was negatively associated with EBF, however confidence in safe preparation of formula was also negatively associated with EBF. The small number of studies and diverse measures regarding behavioral control preclude any conclusion regarding the role of perceived behavioral control in infant feeding practice.

Research Question 5: What gaps and/or challenges towards understanding infant feeding practices among mothers living with HIV currently exist in the literature?

Overall, the results demonstrate a wide range of infant feeding intentions and practice across sub-Saharan Africa. But it in nearly all studies, a need for improvement of infant feeding practices can be identified. Several gaps, inconsistencies, and limitations in the literature became apparent in conducting this study, particularly around the topics of 1) operational definitions; 2) collection of infant feeding data; 3) the time frame of measurement; and 4) generalizability.

Operational Definitions for EBF, MF and ERF. Many studies lack clear operational definitions of feeding practices and information on the measurement of feeding practices. Of the 63 included studies, only 32 included an operational definition of EBF, MF, and/or ERF. Without clearly stated definitions, mothers may not fully understand the actual definitions of these practices. For example, Aishat et al. [12] report that, in Nigeria, only 79% of mothers living with HIV accurately described EBF as breastfeeding only, without any other food or liquid for first 6 months of infant's life. Without clear operational definitions, mothers may think that giving only water with breastfeeding still constitutes exclusive breastfeeding. Tuthill et al. [13] provide an example of an operational definition that ensures prevention of this error in the measure.

> *EBF was assessed based on participant recall. Questions included, "Are you currently exclusively breastfeeding (name of infant)?" and a series of questions about feeding behaviors, to ensure that mothers who responded yes to the EBF question were actually EBF. These questions included "Have you started giving (name of infant) food or fluids in addition to giving breast milk?" and "If your choice was to exclusively breastfeed and you or your family introduced other fluids or foods in addition to your initial choice, when did this occur?"*

Additionally, women may believe that they can provide mixed feeding for a period of time, and then return to exclusive breastfeeding afterwards, and still be classified as EBF. Flax et

al. [14] measures EBF as “the proportion of infants 0–5 months of age who received only breastmilk on the previous day”. While this is a clear operational definition, it fails to ensure the accuracy of the measure, as a woman practicing MF may still only provide breastmilk on certain days.

Even among studies that provide clear operational definitions, large variations in definitions still exist. Goga et al. [16] operationalize existing definitions from the WHO to measure “feeding pattern[s] for the 8 days prior to data collection” for infants 4-8 weeks of age. Whereas Haile et al. [17] provide a different method for retrospectively measuring feeding practice, indicating that “breastfeeding duration was assessed by asking the time lapse from date of birth to the time that a mother stopped breastfeeding”. Anigilaje, et al. [15] explain that two episodes of mixed feeding were required for classification as MF in their study. In addition to time-related factors of the definition, other variation concerns include accounting for HIV-exposed infants that die before 6 months and the management of participants who do not recall past feeding practices.

The lack of operational definitions frequently creates ambiguity regarding infant feeding intention vs. practice. Considering the nuances of these different practices (EBF vs. MF vs. ERF), this often creates some ambiguity in the reported results. For example, while results might refer to feeding practice for 6 months, it is difficult to discern whether this is self-reported feeding intention for 6 months or actual feeding practice throughout this entire time period. For example, Moges et al. [18] state that “294 (96.4%) of infants were on exclusive breastfeeding until 6 months of their life”, yet without any operational definitions or details on data collection it is not clear as to whether this is reported intention or actual practice.

Infant Feeding Data Collection. In addition to operational definitions, clear and consistent methods for collecting infant feeding data are often lacking in the existing studies. Almost half (44.4%) of the articles in this review did not describe the collection of infant feeding data (e.g. who collected the data, where data collection occurred, data collection procedures, etc.,) potentially decreasing the consistency of results. For example, if patients' health care providers ask questions, respondents may feel pressured to respond according to their recommendations. Additionally, locations, privacy, interviewers, explanation of definitions, and other things can all influence patient responses.

The omission of these important details regarding data collection likely occurs for a variety of reasons. First, infant feeding practices are often collected as a secondary variable or risk-factor for another primary outcome of interest. In this review, less than half (46.0%) of included studies addressed infant feeding practice as the primary outcome of interest. Most often, infant feeding practice was a secondary variable in an analysis of HIV transmission, HIV-free survival or other infant outcomes. Even among these studies, infant feeding may still be a component of a larger outcome, such as "adherence to Option B+". This helps to explain the limitations in descriptions of infant feeding measures. Second, many studies are retrospective or secondary data analyses that may not have included detailed descriptions of the infant feeding measures.

Measurement and Reporting. As demonstrated, the measurement and reporting of infant feeding practice demonstrates wide variation. While some studies compare EBF vs. MF vs. ERF, other simply report EBF vs. non-EBF (thereby combining MF and ERF into one category). Further, some studies collected primary data and others used secondary data; some studies reported data prospectively and others reported cross-sectionally; and some reported

cross-sectional data from a single point in time and others within a broader time range – and each of these reporting choices comes with different strengths and weaknesses.

While prospective studies provide many details regarding behavior changes over time, they often have smaller sample sizes and exhibit great loss to follow-up. There are different weaknesses in the cross-sectional studies reporting across 0-6 months. First, this reporting likely overestimates the proportion of women that are successful with EBF through the full 6 months. This is because mothers may report exclusive breastfeeding of 3-month old infants, however, it is not known whether they will continue this practice for another three months. Second, cross-sectional infant feeding data is often collected when infants are brought into health centers for HIV testing. Thus, this creates potential bias based on health-seeking behaviors, which may further overestimate EBF rates at 6 months.

Finally, some studies report composite measures of both primary and secondary assessments of EBF. This seems to occur primarily when samples include infants 0-24 months alongside mothers with infants under 6 months because some report infant feeding as it is occurring and while others retrospectively report infant feeding practice for the first 6 months of life when their child is anywhere up to two years old. For example, Marinda, et al. (2017) report a total of 85 mothers enrolled in the study, 45% (N=38), had infants 6 months of age or less and 55% (N=47) had infants 7-24 months of age. However, infant feeding data was combined for these groups, thus the results contain both composite of cross-sectional and retrospective self-reports.

Generalizability. Even when the population is limited to mothers living with HIV, differences in inclusion and exclusion criteria across studies exist. For example, one study only included women not on ART prior to recruitment into the study, limiting the study sample to

either women with new diagnoses or women in early stages of HIV infection (as CD4 cells counts would have to be high enough to preclude women from initiating ART). Additionally, many studies only include mothers and infants who return for postpartum visits, most often the standard 6-week follow-up visit. This likely points to a self-selection bias for participants already demonstrating healthcare-seeking behaviors. A study by Decker et al. [19] that assessed infant feeding practice at the routine 6-week follow-up found that only 58% of the women recruited during antenatal care returned to their 6-week follow up. Infant feeding practices for mothers that are less compliant with postpartum care is thus unknown, and with a loss to follow-up magnitude like this, the generalizability of the study results are diminished.

Conclusion

This systematic review highlights the complexities of infant feeding practices among mothers living with HIV in sub-Saharan Africa. The results demonstrate that many mothers living with HIV in sub-Saharan Africa struggle to exclusively breastfeed for 6 months, the WHO-recommended practice, though there is variability in both the intention and actual practice of EBF across the region. The prospective analysis reveals that while many mothers intend to practice EBF, adherence drops over time, with EBF rates ranging from 13.98% to 94.90% at six months postpartum. Cross-sectional data support this overall conclusion showing varying rates of EBF, mixed feeding, and exclusive replacement feeding between 0-6 months postpartum.

Few clear predictors of infant feeding intention and practice can be identified: demographic, socioeconomic, and health status characteristics showed inconsistent or insignificant associations across studies. However, mental health (particularly experience with gender-based violence), disclosure of HIV status to family and friends, and increased

engagement with the health system (e.g. facility deliveries, antenatal care, counseling by health care workers) were found to positively influence EBF intention and practice.

Several gaps in the existing literature were also identified. Large discrepancies exist among studies, likely due in part to geographical variation and the diversity of populations represented in this analysis, but stemming from variations in sample sizes, research methodologies, and overall quality of the included studies. Infant feeding practice often remains an overlooked or a secondary consideration in PMTCT research and programming, and improved understanding of barriers and facilitators to infant feeding practice is necessary to improve compliance with WHO recommendations. These limitations call for more targeted and prospective research to better understand and support optimal infant feeding practices in this population. But despite these gaps in the current literature, it is apparent that public health interventions to support women in EBF is needed. Addressing barriers to exclusive breastfeeding and providing more comprehensive support to mothers living with HIV will be crucial in reducing PMTCT and improving child health outcomes in sub-Saharan Africa.

Figure 2.1: Study selection

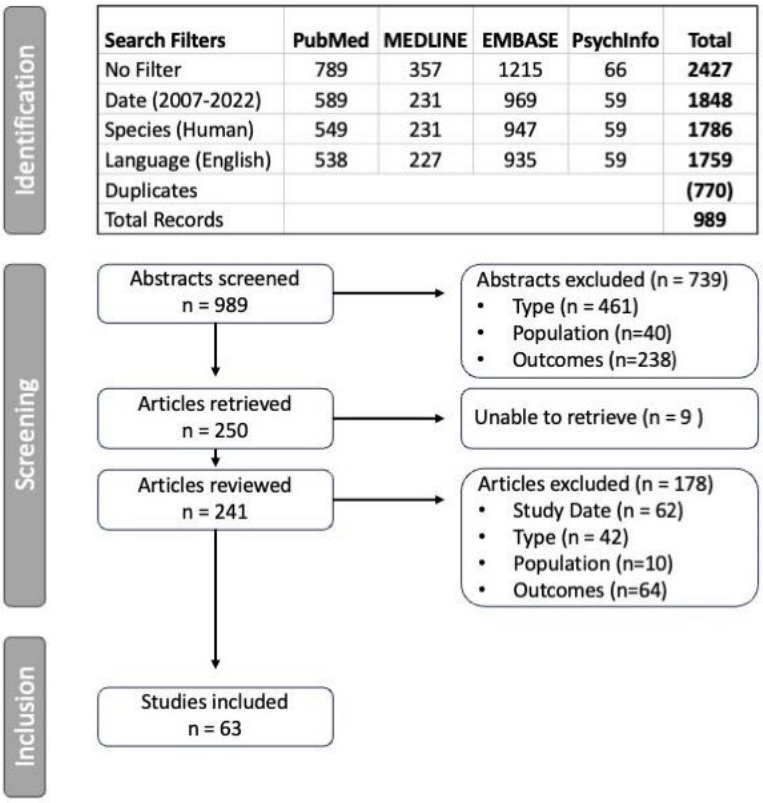


Fig. 2.1 Procedures utilized to select studies for inclusion

Figure 2.2: Geographic distribution of included studies from African countries

Fig. 2.2 Geographical representation of included studies from South Africa (colors and patterns represent the numbers of included studies from each country)

Figure 2.3: Percent of women continuing EBF, 0-24 months postpartum

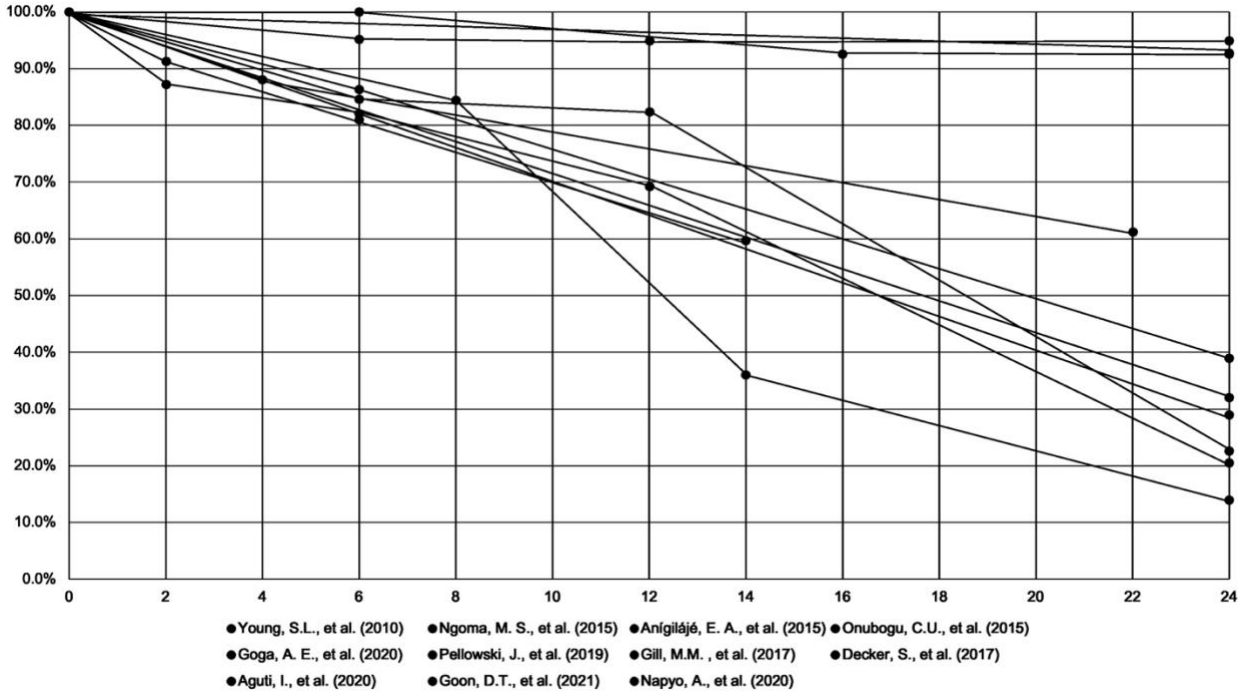


Fig. 2.3 Percent of women continuing to EBF (0-24 months postpartum, across 11 studies listed by author and year)

Figure 2.4: Legend utilized in Appendix A to categorize 62 variables across 18 studies

NS = Not significant
B (+) = Significant, positive association in bivariate analysis
M (+) = Significant, positive association in multivariate analysis
B (-) = Significant, negative association in bivariate analysis
M (-) = Significant, negative association in multivariate analysis

Fig. 2.4 Legend utilized in Appendix A to categorize 62 variables across 18 studies, including significance, direction of effect, and scope of analysis

Table 2.1: Study characteristics

Citation	Study Year(s)	Country	Study Type	Data Type	Data Source	Measures Reported	Intention vs. Practice	Reported Time Frame	Results Category	Predictors/ Correlates of EBF
Lanktree *et al.* 2011	2007-2008	Uganda	Prospective	Cross-sectional	Primary	EBF, MF	Practice	3-months PP	<6 months PP	No
Ukpe *et al.* 2009	2007-2008	South Africa	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF, undecided	Intention Practice	Pregnancy 1-week PP	Intention <6 months PP	No
Torpey *et al.* 2012	2007-2009	Zambia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Young *et al.* 2010	2008-2008	Tanzania	Retrospective	Prospective	Primary	EBF, MF, ERF	Practice	@ 2-months PP @ 4-months PP @ 6-months PP	Prospective @ 6-months PP	No
Ngoma *et al.* 2015	2008-2009	Zambia	Prospective	Prospective	Primary	EBF	Practice	@ Time of birth @ 6-months PP	Prospective	No
Anígilájé *et al.* 2015	2008-2011	Nigeria	Retrospective	Prospective Cross-sectional	Secondary	EBF, MF, ERF	Practice	@ Time of birth @ 6-weeks PP @ 3-months PP @ 6-months PP	Prospective	No
Njom Nlend *et al.* 2018	2008-2013	Cameroon	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-3 months PP	<6 months PP	Yes
Itiola *et al.* 2019	2008-2014	Nigeria	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF, unknown	Practice	0-6 months PP	<6 months PP	No
Ladzani *et al.* 2011	2009-2009	South Africa	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	3-6 months PP	<6 months PP	No
Okong *et al.* 2010	2009-2009	Uganda	Prospective	Cross-sectional	Primary	EBF, MF, ERF	Practice	@ 6-weeks PP @ 10-weeks PP @ 14-weeks PP @ 6-months PP	<6 months PP @ 6-months PP	No
Ahmadu-Ali *et al.* 2014	2009-2010	South Africa	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	6-weeks PP	<6 months PP	No
Kafulafula *et al.* 2013	2009-2010	Malawi	Prospective	Cross-sectional	Secondary	EBF, not EBF (MF+ERF)	Intention	Pregnancy	Intention	Yes
Chi *et al.* 2014	2009-2011	Zambia	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP @ 6-months PP	<6 months PP @ 6-months PP	No
Mwendo *et al.* 2014	2009-2012	Tanzania	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	6-weeks PP	<6 months PP	No

Goga *et al.* 2015	2010-2010	South Africa	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Noubiap *et al.* 2013	2010-2010	Cameroon	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Saounde Temgoua *et al.* 2015	2010-2011	Cameroon	Retrospective Cross-sectional	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Muluye *et al.* 2012	2011-2011	Ethiopia	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	Yes
Iloh *et al.* 2015	2011-2012	Nigeria	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Intention	Time of birth	Intention	No
Goga *et al.* 2016	2011-2013	South Africa	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	6-weeks PP	<6 months PP	No
Moges *et al.* 2017	2011-2015	Ethiopia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Haile *et al.* 2014	2012-2012	Ethiopia	Cross-sectional	Cross-sectional	Secondary	EBF, MF, ERF	Practice	@ 6-months PP	@ 6-months PP	Yes
Onubogu *et al.* 2015	2012-2012	Nigeria	Prospective	Cross-sectional Prospective	Primary	EBF, MF, ERF	Intention Practice	@ Time of birth @ 2-weeks PP @ 6-weeks PP @ 3-months PP @ 6-months PP	Intention Prospective	Yes
Aishat *et al.* 2015	2012-2013	Nigeria	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	Yes
Berhan *et al.* 2014	2012-2013	Ethiopia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Goga *et al.* 2020	2012-2013	South Africa	Prospective	Prospective	Secondary	EBF, MF, ERF	Practice	@ 6-weeks PP @ 3-months PP @ 6-months PP	Prospective <6 months PP @ 6-months PP	No
Lawani *et al.* 2014	2012-2013	Nigeria	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	@ 6-months PP	@ 6-months PP	No
Mama *et al.* 2017	2012-2015	Ethiopia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Moiane *et al.* 2020	2012-2015	Mozambique	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	@ 6-months PP	@ 6-months PP	No
Pellowski *et al.* 2019	2012-2015	South Africa	Prospective	Prospective	Primary	EBF, MF, ERF	Practice	@ 6-weeks PP @ 3-months PP @ 6-months PP	Prospective	No
Thomas *et al.* 2017	2012-2015	South Africa	Retrospective	Prospective	Secondary	EBF	Intention	Time of Birth	Intention	Yes
Oleribe *et al.* 2018	2012-2016	Nigeria	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No

Ashiono *et al.* 2017	2013-2013	Kenya	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF, unknown	Practice	0-6 months PP	<6 months PP	No
Negash, and Ehlers 2016	2013-2013	Ethiopia	Retrospective Cross-sectional	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Dinh *et al.* 2018	2013-2014	Zimbabwe	Prospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	1-3 months PP @ 6-months PP	<6 months PP @ 6-months PP	No
Gill *et al.* 2017	2013-2014	Rwanda	Prospective	Prospective	Primary	EBF	Practice	@Time of birth @ 4-weeks PP @ 6-months PP	Prospective	No
Remmert *et al.* 2020	2013-2014	South Africa	Prospective	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Decker *et al.* 2017	2013-2015	Uganda	Prospective	Prospective	Primary	EBF	Practice	@ 1.5-months @ 4-months PP @ 6-months PP	Prospective	No
Mussa *et al.* 2021	2013-2015	Botswana	Cross-sectional	Cross-sectional	Primary	EBF, ERF	Intention	Time of Birth	Intention	Yes
Hampanda 2016	2014-2014	Zambia	Retrospective Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP @ 6-months PP	<6 months PP @ 6-months PP	Yes
Maonga *et al.* 2016	2014-2014	Tanzania	Retrospective	Prospective	Primary	EBF, MF	Practice	@Time of birth @ 4-weeks PP @ 6-weeks PP	Prospective	Yes
Tuthill *et al.* 2017	2014-2014	South Africa	Retrospective	Cross-sectional	Primary	EBF	Practice	6-weeks PP	<6 months PP	Yes
Flax *et al.* 2016	2014-2015	Malawi	Retrospective Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP @ 6-months PP	<6 months PP @ 6-months PP	No
Obsa, *et al.* 2018	2014-2015	Ethiopia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Adelekan *et al.* 2022	2014-2016	Nigeria	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF, unknown	Practice	@ 6-months PP	@ 6-months PP	No
Aguti *et al.* 2020	2014-2016	Uganda	Retrospective	Prospective	Secondary	EBF, not EBF (MF+ERF)	Intention Practice	Time of birth @ 6-months PP	Intention Prospective	No
Tukei *et al.* 2020	2014-2016	Lesotho	Prospective	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Kassaw *et al.* 2020	2014-2017	Ethiopia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Andare *et al.* 2019	2015-2015	Kenya	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	Yes
Afolabi *et al.* 2018	2015-2016	Nigeria	Prospective	Cross-sectional	Primary	EBF, MF, ERF	Intention Practice	Time of birth 0-6 months PP	Intention <6 months PP	No

Yapa *et al.* 2020	2015-2017	South Africa	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Desta *et al.* 2019	2016-2016	Ethiopia	Cross-sectional	Cross-sectional	*unclear*	EBF, MF, ERF	Practice	1-6 months PP	<6 months PP	No
Iliyasu *et al.* 2019	2016-2016	Nigeria	Retrospective	Cross-sectional Prospective	Primary	EBF, MF, ERF	Practice	@ 6-months PP	@ 6-months PP	Yes
Tchendjou *et al.* 2020	2016-2017	Cameroon	Cross-sectional	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Umar *et al.* 2022	2016-2020	Liberia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	1-6 months PP	<6 months PP	No
Mihret *et al.* 2020	2017-2017	Ethiopia	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	@ 6-months PP	@ 6-months PP	Yes
Bultum *et al*. 2022	2017-2018	Ethiopia	Retrospective Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	@ 6-months PP	@ 6-months PP	Yes
Goon *et al.* 2021	2018-2018	South Africa	Retrospective	Prospective	Primary	EBF	Practice	Time of Birth @ 6-months PP	Prospective	Yes
Tsehay 2019	2018-2018	Ethiopia	Retrospective	Cross-sectional	Secondary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	No
Napyo *et al.* 2020	2018-2020	Uganda	Prospective	Prospective	Primary	EBF, MF	Practice	@ 1-week PP @ 6-weeks PP @ 14-weeks PP	Prospective	Yes
Ashipala *et al.* 2021	2019-2019	Namibia	Cross-sectional study	Cross-sectional	Primary	EBF, not EBF (MF+ERF), undecided	Intention	Time of birth	Intention	Yes
Mebratu *et al.* 2020	2019-2019	Ethiopia	Cross-sectional	Cross-sectional	Primary	EBF, MF, ERF	Practice	0-6 months PP	<6 months PP	Yes
Mutawulira *et al*. 2022	2021-2021	Uganda	Retrospective Cross-sectional	Cross-sectional	Primary	EBF, MF	Practice	0-6 months PP	<6 months PP	No

Table 2.2: Numerical distribution of included studies from African countries

Country	No. of Studies	Country	No. of Studies
Ethiopia	13	Malawi	2
South Africa	12	Botswana	1
Nigeria	10	Liberia	1
Uganda	6	Lesotho	1
Cameroon	4	Mozambique	1
Zambia	4	Namibia	1
Tanzania	3	Rwanda	1
Kenya	2	Zimbabwe	1

Table 2.3: Infant feeding intentions of mothers with HIV, from 9 included studies

Citation	Country	Study Year(s)	Sample Size	EBF		No EBF (MF + EBF)		Undecided	
				N	%	N	%	N	%
Ukpe, IS, *et al.* 2009	South Africa	2007-2008	30	9	30.00%	16	53.33%	5	16.67%
Kafulafula, UK, *et al*. 2013	Malawi	2009-2010	110	85	77.27%	25	22.73%		
Iloh, KK, *et al.* 2015	Nigeria	2011-2012	210	71	33.81%	139	66.19%		
Onubogu, CU, *et al*. 2015	Nigeria	2012	142	39	27.46%	77	54.23%		
Thomas, E*, et al.* 2017	South Africa	2012-2015	192	87	45.31%	105	54.69%		
Afolabi, AY, *et al.* 2018	Nigeria	2015-2016	60	58	96.67%	2	3.33%		
Aguti, I, *et al.* 2020	Uganda	2014-2016	365	345	94.52%	20	5.48%		
Ashipala, DO, *et al.* 2021	Namibia	2019	54	32	59.26%	13	24.07%	9	16.67%
Mussa, A, *et al.* 2021	Botswana	2013-2015	810	194	23.95%	616	76.05%		

Table 2.4: Infant feeding practice over 6 months, from 12 included studies

Citation	Study Year(s)	Country		Time of Birth	2w PP	4w PP	6w PP	8w PP	10w PP	12w PP	14w PP	16w PP	18w PP	20w PP	22w PP	24w PP
			Num / Den	186/186				157/186			67/186					26/186
Young, SL, *et al.* 2010	2008	Tanzania	%	100%				84%			36%					14%
			Num / Den	207/207												192/207
Ngoma, MS, *et al.* 2015	2008-9	Zambia	%	100%												93%
			Num / Den	206/206			196/206			186/196						186/196
Anígilájé, EA, *et al.* 2015	2008-11	Nigeria	%	100%			95%			95%						95%
			Num / Den	39/39	34/39		32/39			27/39						8/39
Onubogu, CU, *et al.* 2015	2012	Nigeria	%	100%	87%		82%			69%						21%
			Num / Den	1450/1450			1227/1450			757/919						382/1691
Goga, AE, *et al.* 2020	2012-13	South Africa	%	100%			85%			82%						23%
			Num / Den	95/95			82/95									37/95
Pellowski, J, *et al.* 2019	2012-15	South Africa	%	100%			86%									39%
			Num / Den	575/575		506/575									352/575	
Gill, MM, *et al.* 2017	2013-14	Rwanda	%	100%		88%									61%	
			Num / Den	67/67			67/67					62/67				62/67
Decker, S, *et al.* 2017	2013-15	Uganda	%	100%			100%					93%				93%
			Num / Den	316/316		241/316										76/316
Maonga, AR, *et al.* 2016	2014	Tanzania	%	100%		76%										24%
			Num / Den	345/345												100/345
Aguti, I, *et al.* 2020	2014-16	Uganda	%	100%												29%
			Num / Den	469/469												150/469
Goon, DT, *et al.* 2021	2018-18	South Africa	%	100%												32%
			Num / Den	446/446	407/446		361/446				266/446					
Napyo, A, *et al.* 2020	2018-20	Uganda	%	100%	91%		81%				60%					

Table 2.5: Cross-sectional results of infant feeding practice, 0-6 months, from 40 included studies

Study #	Country	Time Point	Sample Size	EBF		MF		ERF	
				N	%	N	%	N	%
Lanktree, E, *et al.* 2011	Uganda	3m PP	44	25	56.82%	19	43.18%	0	0.00%
Ukpe, IS, *et al.* 2009	South Africa	1w PP	30	8	26.67%	7	23.33%	15	50.00%
Torpey, K, *et al.* (2012)	Zambia	0-6m PP	7989	4285	53.64%	2077	26.00%	1627	20.37%
Njom Nlend, AE, *et al.* 2018	Cameroon	0-3m PP	1077	405	37.60%	14	1.30%	658	61.10%
Itiola, AJ, *et al.* 2019	Nigeria	0-6m PP	1576	890	56.47%	257	16.31%	429	27.22%
Ladzani, R, *et al*. 2011	South Africa	3-6m PP	803	290	36.11%	101	12.58%	412	51.31%
Okong, P, *et al.* 2010	Uganda	6w PP	51	27	52.94%	1	1.96%	23	45.10%
Okong, P, *et al*. 2010	Uganda	10w PP	21	10	47.62%	0	0.00%	11	52.38%
Okong, P, *et al.* 2010	Uganda	14w PP	20	12	60.00%	1	5.00%	7	35.00%
Ahmadu-Ali, UA, *et al.* 2014	South Africa	6w PP	71	43	60.56%	10	14.08%	18	25.35%
Chi, BH, *et al.* 2014	Zambia	0-6m PP	1250	1088	87.04%	148	11.84%	14	1.12%
Mwendo, EM *et al.* 2014	Tanzania	6w PP	559	497	88.91%	22	3.94%	40	7.16%
Goga, AE, *et al.* 2015	South Africa	0-6m PP	3088	618	20.01%	600	19.43%	1870	60.56%
Noubiap, JJ, *et al.* 2013	Cameroon	0-6m PP	80	40	50.00%	10	12.50%	30	37.50%
Saounde Temgoua, EM, *et al.* 2015	Cameroon	0-6m PP	3789	1,199	31.64%	546	14.41%	2,044	53.95%
Muluye, D, *et al.* 2012	Ethiopia	0-6m PP	209	175	83.73%	22	10.53%	12	5.74%
Goga, AE, *et al.* 2016	South Africa	6w PP	4128	1493	36.17%	377	9.13%	2258	54.70%
Moges, NA, *et al.* 2017	Ethiopia	0-6m PP	305	294	96.39%	9	2.95%	2	0.66%
Aishat, U, *et al.* 2015	Nigeria	0-6m PP	480	293	61.04%	62	12.92%	125	26.04%

Berhan, Z, *et al.* 2014	Ethiopia	0-6m PP	434	402	92.63%	32	7.37%	0	0.00%
Goga, AE, *et al.* 2020	South Africa	6w PP	2246	1227	54.63%	223	9.93%	796	35.44%
Goga, AE, *et al.* 2020	South Africa	3m PP	1776	757	42.62%	162	9.12%	857	48.25%
Mama, A, *et al.* 2017	Ethiopia	0-6m PP	130	118	90.77%	12	9.23%	0	0.00%
Oleribe, OO, *et al.* 2018	Nigeria	0-6m PP	1379	1133	82.16%	139	10.08%	107	7.76%
Ashiono, E, *et al.* 2017	Kenya	0-6m PP	1746	1368	78.35%	164	9.39%	214	12.26%
Negash, TG and Ehlers, VH 2016	Ethiopia	0-6m PP	384	334	86.98%	11	2.86%	39	10.16%
Dinh, TH, *et al.* 2018	Zimbabwe	1-3m PP	1156	811	70.16%	319	27.60%	26	2.25%
Remmert, JE, *et al*. 2020	South Africa	0-6m PP	154	44	28.57%	0	0.00%	110	71.43%
Hampanda, K 2016	Zambia	0-6m PP	157	107	68.15%	50	31.85%	0	0.00%
Tuthill, EL, *et al.* 2017	South Africa	6w PP	54	44	81.48%	10	18.52%	0	0.00%
Flax, VL, *et al.* 2016	Malawi	0-6m PP	40	30	75.00%	10	25.00%	0	0.00%
Obsa, S, *et al.* 2018	Ethiopia	0-6m PP	492	367	74.59%	96	19.51%	29	5.89%
Tukei, VJ, *et al.* 2020	Lesotho	0-6m PP	536	279	52.05%	210	39.18%	47	8.77%
Kassaw, MW, *et al.* 2020	Ethiopia	0-6m PP	217	134	61.75%	2	0.92%	81	37.33%
Andare, N, *et al.* 2019	Kenya	0-6m PP	77	55	71.43%	14	18.18%	8	10.39%
Afolabi, AY, *et al.* 2018	Nigeria	0-6m PP	44	29	65.91%	8	18.18%	7	15.91%
Yapa, HM, *et al.* 2020	South Africa	0-6m PP	229	146	63.76%	7	3.06%	76	33.19%
Desta, ML, *et al.* 2019	Ethiopia	1-6m PP	340	337	99.12%	2	0.59%	1	0.29%
Tchendjou, P, *et al.* 2020	Cameroon	0-6m PP	1790	1086	60.67%	129	7.21%	575	32.12%
Umar, IU, *et al.* 2022	Liberia	1-6m PP	284	276	97.18%	2	0.70%	6	2.11%
Tsehay, AK 2019	Ethiopia	0-6m PP	477	423	88.68%	54	11.32%	0	0.00%
Mebratu, L, *et al.* 2020	Ethiopia	0-6m PP	209	169	80.86%	38	18.18%	2	0.96%
Mutawulira, I *et al.* 2022	Uganda	0-6m PP	108	83	76.85%	25	23.15%	0	0.00%

Table 2.6: Cross-sectional results of infant feeding practice at 6 months, from 14 included studies

Study #	Country	Sample Size	EBF		MF		ERF	
			N	%	N	%	N	%
Young, S.L., et al. (2010)	Tanzania	196	26	13.27%	41	20.92%	129	65.82%
Okong, P., et al. (2010)	Uganda	10	4	40.00%	3	30.00%	3	30.00%
Chi, B. H., et al. (2014)	Zambia	2965	2748	92.68%	182	6.14%	35	1.18%
Haile, D., et al. (2014)	Ethiopia	178	135	75.84%	43	24.16%	0	0.00%
Goga, A. E., et al. (2020)	South Africa	1691	382	22.59%	281	16.62%	1028	60.79%
Lawani, L.O., et al. (2014)	Nigeria	556	510	91.73%	42	7.55%	4	0.72%
Moiane, A., et al. (2020)	Mozambique	923	446	48.32%	441	47.78%	63	6.83%
Dinh, T. H., et al. (2018)	Zimbabwe	853	367	43.02%	453	53.11%	33	3.87%
Hampanda, K. (2016)	Zambia	163	95	58.28%	68	41.72%	0	0.00%
Flax, V. L., et al. (2016)	Malawi	120	99	82.50%	21	17.50%	0	0.00%
Adelekan, B., et al. (2022)	Nigeria	2320	2177	93.84%	43	1.85%	100	4.31%
Iliyasu, Z., et al. (2019)	Nigeria	203	139	68.47%	60	29.56%	4	1.97%
Mihret, M.S., et al. (2020)	Ethiopia	485	358	73.81%	22	4.54%	105	21.65%
Bultum, E. T., et al. (2022)	Ethiopia	218	122	55.96%	96	44.04%	0	0.00%

Chapter 3: Development and Validation of a Theory-Based Tool for Examining Infant Feeding Practices Among Mothers living with HIV in Addis Ababa, Ethiopia

Background

Infant Feeding Practices and HIV

Infant feeding practices are critical in the prevention of mother-to-child transmission (MTCT) of HIV, particularly in sub-Saharan Africa, which bears the highest global burden of pediatric HIV (UNAIDS, 2024). The World Health Organization (WHO) recommends exclusive breastfeeding (EBF) for the first six months of life, followed by continued breastfeeding with appropriate complementary foods up to two years or beyond, for all mothers, including those living with HIV. This guidance is based on evidence that EBF, combined with maternal antiretroviral therapy (ART), can significantly reduce the risk of MTCT to less than 5% while supporting optimal infant growth and development (World Health Organization, 2010, 2016b).

Exclusive breastfeeding provides essential nutrients and immunological protection, reducing the risk of diarrhea, respiratory infections, and malnutrition, which are leading causes of infant mortality in low-resource settings (A. Goga & Coutsoudis, 2018). For HIV-positive mothers, the benefits of EBF outweigh the potential risks of HIV transmission and maximize HIV-free survival. Studies have shown that EBF, particularly when coupled with maternal ART, is associated with lower rates of postnatal HIV transmission compared to mixed feeding or formula feeding (World Health Organization, 2008, 2010).

In contrast, exclusive formula feeding (or replacement feeding) eliminates the risk of HIV transmission through breastfeeding but requires access to safe water, hygienic conditions, and reliable formula supplies, and therefore may increase the risk of malnutrition, diarrhea, and mortality in resource-limited settings (Kuhn & Aldrovandi, 2010). The feasibility of formula

feeding is often compromised in sub-Saharan Africa due to poverty, stigma, inadequate infrastructure, and limited healthcare support (Mallampati et al., 2018; Nyoni et al., 2019).

Mixed feeding, the practice of combining breastmilk with other liquids or foods, is strongly discouraged for HIV-positive mothers, as it increases the risk of MTCT. This elevated risk is attributed to intestinal inflammation caused by exposure to non-breastmilk substances, which facilitates viral entry (Coovadia et al., 2007). Despite this, mixed feeding remains prevalent in sub-Saharan Africa for a number of reasons including cultural norms, maternal perceptions of breastmilk insufficiency, and social pressures from family and community members (Nyoni et al., 2019).

Across sub-Saharan Africa, maternal and infant health outcomes are intricately tied to infant feeding practices. The challenges of promoting and sustaining EBF are complex and multifaceted. Addressing these challenges requires context-specific strategies that balance the risks and benefits of different feeding practices while supporting mothers in adhering to WHO guidelines (Horvath et al., 2009).

Infant Feeding Practices among Mothers living with HIV in Sub-Saharan Africa

Despite the WHO recommendation of EBF for the first six months of life to maximize HIV-free survival, adherence to this practice varies widely across sub-Saharan Africa. Eleven studies that followed mothers from birth to 6 months postpartum reported EBF rates from 14% to 95%, indicating vast differences in adherence to EBF (Aguti et al., 2020; Anígilájé et al., 2015; Decker et al., 2017; Gill et al., 2017; A. E. Goga et al., 2020; Goon et al., 2021; Napyo et al., 2020; Ngoma et al., 2015; Onubogu et al., 2015; Pellowski et al., 2019; Young et al., 2010). Despite these differences, all studies demonstrated substantial drops in adherence over this before 6 months postpartum. No prospective studies on infant feeding practice among mothers

living with HIV have been published in Ethiopia, though 13 cross-sectional studies, published between 2012 and 2022 in various regions of the country, have estimated EBF rates from 56% to 99% (Bultum et al., 2022; Moges et al., 2017).

While the literature points to some correlates or predictors (such as disclosure of HIV status, increased antenatal care attendance, and location of delivery) of infant feeding practice in the region, the causal factors of feeding intention and practice remain largely unknown (Horvath et al., 2009; Kinshella et al., 2021). There is little information available on the factors that underlie women's infant feeding choices and how their decisions, once made, changes over time. Yet, appropriate interventions cannot be designed without first identifying the most significant barriers to EBF.

Theoretical Framework Application

In order to develop interventions that address suboptimal infant feeding practices among mothers living with HIV, it is first necessary to identify underlying mechanisms that drive initiation and maintenance of EBF. Research suggests that intervention strategies based on empirically validated theories are more effective in accomplishing healthy behavior change, than those without a theoretical basis (Glanz et al., 2015). Further, theory can assist in consolidating target variables and mechanisms in the development of effective interventions. The Theory of Planned Behavior (TPB) provides an explanatory model for understanding this type of cognitive process that has been widely used and validated across many behaviors.

The TPB (Figure 3.1) posits that behavioral intention (BI) is the most proximal and important determinant of behavior and is influenced by three direct determinants: attitudes (ATT), the subjective norms (SN) and perceived behavioral control (PBC) regarding a specific behavior. Attitudes toward the behavior reflect an individual's overall evaluation of the behavior,

encompassing both instrumental (e.g., useful/useless) and experiential (e.g., pleasant/unpleasant) aspects. Subjective norms capture the perceived social pressure to perform or not perform the behavior, including both injunctive norms (what others think one should do) and descriptive norms (what others actually do). Perceived behavioral control refers to the individual's belief in their ability to perform the behavior, influenced by both self-efficacy (confidence in performing the behavior) and controllability (perceived control over external factors) (Ajzen, 1985; Conner, 2009; Glanz et al., 2015).

A beneficial attribute of the TPB is that a rigorous and systematic approach for research application has been developed to operationalize the theory (Ajzen, 2006; Francis et al., 2004). The key constructs are measured using direct measures and indirect measures, based on Likert-scale items (Table 3.1). Direct measures provide an overall assessment of each construct. Indirect measures delve deeper into the underlying beliefs that inform these constructs. For attitudes, this involves multiplying the strength of a belief (b) by the evaluation of that belief (e). For subjective norm, the strength of a normative belief (n) is multiplied by the motivation to comply with that referent (m). Similarly, for perceived behavioral control, control belief (c) strength is multiplied by the perceived power of that barrier or facilitator (p). The products are then summed to provide overall indirect scores for each construct.

Developing a TPB-based questionnaire requires a mixed methods approach to ensure both theoretical rigor and contextual relevance. The process begins with qualitative elicitation studies to identify the salient behavioral, normative, and control beliefs that are most relevant to the target population and behavior. These findings inform the creation of questionnaire items tailored to the behavior under study. Quantitative methods are then employed to refine and

validate the measures. By integrating qualitative and quantitative methods, researchers can construct questionnaires that are both context-specific and psychometrically sound.

Ethical Approval

Ethical approval was first obtained from Emory University IRB and the National Research Ethics Review Committee (Ethiopia Ministry of Science and Technology) prior to the initiation of this study. Ethical approval was then additionally granted from each of the study hospitals (AHRI/ALERT Hospital Ethics Review Committee, St. Paul's Hospital of Millennium Medical College IRB, Gandhi Memorial Hospital, and Yekatit 12 Hospital Medical College).

Study Setting and Target Population

For both the qualitative and quantitative phases, study activities took place in Addis Ababa, Ethiopia. This urban area has the largest population of women living with HIV in the country. The target population was comprised of pregnant and postpartum women living with HIV, 15-45 years of age, residing in or seeking HIV treatment in Addis Ababa.

For both study phases, inclusion criteria were: (1) women living with HIV, as verified by hospital records; (2) seeking care at one of the recruitment hospitals in Addis Ababa; (3) between 36 gestational weeks pregnant and 3 months postpartum; (4) understand and speak English and/or Amharic; and (5) able to give informed consent. Exclusion criteria were (1) intend to exclusively formula feed; (2) have severe antepartum or intrapartum complications that preclude involvement (as determined by their health care provider); and (3) have major cognitive impairments (as determined by their health care provider).

Both pregnant and postpartum women were included to ensure that different beliefs that arise across this span of time (the time points of measurement in the quantitative phase) were considered. Because the purpose of this study focused on adherence to EBF, only women who

planned or practiced some level of breastfeeding (e.g., did not intend to exclusively formula feed) were included. This is because salient attitudes, subjective norms and control beliefs regarding exclusive breastfeeding differ from those for formula or exclusive replacement feeding.

Phase I: Qualitative Research

Methods

Study participants were recruited for the qualitative interviews between from two hospitals in Addis Ababa (ALERT Hospital and St. Paul's Hospital). The location of these two hospitals on opposite ends of the city helped to maximize the representativeness of the sample. Due to the relatively low prevalence of HIV (despite the high overall number), it was important that all potential participants be identified and offered the opportunity to participate. Thus, a purposive sampling methodology was used with the aim of recruiting 25 participants for the qualitative phase between June and August 2014. This number is noted in the literature as adequate to reach saturation in obtaining salient TPB-related beliefs.

Ethiopia's Federal Ministry of Health (FMOH) began integrating mother mentors with a Mother Support Group (MSG) into national HIV programing in 2005 to address the special needs of pregnant and postpartum women living with HIV and their children. These mother mentors are living with HIV themselves and trained to work closely with patients from hospitals or health centers. The MSG mother mentors, in collaboration with other hospital clinicians and the research team, reviewed facility records to identify potential participants, screened potential subjects against the inclusion and exclusion criteria (nurses/doctors were available for consult, if necessary), phoned potential participants to provide them with a brief summary of the study and invite them to participate, and finally arranged a meeting between the participant and the

research team. Women who met the inclusion criteria were oriented to the study in greater detail and asked for their verbal informed consent. Subjects were reimbursed 50 ETB (US$2.50) for their transportation to the hospital for the interview.

A semi-structured interview guide was developed to elicit salient behavioral beliefs, normative referents and control beliefs related to exclusive breastfeeding. Direct measure scales were developed prior to the qualitative phase of the study so that they could also be pilot tested, along with the use of several visual scales for assistance (Figure 3.2). Finally, both consent and assent forms with a lay explanation of the study and the patients' rights were drafted. All study materials were translated by a native Amharic and English speaker, and then reviewed by a second native speaker. Any differing interpretations by the two native speakers were discussed, until a mutually agreed upon translation was finalized.

The research team was composed of an interviewer/data collector (who is a native English and Amharic speaker) and the PI who observed the interviews and took field notes. Due to the low literacy rates among the target population, face-to-face interviews were conducted in a private location within the hospitals. The PI reviewed the study purpose, theoretical background and interview guide with the interviewer. The PI and interviewer conducted several mock interviews, so the interviewer could become comfortable with the flow of the questions, clarify any confusion, and practice different techniques to encourage comfortable and ongoing conversation with the participants.

In addition to the semi-structured interview guide, multiple visual scales corresponding to a 5-point Likert scale were tested with drafted quantitative measures based on TPB direct measures (Figure 3.2). Visual scale 1 was shown while the reading of the question, and as the interviewer read off each response, he would point to the corresponding box/arrow. In visual

scale 2, questions were asked in two parts. The respondent was first asked if their response was overall neutral (square), negative (triangle) or positive (circle). If they answered neutrally, there was no follow up. However, if they answered positively or negatively, a second flap of the scale (shown laterally to dotted lines), would be displayed, demonstrating a similar item as a larger size, and participants would be asked which size corresponds more directly to their attitude. Finally, visual scale 3 was tested, using internationally recognized hand gestures ("thumbs up" and "thumbs down"). All participants were asked some questions with each scale, and they were asked to identify which was the clearest or most understandable to them.

Interviews were transcribed in Amharic and then translated to English by three different native Amharic and English speakers. Transcripts in both Amharic and English were maintained to preserve exact language used by participants. To assess quality of transcription and translation, each translator was assigned to another translator's transcripts. He/she selected 10% of transcripts (in both Amharic and English) to evaluate it for accuracy. No significant inaccuracies or discrepancies were reported.

English transcripts were then entered into Nvivo, a qualitative data management software program for analysis, so that interview responses could be content analyzed and grouped by construct. As recommended, both the PI and a second researcher (e.g., the interviewer) completed this process to increase the validity of the analysis. The PI and the interviewer first used open coding and then principles of axial coding were applied to assign each of the codes to one of the four major constructs (intention, attitudes, normative referents, or control beliefs). Alternatively, codes could have been deemed irrelevant to the theoretical framework and removed or determined a necessary modification of the TPB structure. After independent coding was completed, the PI and interviewer compared results. Codes that could fit into more than one

category were discussed, and the best fitting category was used. Any code that constituted a direct measure (e.g., “breastfeeding is good”) were removed. When appropriate, similar codes were grouped together into a more concise code. For example, “breastfeeding is painful” and “breastfeeding is not comfortable” were grouped into the joint code “breastfeeding is uncomfortable”.

Any code with less than 100% agreement, in terms of its code and/or construct assignment were re-evaluated. If agreement could not be achieved it would be dropped, however this did not become necessary. Agreed codes were listed in order, from most to least frequently mentioned, for each of the major constructs. The most frequently mentioned codes by respondents were retained and converted into statements for the preliminary quantitative questionnaire. Transcripts were again reviewed for this process to ensure that the phrasing used in the written statement, matched the phrasing that was used in the original Amharic transcripts.

Results

A total of 23 interviews were completed between July and August of 2014 (an additional 3 interviews, after the proposed 19, were completed for further verification that saturation had been reached). After the first 16 interviews, the interviewer indicated that saturation may have been reached. A preliminary data analysis was conducted, and it was noted that no interviewees reported a child that contracted HIV. MSGs attempted to contact mothers of HIV-infected children, however only 4 were willing and able to participate in the project, and none met the inclusion criteria (as all children were older than 6 months). Despite this, interviews were conducted with these women, in case they could provide any supplemental information. However, in all cases, the participants were unaware of their HIV-status at the time of delivery

and during their first 6 months of infant feeding, thus these transcripts were not included in analysis.

The resulting product was a preliminary quantitative questionnaire, based on results of the elicitation study (Table 3.2), that included indirect items to measure TPB constructs in this target population. To ensure face validity, the pool was shared with three subject matter experts (one practicing physician in Addis Ababa, one maternal-child health researcher, and one expert on health behavior) who all agreed the items appeared valid and comprehensive. Original Amharic transcripts were consulted in determining the exact phrasing of items to ensure that it reflects rhetoric used by the target population. Regarding the visual scales, all participants indicated that scale one (arrows) was the most understandable and useful, and it was decided that it would be used as part of the pre-testing of the quantitative questionnaire.

Phase II: Pre-testing of Quantitative Tool

Methods

For the pre-testing of the quantitative tool, participants were recruited from three hospitals (ALERT Hospital, St. Paul's Hospital, and Ghandi Memorial Hospital), along with satellite health centers associated with these hospitals. 65 participants were recruited for pre-testing of the pilot instrument between April and May 2015.

Based on the final pool of statements from the qualitative phases, a TPB questionnaire was drafted, that included questions on (1) socio-demographic characteristics (e.g., age, obstetric history, ethnicity, religion, level of education, marital status employment status and residence); (2), factors that may modify TPB constructs or actual behavior (e.g., disclosure of HIV status, number of antenatal care visits, time of first antenatal care visit, ART, number of infant counseling sessions, location of birth, and past infant feeding practices); (3) direct measures of

A, SN and PCB; (4) indirect measures of A, SN and PCB (eg. b, e, n, m, c, p); (5) direct measures of BI; and (6) actual infant feeding practice. Translation of all materials (questionnaire, consent and assent forms) and training and data collectors followed a similar methodology as discussed for the qualitative phase.

To assess the reliability of direct measure scale items, Cronbach's alpha coefficients were analyzed. A sample size of 63 was calculated to be sufficient for a 15-item scale with an estimated Cronbach's alpha of 0.7 (and a null hypothesis of 0.5), 80% power, and a significance level of 0.05, derived from Bonnet's formulas for sample size requirements. Correlation analysis, comparing direct and indirect measures of TPB constructs, was conducted to establish concurrent criterion-related validity. Pearson product-moment correlation coefficients were employed to determine the extent to which the two sets of scores were correlated.

Results

There was a total of 65 participants, 16 (25%) were at least 36 weeks pregnant and 49 (75%) were up to 6 months postpartum. Among pregnant women, 13 (81%) intended to exclusively breastfeed, while 1 (6%) intended to mixed feed and 2 (12%) were unsure. Among postpartum women, 46 (94%) were exclusively breastfeeding and 3 (6%) were mixed feeding.

Sixty (92%) of the participants live in Addis Ababa, whereas 5 (8%) participants live in the neighboring Oromiya region. However, only 19 (29%) of the participants originated from Addis Ababa, with the remaining participants originating in Amhara (31%), Oromiya (15%), SNNP (20%) and Tigray (5%). The ages of the participants ranged from 19 to 39, with an average of 29 years. The majority identified as Christian Orthodox (72%), and the remaining were Muslim (17%), Roman Catholic (6%) and Protestant (5%). Twenty-one (32%) of participants received no formal education. Among those who did receive an education, 30 (68%)

only attended primary school, 11 (25%) attended secondary school, and 3 (7%) attended a technical/vocational school. Nearly half (48%) identified their ethnicity as Amhara. The remaining classified themselves as Gamo (2%), Guragie (22%), Kefa (2%), Oromo (19%), Silte (3%), and Tigray (6%).

Direct measures were written as 5-point bipolar Likert scales, ranging from strongly disagree to strongly agree (including a neutral option). The exception to this is the attitude scales which were tailored to the specific adjective used (e.g., very bad, bad, neither good nor bad, good, very good). Each construct had 5 items for its measurement. In the case of the third and fifth measure of PBC, which were phrases in a negative manner, the results were reverse coded before analysis. It is important to note that these items were translated into Amharic, and that there is not always a direct translation.

Internal Consistency Reliability. Internal consistency reliability was assessed with Cronbach's alpha. Cronbach's alpha over 0.7 is considered acceptable, whereas a Cronbach's alpha over 0.8 is considered good internal consistency. However, a very high Cronbach's alpha (0.95 or higher) is not ideal, as it indicates redundant measures. Further, Cronbach alpha values are dependent on the number of items in the scale, and smaller scales can result in smaller Cronbach alpha scores (e.g. <0.5). Thus, some experts recommend when working with scales that have fewer than 10 items, it may be better to consider mean inter-item correlations with an optimal range from 0.2 to 0.4 (Briggs & Cheek 1986).

Cronbach's alpha was calculated for the entire set of items, and items with low item-total correlations or those that reduced the overall alpha were identified. These items were systematically removed in an iterative process, recalculating the alpha after each removal. This procedure was repeated until the highest possible Cronbach's alpha was achieved, ensuring both

optimal reliability and theoretical relevance of the retained items. Due to the low literacy level of the population, the tool was also modified by recoding the original 5-point Likert scale into a simplified 3-point Likert scale. This adjustment was made to assess whether reducing the complexity of the response options would enhance the tool's internal consistency. Additionally, a subgroup analysis was conducted, stratifying participants into pregnant and postpartum groups, to evaluate potential differences in internal consistency across these populations.

For *Behavioral Intention*, the 5-point scale demonstrated strong reliability with a Cronbach's Alpha of 0.825, which increased to 0.882 when one item (BI-3) was excluded. Similarly, the 3-point scale showed comparable reliability with a Cronbach's Alpha of 0.868 across all five items, improving to 0.934 after the removal of BI-3. When analyzing the pregnant and postpartum sub-groups separately, both scales maintained similarly high reliability. These results suggest that both scales effectively capture behavioral intention, but the 3-point scale may oversimplify responses, potentially introducing redundancy and diminishing the distinctions provided by the 5-point scale. The final version of the direct measure scale retained four items (BI-1, BI-2, BI-4, BI-5) with a 5-point scale.

For *Attitude*, the 5-point scale for the attitude construct achieved a Cronbach's Alpha of 0.844 and results indicated that removing items would not improve reliability of the scale. On the 3-point scale, the overall reliability was high for all five items at 0.854, and increased to 0.915 with the removal of the same item (A-4). For the sub-group analysis, reliability was somewhat higher for the pregnant women compared to the postpartum women across both 5-point and 3-point scales, indicating that there may be some difference in how these groups responded to the questions. Similar to the behavioral intention scale, these results indicate that both scales reliably measure attitude, but the 3-point scale may lead to redundancy in the

measures. The final version of the direct measure scale retained all five items (ATT-1, ATT-2, ATT-3, ATT-4, ATT-5) with a 5-point scale.

The reliability of the 5-point scale for *Subjective Norms* was initially very low, with a Cronbach's Alpha of 0.248. Reliability improved to 0.477 after removing SN-3 and further to 0.493 with the removal of SN-2. The 3-point scale demonstrated similar performance, beginning with an Alpha of 0.125, increasing to 0.410 after excluding SN-3, and reaching 0.455 with the additional removal of SN-2. Overall, the 5-point scale appears to be a more reliable scale. For the sub-group analysis, reliability was somewhat higher for the pregnant women compared to the postpartum women across both 5-point and 3-point scales, suggesting potential differences in their interpretation of the questions or their responses. The final version of the direct measure scale retained three items (SN-1, SN-4, SN-5) with a 5-point scale.

The 5-point scale for *Perceived Behavioral Control* initially demonstrated low reliability with a Cronbach's Alpha of 0.399. This was improved to 0.483 by first removing PBC-5, and then to 0.618 by removing PBC-4. The 3-point scale performed comparably with an original Cronbach's Alpha of 0.430, which then increased to 0.508 by first removing PBC-5, and then to 0.623 by removing PBC-4. For the sub-group analysis, reliability was somewhat higher for the postpartum women compared to pregnant women across both 5-point and 3-point scales, indicating that there may be some difference in how these groups responded to the questions. The final version of the direct measure scale retained three items (PBC-1, PBC-2, PBC-3) with a 5-point scale.

Validity of Indirect and Direct Measures. To demonstrate that direct and indirect measures have convergent validity, correlation between these two scales was assessed. For the attitude construct, the correlations between the indirect attitude scale and the direct scale items

were low to moderate. The indirect scale showed a significant positive correlation with four of the five items directly measuring attitudes toward exclusive breastfeeding, including the bad/good scale ($r = 0.459$, $p < 0.001$), the unpleasant/pleasant scale ($r = 0.347$, $p = 0.005$), the unhealthy/healthy scale ($r = 0.433$, $p < .001$), and the favor/oppose scale ($r = 0.393$, $p = 0.001$). However, the correlation with the item assessing exclusive breastfeeding as harmful/beneficial was weaker and not statistically significant ($r = 0.243$, $p = 0.051$). When averaged across all direct attitude measures, the indirect scale showed a moderate positive correlation ($r = 0.480$, $p<.001$), highlighting a statistically significant correlation between the indirect and direct attitude measures.

For subjective norms, the indirect scale was weakly to moderately correlated with most individual direct scale items. The correlation with "most people important to me think I should EBF for 6 months" was small and nonsignificant ($r = .215$, $p=.086$). However, the items measuring “the women that I know EBF for 6 months” and “the people that I go to for advice want me to EBF for 6 months” showed small though significant relationships ($r =. 303$, $p=.014$ and $r = 0.441$, $p<.001$, respectively). Moreover, when the direct subjective norm measures were averaged, the indirect scale showed a somewhat stronger statistically significant correlation ($r =. 447$, $p<.001$), suggesting the indirect scale aligns well with the direct scale of subjective norms.

Similarly, for perceived behavioral control, the correlations between the indirect scale and the individual direct scale items were weak to moderate. The correlation of the indirect scale with “it is easy for me to exclusively breastfeed for six months” and “I am confident that I can exclusively breastfeed for 6 months” moderate and significant relationships ($r = . 388$, $p=.001$ and $r = 0.298$, $p=.016$, respectively). However, the relationship with “the decision to exclusively breastfeed for 6 months is within my control” was not significant. Despite this, the indirect scale

was significantly correlated with the average direct measure scale (r = .341, p=.006), suggesting the indirect scale does align with the direct measures.

Discussion

This study aimed to develop and validate a culturally relevant survey questionnaire based on the TPB to examine EBF practices among mothers living with HIV in Addis Ababa, Ethiopia. The findings provide valuable information about the decision-making processes influencing EBF decision making and adherence among this population. The qualitative phase identified salient behavioral beliefs, normative referents, and control beliefs related to EBF, which were then used to construct indirect measures for the quantitative phase. The pre-testing of the quantitative tool demonstrated acceptable reliability and validity for most TPB constructs, particularly for behavioral intention and attitude. Finally, the correlation analysis between direct and indirect measures demonstrated evidence of convergent validity, particularly for the attitude construct, though the correlations for subjective norms and perceived behavioral control were weaker. Correlations appeared consistent with relationships found in the literature. Conner et al. (2009) published a meta-analysis of correlations between TPB measures and reported attitudes and behavioral beliefs to have a mean correlation of r=0.54, subjective norms and normative beliefs to have a mean correlation of r=0.49, and perceived behavioral control and control beliefs to have a mean correlation of r=0.52 (Conner, 2009).

One of the key strengths of this study is its grounding in the Theory of Planned Behavior, which provides a robust theoretical framework for understanding the cognitive processes underlying EBF practices. By incorporating both qualitative and quantitative methods, the study was able to capture the context-specific behavioral, normative, and control beliefs influencing EBF adherence among HIV-positive mothers in Addis Ababa. The use of culturally adapted

measures and visual aids to assist with Likert scale responses also enhanced the tool's accessibility for a population with varying literacy levels.

Despite its strengths, the study has several limitations. First, the recruitment of participants through hospitals and health canters may introduce self-selection bias, as the findings may not be generalizable to HIV-positive mothers who do not seek antenatal care. Further, the recruitment through the mother mentors may also bias the sample to those who are more engaged in their own care and/or demonstrate active health seeking behavior. The stigma associated with HIV in Ethiopia may have influenced participation rates and the willingness of mothers to disclose their HIV status or discuss their infant feeding practices openly.

Additionally, the study focused exclusively on mothers who intended to breastfeed, excluding those who planned to exclusively formula feed. While this decision was necessary to align with the TPB's validated methodology for studying a singular health behavior, it limits the generalizability of the findings, as formula or replacement feeding may be an appropriate option for some HIV-positive mothers.

Finally, the reliability of the subjective norms and perceived behavioral control scales was comparatively lower to behavioral intention and attitude, and below the generally accepted Cronbach's alpha of 0.70. There are several possible reasons for this. First, this may suggest more complexity within these broad constructs. For example, subjective norms includes both injunctive norms and descriptive norms. An injunctive normative belief is the perception as to whether a specific individual or group approves or disapproves of a behavior. In contrast, descriptive normative beliefs reflect whether those individuals themselves engage in the behavior. For example, in the complex circumstance of HIV and infant feeding "the women that I know exclusively breastfeed for 6 months" and "it is expected of me that I should exclusively

breastfeed for 6 months" may tap into slightly different latent constructs within subjective norms. Similarly, in the context of PBC, "whether I exclusively breastfeed for 6 months or not is entirely my choice" and "it is easy for me to exclusively breastfeed for 6 months" may also not consistently be aligned, but each may still measure an important aspect of infant feeding decision making. Second, the variability in responses was notably low, which may be due to the sample size or homogeneity of respondents. Sub-group analyses attempted to investigate this, but the stratification by pregnant or postpartum status did not reveal notable differences. Additionally, despite rigorous translation and back-translation processes, it remains possible that the concepts articulated in the English language did not translate well into the Amharic language. Similarly, the literacy and education of the sample population may have also contributed to these outcomes. It is recognized that simpler 5-point scales are more reliable for populations with lower literacy levels, compared to 7-point scales. Even with the use of a 5-point scale and a visual aid to assist in comprehension, it's possible that lack of familiarity or understanding of Likert scales in this culture contributed to these outcomes. Finally, testing conditions always have the potential to introduce biases. For example, a social desirability bias among the participants could have skewed responses about EBF and thereby impact the results. Further analyses of these results, such as assessing the impact of outliers (particularly considering the low variability in responses) or performing factor analysis to assess for latent factors within broader constructs, could shed further light on these outcomes. Additionally, further research with a larger or more representative sample, different scales or a modified survey administration methodology may result in different outcomes.

In conclusion, this newly developed theory-based questionnaire focused on EBF among mothers living with HIV in Addis Ababa, Ethiopia demonstrates adequate reliability and validity

to be used in larger population studies. Application of this tool will allow for further assessment of its psychometric properties, and it could potentially be adapted for similar populations or health behaviors. Finally, this tool can address gaps in understanding of infant feeding practices in the context of HIV and ultimately lead to improved interventions to support EBF among mothers living with HIV and reduce postnatal transmission of HIV.

Figure 3.1: The Theory of Planned Behavior

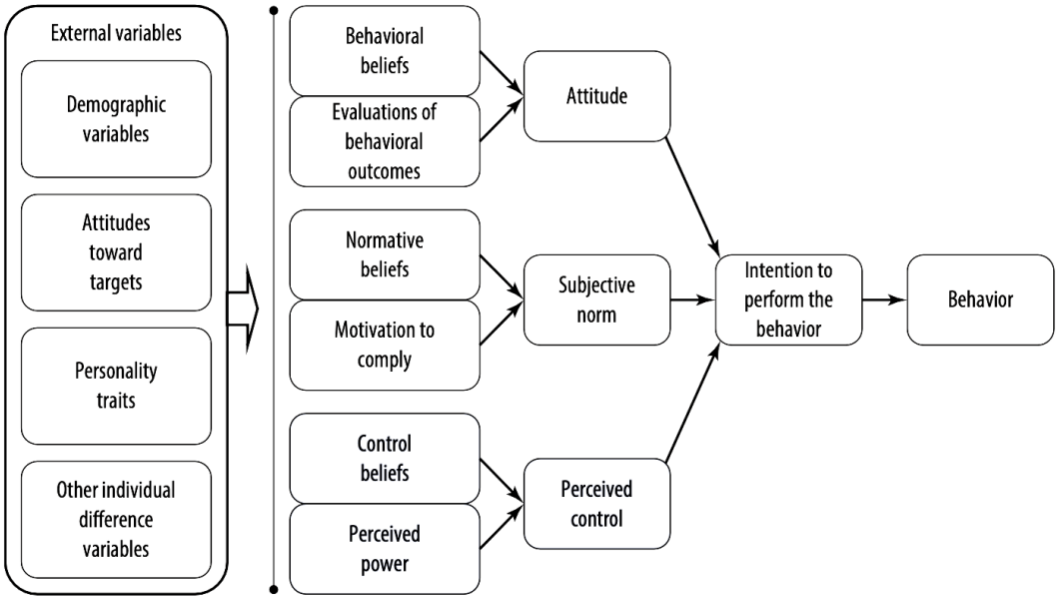
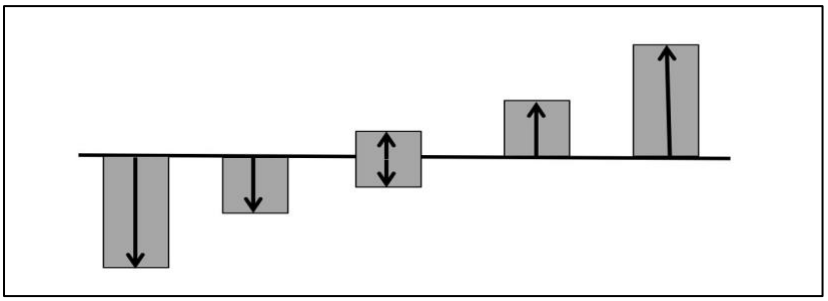
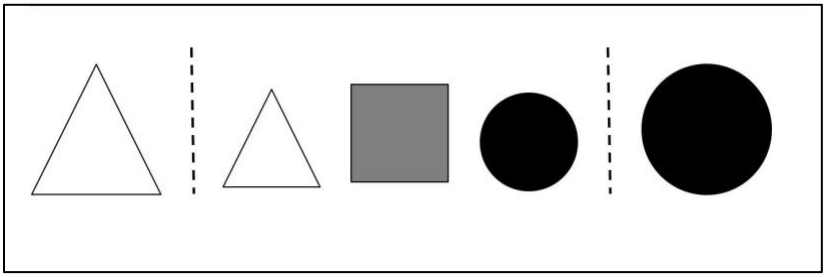


Fig 1. The Theory of Planned Behavior (adapted from Glanz, Rimer, Viswanath)

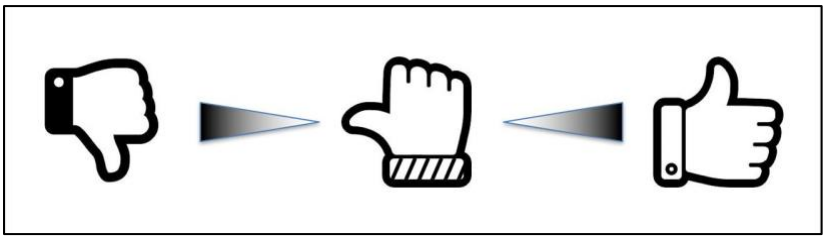
Figure 3.2: Visual scales corresponding to 5-point Likert scale



Scale #1 (Bars and Arrows)



Scale #2 (Shapes)



Scale #3 (Thumbs Up/Thumbs Down)

Table 3.1: TPB Key constructs, operational definitions, and measures

Construct		Operational Definition	Measure
Behavioral Intention	**BI**	**Perceived likelihood of performing the behavior**	**Bipolar Unlikely/Likely -2 to +2**
Attitude	**ATT**	**The degree to which performance of a behavior is positively or negatively valued** ● Experiential attitude (affect) ● Instrumental attitude	**Bipolar Semantic differential -2 to +2**
Behavioral belief	b	Belief that behavioral performance is associated with certain positive or negative feelings	Bipolar Unlikely/Likely -2 to +2
Outcome evaluation	e	Value attached to a behavioral outcome or attribute	Bipolar Bad/Good -2 to +2
Subjective Norms	**SN**	**The perceived social pressure to engage or not to engage in a behavior** ● Injunctive norms ● Descriptive norms	**Bipolar Disagree/Agree -2 to +2**
Normative beliefs	n	Belief about whether each referent approves or disapproves of the behavior	Bipolar Disagree/Agree -2 to +2
Motivation to comply	m	Motivation to do what each referent thinks	Unipolar Important/Not important 1 to 5
Perceived Behavioral Control	**PBC**	**Perceptions of ability to perform a given behavior (similar to self-efficacy)**	**Bipolar Unlikely/Likely -2 to +2**
Control belief	c	Perceived likelihood of occurrence of each facilitating or constraining condition	Bipolar Unlikely/Likely -2 to +2
Perceived power	p	Perceived effect of each condition in making behavioral performance difficult or easy	Bipolar Difficult/Easy -2 to +2

Table 3.2: Salient behavioral beliefs, normative references, and control beliefs

Behavioral Beliefs	**Normative Referents**	**Control Beliefs (Facilitators and barriers)**
EBF for 6 months is best for a child's growth and development	Health professionals	Ability to eat a healthy diet every day
EBF for 6 months prevents illness/disease in children	Elder mothers	Ability to drink a lot of fluids every day
My baby may acquire the HIV virus if I EBF for 6 months	Young women	"Economy" or living conditions
Breastfeeding is a way of showing intimacy with your child	Educated people	Paying job
Breastmilk alone is adequate to meet my child's nutritional needs for 6 months	Modern women	Work or home responsibilities that require time away from baby
Giving supplemental food/drink (water, porridge, abesh) before 6 months supports a child's health	Relatives	Social obligations that baby cannot attend
Breastfeeding makes me happy	Husband	Adequate breast milk production
Breastfeeding is uncomfortable	Other mothers living with HIV	Domestic help
Cessation of EBF at 6 months could result in suspicion of my HIV status	Neighbors	Breast "wounds"
EBF for 6 months prevents transmission of HIV	Friends	Help with childcare is necessary
Tena Adam in water relieves children's abdominal cramps	Doctors	
Breast milk is a natural source of food for my baby	People who know my HIV status	
EBF for 6 months is a convenient way of feeding my baby	People who do not know my HIV status	
EBF makes my baby thirsty		

Table 3.3: Frequency of overall participant response to direct measure questionnaire items

Behavioral Intention (BI)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I expected to exclusively breastfeed for 6 months	0 (0)	4 (6.2)	3 (4.6)	46 (70.8)	12 (18.5)
2. I want to exclusively breastfeed for 6 months	1 (1.5)	3 (4.6)	1 (1.5)	50 (76.9)	10 (15.4)
3. I intend to exclusively breastfeed for 6 months	0 (0)	8 (12.3)	3 (4.6)	46 (70.8)	8 (12.3)
4. I am going to exclusively breastfeed for 6 months	0 (0)	4 (6.2)	0 (0)	49 (75.4)	12 (18.5)
5. I plan to exclusively breastfeed for 6 months	0 (0)	4 (6.2)	0 (0)	49 (75.4)	12 (18.5)
Attitude (ATT)					
	Very bad	Bad	Neither Good nor Bad	Good	Very Good
1. I feel ___ about exclusive breastfeeding for 6 months	0 (0)	0 (0)	2 (3.1)	41 (63.1)	22 (33.8)
	Very Harmful	Harmful	Neither Beneficial nor Harmful	Beneficial	Very Beneficial
2. Exclusively breastfeeding for 6 months is ____	0 (0)	0 (0)	2 (3.1)	48 (73.8)	15 (23.1)
	Very Unpleasant	Unpleasant	Neither Pleasant nor Unpleasant	Pleasant	Very Pleasant
3. Exclusively breastfeeding for 6 months is ____	0 (0)	2 (3.1)	0 (0)	51 (78.5)	12 (18.5)
	Very Unhealthy	Unhealthy	Neither Healthy nor Unhealthy	Healthy	Very Healthy
4. Exclusively breastfeeding for 6 months is ____	1 (1.5)	0 (0)	1 (1.5)	46 (70.8)	17 (26.2)
	Very Negative	Negative	Neither Position nor Negative	Positive	Very Positive
5. I feel ___ about exclusive breastfeeding for 6 months	0 (0)	0 (0)	2 (3.1)	51 (78.5)	12 (18.5)
Subjective Norms (SN)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. Most people who are important to me think that I should exclusively breastfeed for 6 months	1 (1.5)	20 (30.8)	6 (9.2)	35 (53.8)	3 (4.6)
2. It is expected of me that I should exclusively breastfeed for 6 months	0 (0)	1 (1.5)	1 (1.5)	52 (80.0)	9 (13.8)

3. I feel under social pressure to exclusively breastfeed for 6 months	1 (1.5)	45 (69.2)	3 (4.6)	15 (23.1)	1 (1.5)
4. The women that I know exclusively breastfeed for 6 months	2 (3.1)	27 (41.5)	9 (13.8)	25 (38.5)	2 (3.1)
5. The people that I go to for advice want me to exclusively breastfeed for 6 months	0 (0)	12 (18.5)	3 (4.6)	46 (70.8)	4 (6.2)
Perceived Behavioral Control (PBC)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. It is easy for me to exclusively breastfeed for 6 months	0 (0)	9 (13.8)	1 (1.5)	50 (76.9)	5 (7.7)
2. I am confident that I can exclusively breastfeed for 6 months	0 (0)	5 (7.7)	0 (0)	48 (73.8)	12 (18.5)
3. The decision to exclusively breastfeed for 6 months is beyond my control	0 (0)	11 (16.9)	1 (1.5)	52 (80)	1 (1.5)
4. Whether I exclusively breastfeed for 6 months or not is entirely my choice	1 (1.5)	2 (3.1)	0 (0)	57 (87.7)	5 (7.7)
5. Whether I exclusively breastfeed for 6 months is not my decision	1 (1.5)	3 (4.6)	2 (3.1)	57 (87.7)	2 (3.1)

Table 3.4: Internal consistency reliability for direct measure questionnaire items measured using Cronbach's Alpha. Item responses are captured using a 5-point scale.

	Overall (N=65)	Pregnant sub-group (N=16)	Postpartum sub-group (N=49)
Behavioral Intention			
Items 1-5	0.825	0.815	0.830
Items 1-2, 4-5	0.882	0.825	0.906
Attitude			
Items 1-5	0.844	0.900	0.817
Subjective Norms			
Items 1-5	0.248	0.435	0.226
Items 1-2, 4-5	0.477	0.533	0.487
Items 1, 4-5	0.493	0.643	0.448
Behavioral Control			
Items 1-5	0.399	0.404	0.449
Items 1-4	0.483	0.600	0.473
Items 1-3	0.618	0.534	0.698

Table 3.5: Internal consistency reliability for direct measure questionnaire items measured using Cronbach's Alpha. Item responses are captured using a 3-point scale.

	Overall (N=65)	Pregnant sub-group (N=16)	Postpartum sub-group (N=49)
Behavioral Intention			
Items 1-5	0.868	0.882	0.859
Items 1-2, 4-5	0.934	0.893	0.955
Attitude			
Items 1-5	0.826	0.944	0.655
Subjective Norms			
Items 1-5	0.125	0.355	0.099
Items 1-2, 4-5	0.410	0.517	0.413
Items 1, 4-5	0.455	0.621	0.449
Behavioral Control			
Items 1-5	0.43	0.318	0.482
Items 1-4	0.508	0.318	0.574
Items 1-3	0.623	0.469	0.708

Table 3.6: Correlation Table for Attitudes

		ATT-1	ATT-2	ATT-3	ATT-4	ATT-5	ATT AVG
		I feel [bad/good] about EBF for 6 months	EBF for 6 months is [harmful/ beneficial]	EBF for 6 months is [unpleasant/ pleasant]	EBF for 6 months is [unhealthy/ healthy]	I [favor/ oppose] EBF for 6 months	Attitude (Average of direct measures, Items 1-5)
Attitude (Total Indirect Scale)	Pearson Correlation	.459**	0.243	.347**	.433**	.393**	.480**
	Sig. (2-tailed)	<.001	0.051	0.005	<.001	0.001	<.001
	N	65	65	65	65	65	65

Table 3.7: Correlation Table for Subjective Norms

		SN-1	SN-4	SN-5	SN AVG
		Most people important to me think I should exclusively breastfeed for 6 months	The women that I know exclusively breastfeed for six months	The people that I go to for advice want me to exclusively breastfeed for 6 months	Subjective Norms (Average of direct measures, Items 1, 4-5)
Subjective Norms (Total Indirect Scale)	Pearson Correlation	0.215	.303*	.441**	.447**
	Sig. (2-tailed)	0.086	0.014	<.001	<.001
	N	65	65	65	65

Table 3.8: Correlation Table for Perceived Behavioral Control

		BI-1	BI-2	BI-3	BI AVG
		It is easy for me to exclusively breastfeed for six months	I am confident that I can exclusively breastfeed for 6 months	The decision to exclusively breastfeed for 6 months is within my control	Perceived Behavioral Control (Average of direct measures, Items 1-3)
Perceived Behavioral Control (Total Indirect Scale)	Pearson Correlation	.388**	.298*	0.087	.341**
	Sig. (2-tailed)	0.001	0.016	0.491	0.006
	N	65	65	65	65

Chapter 4: Applying the Theory of Planned Behavior to Infant Feeding Practices among Mothers Living with HIV in Addis Ababa, Ethiopia

Background

Ethiopia has one of the highest HIV burdens in Eastern Africa, with an estimated 610,000 people living with HIV as of 2022, including 27,000 children under 14 years of age (UNAIDS, 2023). While substantial progress has been made in reducing the overall prevalence of HIV, challenges remain in achieving equitable access to prevention and treatment services. Mother-to-child transmission (MTCT) of HIV remains a significant public health challenge in Ethiopia. The Ethiopian Public Health Institute estimates a MTCT rate of 8.6% nationally (Ethiopian Public Health Institute, 2024). This route of transmission can occur during pregnancy, delivery, or breastfeeding, making the prevention of mother-to-child transmission (PMTCT) a critical intervention in the fight against HIV/AIDS. HIV prevalence rates in Addis Ababa are notably higher compared to many rural regions of Ethiopia, reflecting disparities in urban and rural HIV burden. Addis Ababa has an HIV prevalence rate of 2.6% among pregnant women, which is more than double the national average of 0.9%. These elevated rates in urban centers like Addis Ababa underscore the need for targeted PMTCT interventions (UNAIDS, 2023).

Ethiopia's national PMTCT strategy aligns with the WHO's Four-Pronged Approach, encompassing prevention of HIV among women of reproductive age, prevention of unintended pregnancies, prevention of vertical transmission, and treatment and care for women living with HIV and their families (Ethiopia Ministry of Health, 2021; World Health Organization, 2012). The national guidelines for infant feeding among mothers with HIV in Ethiopia, which are tailored to the country's resource constraints and epidemiological profile, recommend exclusive breastfeeding (EBF) for the first six months of life, along with antiretroviral therapy (ART), as

this practice can reduce the risk of HIV transmission to less than 5% (World Health Organization, 2016b). In 2021, over 91.9% of HIV-positive pregnant women in Ethiopia received ART, and early infant diagnosis coverage reached 74.5%, reflecting progress in implementing PMTCT services (Ethiopia Ministry of Health, 2021). In cases where safe and affordable alternatives to breastfeeding are available, formula feeding may be advised. However, exclusive breastfeeding often remains the most feasible option for many mothers in Addis Ababa due to economic and sociocultural factors (Gebremariam et al., 2024; Kinshella et al., 2021).

While breastfeeding is vital for infant nutrition and immune development, mixed feeding—combining breastmilk with other foods or liquids—significantly increases the risk of HIV transmission by up to four times (World Health Organization, 2008). A recent study in Ethiopia found that, even in the current environment with increasingly access to lifelong ART, infants who received mixed feeding before six months of age were twice as likely to acquire HIV compared to those on exclusive breastfeeding (Facha et al., 2024). Mixed feeding can cause intestinal inflammation, which may facilitate viral entry (De Cock et al., 2020). Thus, promoting exclusive feeding practices aligned with WHO guidelines is essential for reducing MTCT rates and improving health outcomes for infants born to mothers living with HIV.

Understanding the issues that influence a mother's infant feeding decision and behavior can allow for targeted interventions to promote EBF and reduce MTCT of HIV. The Theory of Planned Behavior (TPB) provides a framework to analyze these issues (Figure 4.1) (Glanz et al., 2015). The TPB posits that individual behavior is influenced by intentions, which are shaped by attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991). The TPB is based on an expectancy-value model, and thus further postulates that the attitudes, subjective norms, and perceived behavioral control (direct measures) results from an interaction between underlying

salient beliefs combined with the subjective value that individual attributes to those beliefs (indirect measures). Direct measures assess the major constructs—attitude, subjective norms, and perceived behavioral control—through general evaluations. Indirect measures, however, delve into the specific beliefs underlying these constructs, offering a more nuanced understanding. While direct measures are often more strongly associated with outcomes, indirect measures provide valuable insights into the belief structures that shape these constructs, which can be crucial for designing effective interventions (Conner, 2009).

By applying TPB to this context, this study aims to explain EBF decision making and practice between time of birth and 4 months postpartum, identify predictors that can explain EBF behavior, and assess if the indirect measures of the TPB can explain changes in the drivers of behavior from baseline to follow up, particularly for mothers who discontinue EBF by 4 months postpartum.

Methods

Design and Sample Size

This study used a prospective, cohort study design to assess infant feeding intention between near time of birth and infant feeding practice at three months postpartum. Required sample size was calculated, based on Monte Carlo simulations, was determined to be 168 participants. Ethical approval was first obtained from Emory University IRB and the National Research Ethics Review Committee (Ethiopia Ministry of Science and Technology) prior to the initiation of this study. Ethical approval was then additionally granted from each of the study hospitals (AHRI/ALERT Hospital Ethics Review Committee, St. Paul's Hospital of Millennium Medical College IRB, Gandhi Memorial Hospital, and Yekatit 12 Hospital Medical College).

Participants and Recruitment

The target sample is comprised of pregnant women with HIV, 15-45 years of age, residing in or seeking HIV treatment in Addis Ababa. The study participants were recruited from four hospitals Addis Ababa (Alert Hospital, Gandhi Memorial Hospital, St. Paul's Hospital, and Yekatit 12 Hospital) as well as their satellite health centers. Inclusion criteria were: (1) woman living with HIV, as verified by hospital records; (2) seeking care at one of recruitment hospitals in Addis Ababa; (3) between 36 gestational weeks pregnant and 1 week postpartum; (4) understand and speak English and/or Amharic; and (5) able to give informed consent. Exclusion criteria were (1) intend to exclusively formula feed; (2) have severe antepartum or intrapartum complications that preclude involvement (as determined by their health care provider); and (3) have major cognitive impairments (as determined by their health care provider).

The study started enrollment in June 2015 and continued through December 2015. ANC records were reviewed with the help of PMTCT nurses and volunteer "mother mentors" to identify potential participants that would meet the inclusion criteria. Mother mentors then phoned potential participants to provide them with a brief summary of the study, invite them to participate, and arrange a meeting between the participant and the research team.

The research team screened potential participants against inclusion and exclusion criteria and those who met the inclusion criteria were oriented to the study in greater detail and asked for their verbal informed consent. Subjects were reimbursed 50 ETB (US$2.50) for their transportation to the hospital for the interview. Study participants were then contacted approximately 6-8 weeks after their baseline interview was completed to ascertain their exact delivery date and to schedule a follow-up interview at 4 months (12 weeks) postpartum. Follow-up interviews were completed through May 2016.

Instruments & Measures

This study utilized a questionnaire based on the TPB (Figure 1) that was previously developed based on standard procedures to ensure validity and reliability. A full description of TPB measures, tool development and validation can be found in Chapter 3.

Briefly, direct measures of behavioral intention (BI), attitude (ATT), subjective norms (SN) and perceived behavioral control (PBC) were measured using items on a 5-point bipolar self-reporting scale with possible responses ranging from strongly disagree (-2) to strongly agree (+2). Averages of these scores were used in analysis. Indirect measures of ATT, SN, and PBC are composite scores calculated by multiplying each belief's strength by the evaluation of that belief, and then summing these products across all salient beliefs. Each belief and outcome were measured on a 5-point Likert scale.

At baseline (time of birth), the questionnaire included several questions to assess demographic and socioeconomic characteristics, as well as health-related information. Behavioral intention was assessed, in addition to the TPB direct and indirect items.

At follow up (4 months postpartum), participants were asked if they have “given nothing but breastmilk”, in order to determine infant feeding practice. This was then confirmed with follow up questions verifying that no water, other liquid or food was given to the baby. Behavioral intention was then re-assessed (asking specifically about intention to continue EBF from four to six months postpartum) and identical TPB direct and indirect items were repeated.

Data Analysis

Responses from the questionnaire were imported from RedCap into an SPSS database for analysis. Univariate analyses were conducted for demographic, socioeconomic and health-related data to describe the sample’s baseline characteristics and to describe infant feeding behaviors at

follow up (4 months postpartum). Chi-square analyses and logistic regression were also used to assess any associations between baseline characteristics and EBF behavior at 4 months. Finally, paired t-test and logistic regression analysis was conducted with indirect scale items to identify what changes occurred in behavioral beliefs, normative beliefs, and control beliefs between birth and 4 months postpartum for both mothers continuing and discontinuing EBF.

Results

169 women living with HIV between 36 weeks' gestation and 1 week postpartum were enrolled in the study. Two potential participants were excluded due to their intention to exclusively formula feed, rather than breastfeed. It was also noted that 8 women completed the baseline questionnaire twice, either at a different health center/hospital or with a different data collector. In these cases, the data from the later questionnaire was retained as it was closest to time of birth. Thus, 161 unique women were included in the sample. Participants were successfully recruited from 29 different hospitals and health centers, in eight of the ten sub-cities of Addis Ababa.

Baseline Characteristics

All participants were in their third trimester of pregnancy, with gestational ages ranging from 36 to 44 weeks. Nearly all, 156 participants (96.9%), planned to exclusively breastfeed (EBF), while four (2.5%) intended to mix feed, and one (0.6%) was undecided. Baseline characteristics of the study participants are summarized in Table 4.1. Information was collected on age, ethnicity, religion, residence, marital status, education, employment and maternity leave, socioeconomic indicators (employment, home ownership, etc.), obstetric history, ANC care, infant feeding counseling, HIV care and treatment, and disclosure of HIV status.

The number of pregnancies reported by participants ranged from 1 to 5, with 36 (22.4%) participants reporting this as their first pregnancy, 67 (41.6%). Twenty-three (14.2%) reported a history of stillbirth, 10 (6.2%) reported having a child infected with HIV, and 17 (10.6%) reported a history of neonatal or child death.

All 161 participants reported receiving some form of antenatal care (ANC). The timing of the first ANC visit varied, with 88 (55.0%) participants reporting their first visit in the first trimester, 64 (40.0%) in the second trimester, and 8 (5.0%) in the third trimester. The number of ANC visits also varied: 2 (1.3%) participants reported only one visit, 67 (41.9%) reported 2 to 4 visits, 83 (51.9%) reported 5 to 8 visits, and 8 (5.0%) reported 9 or more visits. One hundred three (64.0%) of participants indicated that they received some counseling on infant feeding practices during their care, with 27 (16.8%) indicating they received counseling on one occasion, 32 (19.9) were counseled twice, 18 (11.2%) were counseled three times, and 26 (16.1%) were counseled 4 or more times.

Fifty-two participants (32.5%) reported they were newly diagnosed with HIV during this pregnancy, while 108 (67.5%) were previously diagnosed. Among those with an existing diagnosis, seventy-eight (73.6%) reported taking antiretroviral therapy (ART) before pregnancy. A total of 132 (82.5%) reported taking ART during pregnancy (either continuing treatment or initiating during pregnancy). Postnatal ART was planned for 153 (95.6%) participants, while 7 (4.4%) did not plan to continue ART after delivery. For infants, 116 (73.0%) participants planned to provide ART, while 43 (27.0%) were uncertain at the time of interview.

Disclosure of HIV status varied among participants. Thirty-two (19.9%) participants had not disclosed their status to anyone, while 64 (39.8%) had disclosed to one person, 29 (18.0%) had disclosed to 2 to 5 people, and 36 (22.4%) had disclosed to 6 or more people. The most

common individuals to whom participants disclosed their status were their husband or partner (67.1%), followed by sisters (23.0%) and brothers (22.4%), and other relatives (23.0%). Fewer participants disclosed to their mother (16.8%), father (12.4%), mother-in-law (7.5%), father-in-law (7.5%), friends (10.6%), or other non-relatives (11.2%).

Follow-Up Characteristics and Infant Feeding Behaviors

Follow-up data was collected for 143 participants (88.8%). Ten (6.2%) were lost to follow up, 3 (1.9%) reported a stillbirth, 1 reported a neonatal death (0.6%), 3 (1.9%) refused, and 1 (0.6%) was excluded as her EGA at baseline was discovered to be incorrect.

All 143 participants reported that they delivered in a public hospital or health center and received care from an individual or team of nurses (54.2%), midwives (63.4%) or doctors (40.8%). No one reported receiving care during labor and delivery from anyone else, such as traditional birth attendants, health extension workers, community health workers, or family members. Additionally, all 143 participants reported that both they and their infant were on ART. One hundred twenty-five (88.0%) indicated that their baby had an HIV test at 45 days, with 112 (90.3%) reporting a negative result, 3 (2.1%) uncertain of the result, and 9 (6.3%) reporting a positive result.

All 143 participants indicated that they breastfed their baby, with 140 (97.9%) reporting they breastfed immediately after delivery and the remaining 3 (2.1%) reporting they breastfed within 2 hours of delivery. One hundred fifteen (71.4%) fed their baby nothing but breastmilk, 24 (14.9%) had fed something besides breastmilk, and 3 (1.9%) were uncertain due to other caregivers. Of the 24 that reported no longer practicing EBF, 21 (87.5%) were practicing mixed feeding and 3 (12.5%) had switched to exclusive replacement feeding.

Among those who fed their baby something besides breastmilk, 22 (91.7%) indicated that they fed their baby water, and 20 (83.3%) indicated that they fed their baby a liquid besides water, including cow's milk (n=10), fortified milk (n=8), broth/soup (n=1), *abesh* (n=1), and diluted Fanta (n=1). Fifteen (62.5%) participants reported feeding their baby food, including porridge or oatmeal (n=12), bread (n=5), biscuits (n=1), banana (n=1), potato (n=1), and papaya (n=1).

Associations of Baseline Characteristics and Infant Feeding Practice at 4 months PP

Chi-square analysis was first conducted to assess bivariate associations between any baseline demographic, socioeconomic or health-related indicators and EBF practice at 4 months postpartum. The chi-square analysis revealed a significant association between religion and EBF status at three months postpartum ($\chi^2(2) = 6.157$, $p = 0.046$), with Christian Orthodox mothers being more likely to practice EBF compared to other religious groups. Additionally, the timing of the first antenatal care (ANC) visit was significantly associated with EBF status ($\chi^2(2) = 6.318$, $p = 0.042$), as well as the total number of ANC visits ($\chi^2(1) = 5.949$, $p = 0.015$), where mothers who had fewer than five ANC visits were less likely to practice EBF. Other demographic and socioeconomic factors did not show statistically significant associations with EBF status at three months.

Logistic regression analysis was conducted to identify all potential predictors of EBF at 4 months postpartum. Using the forced entry method for the model selection, the initial model included three variables identified as significant in prior chi-square analysis: religion, trimester of first antenatal (ANC) visit, and the number of ANC visits attended.

In this initial model with 3 predictors, religion emerged as a statistically significant predictor of EBF. Specifically, Protestant women were significantly less likely to practice

exclusive breastfeeding compared to their Orthodox counterparts (OR = 0.171, 95% CI: 0.039–0.747, p = .019), indicating they had approximately 83% lower odds of EBF. The odds for Muslim women were also lower compared to Orthodox women, though this difference was not statistically significant (OR = 0.517, 95% CI: 0.139–1.917, p = .324). Neither time of first ANC visit nor number of ANC visits were significant in this regression model. However, given the significant association between timing of first ANC visit and number of ANC visits observed with chi-square analysis ($\chi^2(2) = 19.171$, $p < .001$), a second logistic regression model was conducted to address potential multicollinearity. This model retained only religion and number of ANC visits.

In the refined model, both predictors were statistically significant. Protestant women remained less likely to exclusively breastfeed than Orthodox women (OR = 0.199, 95% CI: 0.046–0.864, p = .031). Additionally, women who attended five or more ANC visits had significantly higher odds of practicing EBF at four months postpartum compared to those with fewer visits (OR = 2.991, 95% CI: 1.176–7.607, p = .021). These findings underscore the influence of both religious affiliation and engagement in ANC on EBF.

Overall, the omnibus test of model coefficients was statistically significant ($\chi^2 = 10.546$, $p = .014$), indicating that the model provides a better fit than a null model. The Nagelkerke R^2 value of .122 suggests that the model explains about 12.2% of the variance in EBF status. The Hosmer and Lemeshow test ($\chi^2 = 4.005$, $p = .261$) indicates good model fit. The classification table indicates an overall predictive accuracy of 84.2%, with high sensitivity in predicting non-EBF cases (99.1%) but poor sensitivity for identifying EBF cases (12.5%). This suggests that the model performs well in detecting women who do not EBF but struggles to predict those who do EBF.

Analysis of Changes from Baseline to Follow Up

Paired t-test analyses were conducted for each of the indirect items in the questionnaire for both mothers continuing to EBF at 4 months postpartum ("EBF Group") and discontinuing EBF by 4 months postpartum ("Non-EBF Group").

Behavioral Beliefs (Attitude). For the EBF Group, 9 out of 14 behavioral belief items demonstrated significant positive changes, including ATT 1, ATT 2, ATT 4, ATT 5, ATT 6, ATT 7, ATT 11, ATT 12, and ATT 13 (Table 4.2). This indicates many mother that continued to EBF experienced improved attitudes toward EBF between time of birth and 4 months postpartum. In contrast, only one behavioral belief (ATT 1) increased for the non-EBF group (Table 4.2), indicating that attitudes towards EBF did not improve over time in the same way they did for the EBF group. While not statistically significant, four behavioral beliefs, including ATT 6, ATT 8, ATT 9 and ATT 13, decreased from time of birth to postpartum among mothers that discontinued EBF.

To assess whether changes in behavioral beliefs influenced exclusive breastfeeding (EBF) practice at four months postpartum, a logistic regression analysis was conducted using the change in each indirect attitude belief (from baseline to follow-up) as predictor variables. Four behavioral beliefs emerged as statistically significant predictors of EBF practice. Specifically, women who more strongly endorsed the belief that "EBF for 6 months is best for a child's growth and development" (ATT 1) had significantly lower odds of continuing EBF (OR = 0.41, 95% CI: 0.23–0.73, p = .002). Similarly, an increase in the belief that "EBF for 6 months prevents transmission of HIV" (ATT 10) was also associated with an increased likelihood of stopping EBF (OR = 0.76, 95% CI: 0.59–0.97, p = .027). This suggests that some attitudes may fluctuate significantly, but still not do impact behavior. In contrast, increases in two other beliefs were linked with higher odds of continuing EBF. Specifically, greater agreement with the belief

that “Breast milk is a natural source of food for my baby” (ATT 12) predicted a higher likelihood of continuing EBF for four months (OR = 1.42, 95% CI: 1.04–1.95, p = .029). Even more notably, women who increasingly believed that “EBF for 6 months is a convenient way of feeding my baby” (ATT 13) had more than twice the odds of continuing EBF (OR = 2.31, 95% CI: 1.39–3.85, p = .001).

Normative Beliefs (Subjective Norms). Paired t-test results for normative beliefs are shown in Table 4.3. For the EBF Group, two normative beliefs, SN 1 and SN 11, increased significantly from birth to 4 months postpartum. This indicates that the EBF group felt increased support for EBF from their doctor and other health professionals over the postpartum period and motivation to comply with this opinion. The non-EBF group did not experience any significant changes in their normative beliefs to EBF related to health workers or their doctor. However, a significant negative change did emerge for SN 7, indicating a decrease in perceived support from their husband to EBF, accompanied by an increased motivation to comply with this opinion.

To explore whether changes in normative beliefs predicted EBF practice at four months postpartum, logistic regression was conducted using the change scores for all 13 normative beliefs as predictors. Only one belief, “my husband believes that I should EBF for 6 months” (SN 7) emerged as a statistically significant predictor. An increase in perceived support from one's husband was associated with significantly higher odds of continuing to exclusively breastfeed (OR = 1.26, 95% CI: 1.07–1.49, p = .007). When assessed along with the chi-square results, it becomes apparent that many women experienced a decline in support from their husbands to practice EBF and this led to the discontinuation of EBF well before the recommended six months.

Control Beliefs (Perceived Behavioral Control). For the EBF Group, there were four control beliefs that significantly increased between time of birth and four months postpartum (Table 4.4), including PBC 2 ("I am able to drink a lot of fluids every day"), PBC 9 ("I am able to prevent getting wounds on my breast"), PBC 7 ("My breasts produce adequate amounts of milk for my child") and PBC 10 ("I never have to let someone else care for my baby"). This indicates that mothers viewed each of these potential influencers on EBF practice increasingly as facilitators and less as barriers in their personal circumstances. In this group, there was one item that decreased significantly in this group, PBC 3 ("my economy or living conditions are poor") indicating that their economic status was more of a barrier that would have to be overcome to continue EBF. By contrast, the non-EBF group experienced only one significant negative change in their control beliefs for PBC 7 (Table 4.4). This indicates that mother who discontinued EBF by 4 months, became less confident in their ability to produce enough milk for their baby.

To assess whether changes in control beliefs predicted EBF practice at four months postpartum, logistic regression analysis was conducted using change scores for each of the 10 control beliefs and two emerged as statistically significant predictors. First, changes in the belief that "my breasts produce adequate amounts of milk for my child" (PBC7) were strongly associated with feeding outcomes. Women who experienced a decline in confidence in their milk supply were nearly twice as likely to discontinue EBF by four months (OR = 1.98, 95% CI: 1.30–3.04, p = .002). Second, women who reported an increased reliance on others to care for their baby, reflected in the belief "I never have to let someone else care for my baby" (PBC10), were also significantly more likely to stop exclusively breastfeeding (OR = 1.97, 95% CI: 1.03–3.05, p = .040).

Discussion

This study applied the Theory of Planned Behavior (TPB) to examine predictors of exclusive breastfeeding (EBF) practice among mothers living with HIV in Addis Ababa from birth through four months postpartum. The results provide support for the TPB as a useful framework for understanding and predicting EBF behavior in this context. Several important findings emerged.

At four months postpartum, only 71.4% of mothers reported maintaining EBF, a proportion that aligns favorably with national estimates but also indicates that nearly 30% of mothers either introduced other foods/liquids, stopped breastfeeding entirely, or were uncertain of EBF status (due to other caretakers). Notably, mixed feeding practices—associated with increased risk of MTCT—were reported by 21 participants, suggesting an ongoing gap in sustained adherence to recommended feeding practices. Further, while excluded from most statistical analyses (as only two outcomes were included in the model: EBF and non-EBF), the recognition that some participants were uncertain of infant feeding practice, suggests the need for improved planning when multiple caregivers are responsible for an HIV-exposed infant.

Few demographic and socioeconomic indicators appeared to influence infant feeding practice at 4 months postpartum. Religion may be predictive, but further exploration would be necessary to understand this relationship, as only nine Protestant women were included in the sample. The finding that early and increased ANC visits were linked to increased adherence to EBF practice is consistent with previous studies (Bultum et al., 2022; Dagnew & Teferi, 2021; Mihret et al., 2020). While antenatal infant feeding counseling did not appear to impact infant feeding practice, it may still play a role as a component of ANC. Quality of counseling was not captured in this study, as indicators focused more on quantity, and this may be a gap in the results that warrant further investigation. Certainly, the components of ANC that promote optimal infant feeding practice merit further understanding, as this is a key opportunity to influence decision-making,

provide anticipatory guidance on breastfeeding (including potential challenges), and establish relationships that can provide support through the postpartum period.

The exploratory analyses of the changes in indirect measures (behavioral beliefs, normative beliefs, and control beliefs) between time of birth and 4 months postpartum revealed some notable trends. Significant increases in attitudes for the EBF group were consistently noted, that were not seen in the non-EBF group. The role of "convenience" in EBF practice (ATT13) appears be an important driver in determining infant feeding practice. While, changes in three additional behavioral beliefs demonstrated a significant impact on infant feeding practice in regression, further analysis would be necessary to clarify their impact, as directionality and differences between groups were not as clear. Regarding subjective norms, decreases in the normative beliefs related to husband's support for EBF appeared to be a significant risk factor for EBF. Finally, for perceived behavioral control, perceptions of breastmilk production and reliance on someone else to care for the infant also emerged as important predictors of infant feeding practice. In fact, the role of breast milk adequacy may challenge the key assumption of "volitional control" within the TPB, and therefore impact the model's ability to predict behavior. This warrants further investigation as the perception of breast milk adequacy and actual breast milk adequacy may or may not align.

There are several implications for programming that can be considered from these results. Infant feeding is a complex process shaped by multiple factors, both within and outside of a mother's control. The findings from this study can help to highlight key challenges that may arise over the course of the postpartum period, and the questionnaire items could be used for screening purposes or quality counseling and support (for example, through improved anticipatory guidance and planning so that EBF does not become "inconvenient"). The

importance of ANC and inclusion of spouses in ANC to improve likelihood of continued EBF may be key for this population. Clinical practitioners should anticipate concerns about or actual challenges of milk supply. Addressing this through education about infant feeding needs and how to assess adequacy of breast milk, or with clinical interventions to help increase milk supply, if necessary, could help improve infant feeding practices.

The application of the TPB framework provided a strong basis to explore this complex behavior. Many TPB studies in the literature do not include indirect measures, which limits its application to interventions. This study's use of indirect measures allowed more a more comprehensive understanding of the outcomes. Further, the longitudinal nature of the study combined with the repeated measures of theoretical constructs is also a novel application of the theory, which allowed for assessment of how the key constructs change over time, offering insight into the evolving factors that influence EBF behavior. Geographic representation across Addis Ababa (with participant recruited from 29 health centers, in eight of ten sub-cities) and also ensured validity of the study results and generalizability to the population of interest. Limitations included the sample size, which may have contributed large number of non-significant results noted in the study, and self-reported measures of infant feeding practice which may be subject to recall or social desirability bias. Additionally, as the study ended at 4 months postpartum, it is unknown how many participants ultimately completed EBF through the recommended 6 months.

Future research could include analysis of how the complete TPB model (including both direct and indirect measures), as a whole can predict intention and explain infant feeding behavior through Structural Equation Modeling (SEM). Additionally, new qualitative research could build

upon these findings and provide deeper understanding of the nuanced experiences, support, barriers and facilitators mothers face, particularly in the postpartum period.

Figure 4.1: The Theory of Planned Behavior

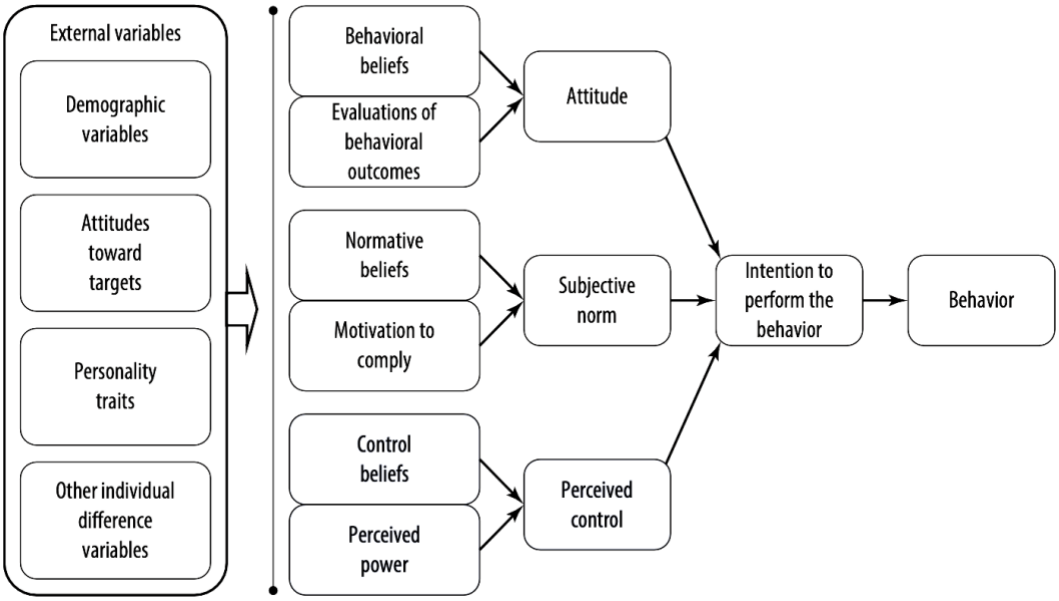


Table 4.1: Descriptive Statistics of Respondents at Baseline

Characteristic	Category	N	%
Age (n=161)	15-24	16	9.9
	25-34	108	67.1
	35-45	37	23.0
Marital status (n=161)	Married	126	78.2
	Single	18	11.2
	Widowed	1	0.6
Religion (n=161)	Christian Orthodox	133	82.6
	Protestant	11	6.8
	Muslim	17	10.6
Ethnicity (n=161)	Amhara	87	54.0
	Oromo	46	28.6
	Guragie	15	9.3
	Tigray	8	5.0
	Other	5	3.1
Current region of residence (n=161)	Addis Ababa	151	93.8
	Oromiya	10	6.2
Education level (n=161)	None	36	22.4
	Primary	66	41.0
	Secondary	50	31.1
	Technical or Vocational	6	3.7
	Higher	3	1.9
Education level of spouse (n=126)	None	20	15.9
	Primary	27	21.4
	Secondary	50	39.7
	Technical or Vocational	7	5.6
	Higher	18	14.3
	Unknown	4	3.2
Employment (n=161)	No work	106	65.8
	Work for self/family	36	22.4

	Work for someone else	19	11.8
Maternity Leave (n=19)	No	6	31.5
	Yes	11	57.9
	Unknown	2	10.5
Home ownership (n=161)	Rent	134	83.2
	Own	27	16.8
Household (n=161)	Lives Alone (or alone with children)	23	14.3
	Lives with Husband only (or husband and children)	86	53.4
	Lives with Extended Family	32	19.9
	Lives with Others	20	12.4
Previous pregnancies (n=161)	First pregnancy	36	22.4
	Not first pregnancy	125	77.6
History of stillbirth (n=161)	No	138	85.7
	Yes	23	14.3
History of child death (n=161)	No	144	89.4
	Yes	17	10.6
Hx of child infected with HIV (n=161)	No	151	93.8
	Yes	10	6.2
Attended any ANC visits (n=161)	Yes	161	100.0
Fist ANC visit (n=160)	1st	88	55.0
	2nd	64	40.0
	3rd	8	5.0
Number of ANC visits (n=161)	1-4 visits	69	42.9
	5 or more visits	92	57.1
Received counseling on infant feeding during pregnancy (n=161)	No	58	36.0
	Yes	103	64.0
	0	58	36.0

Number of times counseled on infant feeding (n=161)	1	27	16.8
	2	32	19.9
	3	18	11.2
	4 or more	26	16.1
New HIV diagnosis (n=160)	No	108	67.5
	Yes	52	32.5
Taking ARVs during pregnancy (n=160)	No	28	17.5
	Yes	132	82.5
Plan to take ARVs postnatally (n=160)	No	7	4.4
	Yes	153	95.6
Plan for infant to take ARVs (n=159)	No / Don't Know	43	27.0
	Yes	116	73.0
Number of people aware of HIV status, excluding health workers (n=161)	0	32	19.9
	1	64	39.8
	2 to 5	29	18.0
	6 or more	36	22.4

Table 4.2: Paired T-Test for Behavioral Beliefs (for EBF and Non-EBF sub-groups)

Item #	Variable	Group	Mean (SD) Time 1	Mean (SD) Time 2	Mean Difference (T2 - T1)	t	df	p-value
ATT 1	EBF for 6 months is best for a child's growth and development	EBF	2.14 (1.30)	2.48 (1.33)	0.34	2.28	114	0.024
		Non-EBF	1.83 (1.13)	2.58 (1.41)	0.75	2.43	23	0.023
ATT 2	EBF for 6 months prevents illness/disease in children	EBF	2.00 (1.30)	2.42 (1.33)	0.42	2.56	114	0.012
		Non-EBF	2.00 (1.29)	2.38 (1.35)	0.38	1.06	23	0.302
ATT 3	My baby may acquire the HIV virus if I EBF for 6 months	EBF	0.80 (1.43)	0.76 (1.65)	-0.04	-0.22	114	0.825
		Non-EBF	0.75 (1.70)	0.79 (1.14)	0.04	0.11	23	0.914
ATT 4	Breastfeeding is a way of showing intimacy with your child	EBF	1.83 (1.19)	2.20 (1.33)	0.37	2.43	114	0.017
		Non-EBF	1.92 (1.18)	1.96 (1.16)	0.04	0.12	23	0.907
ATT 5	Breastmilk alone is adequate to meet my child's nutritional needs for 6 months	EBF	1.53 (1.37)	2.15 (1.53)	0.62	3.04	114	0.003
		Non-EBF	1.71 (1.55)	1.83 (1.43)	0.13	0.31	23	0.758
ATT 6	Giving supplemental food/drink (water, porridge, abesh) before 6 months supports a child's health	EBF	1.37 (1.75)	1.85 (1.58)	0.49	2.44	114	0.016
		Non-EBF	1.75 (1.51)	1.46 (1.64)	-0.29	-0.54	23	0.592
ATT 7	Breastfeeding makes me happy	EBF	1.90 (1.24)	2.22 (1.38)	0.32	2.11	114	0.037
		Non-EBF	1.83 (1.01)	1.92 (1.10)	0.08	0.27	23	0.788
ATT 8	Breastfeeding is uncomfortable	EBF	1.21 (1.40)	1.37 (1.58)	0.16	0.82	114	0.415
		Non-EBF	1.17 (1.37)	0.88 (1.57)	-0.29	-0.62	23	0.543
ATT 9	Cessation of EBF at 6 months could result in suspicion of my HIV status	EBF	0.47 (1.40)	0.70 (1.48)	0.23	1.30	114	0.195
		Non-EBF	0.71 (1.37)	0.46 (1.44)	-0.25	-0.70	23	0.491
ATT 10	EBF for 6 months prevents transmission of HIV	EBF	0.87 (1.75)	1.10 (1.84)	0.23	0.94	114	0.349
		Non-EBF	0.17 (2.16)	1.13 (1.80)	0.96	1.79	23	0.087
ATT 11	Tena Adam in water relieves children's abdominal cramps	EBF	0.56 (1.68)	1.12 (1.79)	0.57	2.71	114	0.008
		Non-EBF	0.79 (1.67)	0.92 (1.89)	0.13	0.25	23	0.802
ATT 12	Breast milk is a natural source of food for my baby	EBF	1.58 (1.63)	2.10 (1.66)	0.51	2.40	114	0.018
		Non-EBF	1.67 (1.83)	1.71 (1.92)	0.04	0.08	23	0.940
ATT 13		EBF	1.53 (1.28)	2.08 (1.39)	0.55	3.07	114	0.003

	EBF for 6 months is a convenient way of feeding my baby	Non-EBF	1.96 (1.30)	1.38 (1.17)	-0.58	-1.66	23	0.110
ATT 14	Exclusive breastfeeding makes my baby thirsty	EBF	0.42 (1.54)	0.60 (1.85)	0.18	0.87	114	0.383
		Non-EBF	0.00 (1.96)	0.46 (1.79)	0.46	0.96	23	0.347

Table 4.3: Paired T-Test for Normative Beliefs (for EBF and Non-EBF sub-groups)

Item #	Variable	Group	Mean (SD) Time 1	Mean (SD) Time 2	Mean Difference (T2 - T1)	t	df	p-value
SN 1	Health professionals believe that I should EBF for 6 months	EBF	5.85 (2.79)	7.07 (2.92)	1.22	3.21	114	0.002
		Non-EBF	6.00 (3.04)	6.54 (3.22)	0.54	0.56	23	0.579
SN 2	Elder mothers believe that I should EBF for 6 months	EBF	1.72 (3.67)	1.54 (3.45)	-0.18	-0.39	114	0.697
		Non-EBF	1.88 (3.52)	0.96 (2.69)	-0.92	-1.14	23	0.268
SN 3	Young women believe that I should EBF for 6 months	EBF	2.24 (3.45)	1.79 (3.14)	-0.45	-1.03	114	0.307
		Non-EBF	1.21 (3.02)	0.50 (3.12)	-0.71	-0.86	23	0.399
SN 4	Educated people believe that I should EBF for 6 months	EBF	4.83 (2.74)	4.88 (3.20)	0.05	0.13	114	0.893
		Non-EBF	4.08 (3.92)	4.21 (3.34)	0.13	0.11	23	0.916
SN 5	"Modern women" believe that I should EBF for 6 months	EBF	0.88 (3.24)	0.61 (2.98)	-0.27	-0.70	114	0.483
		Non-EBF	-0.33 (2.88)	-0.92 (3.30)	-0.58	-0.64	23	0.529
SN 6	My relatives believe that I should EBF for 6 months	EBF	1.68 (3.07)	1.63 (3.29)	-0.04	-0.11	114	0.911
		Non-EBF	2.54 (3.15)	1.83 (2.57)	-0.71	-1.16	23	0.259
SN 7	My husband believes that I should EBF for 6 months	EBF	3.94 (2.74)	4.48 (3.10)	0.54	1.65	114	0.102
		Non-EBF	4.42 (2.19)	2.50 (3.26)	-1.92	-2.11	23	0.046
SN 8	Other mothers living with HIV believe that I should EBF for 6 months	EBF	4.37 (2.62)	4.48 (2.70)	0.11	0.36	114	0.719
		Non-EBF	3.79 (3.34)	4.08 (3.36)	0.29	0.30	23	0.771
SN 9	My neighbors believe that I should EBF for 6 months	EBF	1.17 (2.99)	0.88 (3.20)	-0.30	-0.76	114	0.449
		Non-EBF	1.38 (2.72)	1.04 (2.79)	-0.33	-0.45	23	0.654
SN 10	My friends believe that I should EBF for 6 months	EBF	1.01 (3.39)	1.51 (3.57)	0.50	1.07	114	0.288
		Non-EBF	1.50 (4.31)	0.46 (3.78)	-1.04	-1.05	23	0.305
SN 11	My doctor believes that I should EBF for 6 months	EBF	5.94 (2.80)	6.68 (2.89)	0.74	2.06	114	0.042
		Non-EBF	5.79 (3.01)	6.54 (3.22)	0.75	0.71	23	0.485
SN 12	People who know my HIV status believe that I should EBF for 6 months	EBF	3.77 (3.17)	4.23 (2.98)	0.45	1.18	114	0.239
		Non-EBF	4.75 (3.27)	3.42 (3.56)	-1.33	-1.29	23	0.210
SN 13	People who do not know my HIV status believe that I should EBF for 6 months	EBF	-0.30 (3.42)	-0.24 (3.00)	0.05	0.11	114	0.909
		Non-EBF	0.54 (4.14)	-0.83 (2.20)	-1.38	-1.61	23	0.121

Table 4.4: Paired T-Test for Control Beliefs (for EBF and Non-EBF sub-groups)

Item #	Variable	Group	Mean (SD) Time 1	Mean (SD) Time 2	Mean Difference (T2 - T1)	t	df	p-value
PBC 1	I am able to eat a healthy diet every day	EBF	0.17 (1.24)	0.29 (1.41)	0.11	0.82	114	0.416
		Non-EBF	0.21 (1.02)	0.29 (0.95)	0.08	0.34	23	0.739
PBC 2	I am able to drink a lot of fluids every day	EBF	0.30 (1.12)	0.70 (1.40)	0.40	3.26	114	0.001
		Non-EBF	0.54 (1.32)	0.62 (1.13)	0.08	0.26	23	0.796
PBC 3	My economy or living conditions are poor	EBF	-0.31 (1.19)	-0.62 (1.25)	-0.30	-2.15	114	0.034
		Non-EBF	-0.42 (0.83)	-0.67 (1.17)	-0.25	-1.10	23	0.283
PBC 4	I have a job that pays well	EBF	-0.47 (1.18)	-0.69 (1.38)	-0.22	-1.55	114	0.124
		Non-EBF	-0.46 (1.18)	-0.46 (1.06)	0.00	0.00	23	1.000
PBC 5	My work or home responsibilities requires me to spend time away from my baby	EBF	0.20 (1.52)	0.45 (1.65)	0.25	1.23	113	0.223
		Non-EBF	0.46 (1.28)	-0.04 (1.08)	-0.50	-1.57	23	0.130
PBC 6	I have many social obligations that I cannot take my baby to	EBF	0.59 (1.19)	0.59 (1.16)	0.00	0.00	113	1.000
		Non-EBF	0.54 (0.88)	0.71 (1.16)	0.17	0.58	23	0.567
PBC 7	My breasts produce adequate amounts of milk for my child	EBF	0.54 (0.98)	1.03 (1.30)	0.49	3.23	114	0.002
		Non-EBF	0.88 (0.99)	0.08 (0.72)	-0.79	-2.94	23	0.007
PBC 8	I have someone to assist me with work at home	EBF	-0.08 (1.11)	-0.12 (1.20)	-0.04	-0.34	114	0.736
		Non-EBF	0.25 (1.15)	0.29 (0.62)	0.04	0.18	23	0.857
PBC 9	I am able to prevent getting wounds on my breast	EBF	1.00 (1.24)	1.44 (1.45)	0.44	2.70	114	0.008
		Non-EBF	1.00 (1.72)	0.75 (1.19)	-0.25	-0.57	23	0.575
PBC 10	I never have to let someone else care for my baby	EBF	-0.15 (0.81)	0.15 (1.09)	0.30	2.47	114	0.015
		Non-EBF	0.08 (0.78)	-0.08 (0.28)	-0.17	-1.16	23	0.257

Chapter 5: Integrative Summary

Summary & Key Findings

Mother-to-child transmission of HIV remains a major public health challenge across sub-Saharan Africa, with infant feeding practices playing a crucial role in this dynamic. The WHO recommends EBF for the first six months of life for mothers living with HIV, yet adherence to this recommendation is highly variable and often compromised by complex sociocultural and behavioral factors. This dissertation, comprising three interrelated papers, provides a comprehensive, theory-driven examination of the determinants of infant feeding intentions and practices among HIV-positive mothers in Addis Ababa, Ethiopia.

Chapter 2 describes a systematic review of observational studies conducted between 2007 and 2022 across 16 sub-Saharan African countries, which sets the foundation for this study. The review revealed wide variation in both infant feeding intentions and practices among mothers living with HIV. Notably, prospective studies reported EBF rates at six months ranging from 13.3% to 94.9% and demonstrated that intention to EBF was often high at birth, but actual adherence dropped significantly over time. Key predictors of EBF included maternal education, disclosure of HIV status, antenatal care attendance, infant feeding counseling, and delivery at a health facility. However, the review also highlighted substantial limitations in the literature, such as inconsistent operational definitions of EBF and other infant feeding practices, unclear data collection methodologies, and variation in measurement of infant feeding. Further, few studies employed behavioral theory to guide the exploration of feeding decisions, and fewer still followed mothers over time to assess how intentions evolved into or diverged from actual practices. This review identified a critical gap and the need for theoretically grounded,

longitudinal research to better understand how mothers form their infant feeding intentions and why intentions and behavior often change over time.

Chapter 3 focuses on the development and validation a TPB-based questionnaire to assess the determinants of infant feeding intention and practice among HIV-positive mothers, following a validated, multi-phase process. First, qualitative interviews were conducted with HIV-positive mothers to elicit salient behavioral, normative, and control beliefs. These results informed the creation of a culturally relevant quantitative questionnaire that captured both direct and indirect measures of TPB constructs. The tool was pretested with a sample of pregnant and postpartum women and demonstrated acceptable internal reliability and face validity. Some subscales however, particularly those related to SN and PBC, showed comparatively lower internal consistency, suggesting the questionnaire may not have adequately captured these constructs. Although further exploration of these findings and refinement of the tool are warranted, it nevertheless fills a methodological gap and provides a foundation for more rigorous, longitudinal research to examine adherence to EBF over time.

Chapter 4 describes the prospective cohort study that followed HIV-positive mothers from late pregnancy through four months postpartum. Nearly all participants reported an intention to EBF at baseline. However, by four months postpartum, nearly 30% had introduced mixed feeding or stopped breastfeeding altogether. This disconnect between initial intention and behavior underscores the importance of understanding the evolving nature of infant feeding attitudes, subjective norms, and perceived behavioral control. Analysis of participant characteristics identified two key predictors of sustained EBF: religious affiliation and engagement with antenatal care (ANC). Longitudinal changes in indirect measures of TPB constructs revealed that many beliefs are not static and evolve over the postpartum period.

Regarding behavioral beliefs, mothers who continued EBF showed significant increases in the beliefs that EBF is a natural and convenient way of feeding over the postpartum period. Conversely, a rise in the beliefs that EBF is best for growth and development and that EBF prevents HIV transmission was unexpectedly noted in mothers who discontinued EBF, suggesting that despite significant change these beliefs were not relevant in determining behavior. For normative beliefs, only perceived support from husbands emerged as a significant predictor, with decreased spousal support strongly linked to discontinuation of EBF. Among control beliefs, increased confidence in breastmilk adequacy and the ability to avoid sharing caregiving responsibilities were both significantly associated with continued EBF, while mothers who doubted their milk supply or relied more on others to care for their infants were more likely to stop EBF early.

Strengths & Limitations

This study has several notable strengths that enhance the credibility and applicability of its findings. First, the mixed methods, prospective cohort design, grounded in behavioral theory, allowed for both breadth and depth of findings, capturing temporal changes in beliefs and behaviors while also offering insight into causal pathways. The study employed a carefully validated instrument developed through qualitative and quantitative research, increasing its cultural and theoretical relevance. The study's use of both direct and indirect TPB measures provided a more nuanced understanding of the cognitive drivers of EBF, moving beyond intention alone to uncover the belief structures underlying behavioral patterns. Repeated measurement of TPB constructs at both baseline and four months postpartum is a unique strength, enabling an analysis of how attitudes, subjective norms, and perceived behavioral control evolve over time and affect sustained EBF. The inclusion of belief-based change

measures linked to actual behavior also sets this study apart from many cross-sectional applications of TPB, making it one of the few longitudinal analyses to explore these dynamics in this population. Further, the study's geographic representation across 29 health facilities in eight of the ten sub-cities of Addis Ababa ensures strong contextual relevance and generalizability within the urban Ethiopian setting. In-person questionnaire administration by trained staff likely enhanced data quality by reducing misunderstanding of survey items and minimizing missing data.

Despite its contributions, this study has several limitations that should be acknowledged. The modest sample size limited statistical power for subgroup comparisons and may have contributed to the non-significance of several potentially meaningful associations. Moreover, follow-up data were only collected through four months postpartum, falling short of the full six-month duration recommended for exclusive breastfeeding by WHO, and leaving the final phase of infant feeding behavior unexamined. Self-selection bias may also be present, as participants were recruited from health facilities and may have differed systematically from mothers not seeking care or unwilling to participate. Additionally, the reliance on self-reported data for feeding practices and TPB constructs introduces the risk of social desirability bias, particularly in a context where exclusive breastfeeding is strongly promoted by health providers.

Clinical and Public Health Programming Implications

The findings of this study highlight several important implications for strengthening PMTCT programs and clinical support for HIV-positive mothers. Consistent with prior evidence, early and frequent engagement with the health system through ANC visits plays a critical role in supporting sustained EBF, and continued counseling and support through postnatal care (PNC) is equally important as beliefs and perceptions regarding infant feeding evolve over this time

(Belay & Wubneh, 2019). However, it is not only the frequency but also the quality of care that determines its effectiveness. The findings of this study are particularly relevant for shaping the content of counseling to ensure that it is relevant to the population. Counseling on infant feeding should go beyond general messaging and should incorporate the salient beliefs identified in this study (particularly related to convenience, spousal support, breast milk adequacy, and coordination across multiple caregivers), so that anticipatory guidance on breastfeeding challenges and personalized support can be provided from pregnancy through the postpartum period.

Specific drivers of EBF discontinuation identified in this study offer clear targets for messaging and other interventions. First, perceptions and experiences regarding convenience emerged as a key predictor of continued EBF, suggesting that helping mothers anticipate challenges and develop practical strategies for managing breastfeeding alongside other responsibilities may improve adherence. Alternative or supplementary approaches to one-on-one counseling during facility visits, such as breastfeeding support groups, peer counselors, mobile phone follow-ups, and home visits, can provide the ongoing support needed to reinforce counseling messages and address emerging barriers (Pezley et al., 2022; Skouteris et al., 2014). Group ANC or PNC models may be especially useful for fostering peer learning and shared problem-solving (Byerley & Haas, 2017; Novick et al., 2013). Next, spousal support also proved critical in this study, and partner involvement in counseling and education has been shown to increase EBF rates by improving communication and enhancing shared decision-making (Suandi et al., 2020; Yargawa & Leonardi-Bee, 2015). Interventions might include couple-based counseling sessions, informational materials tailored for men, or community-based campaigns to normalize male involvement in infant care, and importantly should focus on sustained support as

feeding experiences evolve over the postpartum period. Lastly, the perception of inadequate breastmilk was another strong barrier to EBF practice, echoing findings from studies in both HIV and non-HIV populations (Galipeau et al., 2018; Huang et al., 2022). Importantly, this perception does not always reflect a physiological issue. Health workers should be equipped to differentiate between perceived and actual insufficiency, offer reassurance when appropriate, and provide clinical interventions, such as lactation support, education on feeding cues, and techniques to enhance milk production, when appropriate. Teaching mothers how to assess breastmilk adequacy (e.g., via infant growth, output, and satiety) is a crucial step in addressing these concerns.

Finally, the TPB-based questionnaire developed for this study could be adapted into a screening tool for routine clinical use. Administered during ANC and postpartum visits, it could help providers identify mothers at increased risk of discontinuing EBF and tailor counseling accordingly. This proactive approach would allow for more targeted, efficient allocation of support and follow-up, particularly in resource-constrained settings where individualized attention may be limited.

Future Research

While this study contributes valuable insights to the evidence base, it also points to directions for future investigation. First, extending the follow-up period through six months postpartum (and then beyond to include complementary feeding) would provide a more complete picture of EBF adherence relative to WHO guidelines. Second, future studies could further investigate the ability of the TPB to explain EBF intention and practice in this population. Analyses employing structural equation modeling (SEM) to test the full TPB model, including both direct and indirect measures, could better quantify the relative weight of each construct in

determining intention and predicting behavior. Further, TPB model fit could be assessed and the model could be modified, as needed, to better explain how these theoretical constructs can improve our understanding of infant feeding decision making and behaviors. Qualitative studies could also deepen understanding of the mechanisms underlying belief changes in the postpartum period. Finally, extending this research to more diverse populations, both geographically and including HIV-negative populations, would also be valuable to expand the generalizability of these study findings.

Conclusion

In summary, this dissertation contributes to a more nuanced understanding of infant feeding intention and practices among HIV-positive mothers in Addis Ababa, Ethiopia. It demonstrates the importance of early and sustained engagement with the health system, the critical role of social support and counseling, and the need for targeted interventions that are responsive to evolving maternal beliefs and real-world challenges. By grounding this study in the TPB, the research provides both empirical evidence and a conceptual foundation for improving adherence to EBF recommendations, thereby supporting maternal and child health outcomes in Ethiopia.

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Appendix A: Table of correlations from bivariate and multivariate analyses

			Kafulafula, U. K., et al. (2013)	Thomas, E., et al. (2017)	Mussa, A., et al. (2021)	Ashipala, D. O., et al. (2021)	Njom Nlend, A. E., et al. (2018)	Tuthill, E. L., et al. (2017)	Napyo, A., et al. (2020)	Muluye, D., et al. (2012)	Onubogu, C.U., et al. (2015)	Aishat, U., et al. (2015)	Thomas, E., et al. (2017)	Hampanda, K. (2016)	Andare, N., et al. (2019)	Mebratu, L., et al. (2020)	Maonga, A.R., et al. (2016)	Iliyasu, Z., et al. (2019)	Mihret, M.S., et al. (2020)	Bultum, E. T., et al. (2022)	Goon, D.T., et al. (2021)
	Country		Malawi	South Africa	Botswana	Namibia	Cameroon	South Africa	Uganda	Ethiopia	Nigeria	Nigeria	South Africa	Zambia	Kenya	Ethiopia	Tanzania	Nigeria	Ethiopia	Ethiopia	South Africa
	Outcome		Intention	Intention	Intention	Intention	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice	Practice
	Time of measurement		Prenatal	Time of Birth	Time of Birth	Time of Birth	0-3m PP	6 weeks PP	3 months PP	0-6m PP	0-6m PP	0-6m PP	0-6m PP	0-6m PP	0-6m PP	0-6m PP	6 months PP	6 months PP	6 months PP	6 months PP	6 months PP
	Type of Analysis		Bivariate & Multivariate	Bivariate & Multivariate	Bivariate & Multivariate	Bivariate	Bivariate	Multivariate	Bivariate & Multivariate	Multivariate	Bivariate & Multivariate	Multivariate	Bivariate & Multivariate	Bivariate & Multivariate	Multivariate	Bivariate & Multivariate	Bivariate & Multivariate	Multivariate	Bivariate & Multivariate	Multivariate	Multivariate
	Variable	**Referent Group**																			
Maternal Characteristics	Age	Older	NS	NS	NS		NS	NS	NS	NS			NS	NS	NS	NS	M (+)		NS	NS	NS
	Marital Status	Single (vs. Married/Union)	NS	NS	NS		NS	NS	NS	NS	B (-)		NS		NS	NS	NS		NS	NS	M (-)
	Length of Relationship	Longer												NS							
	Living wth Mother	Yes (vs. No)						M (+)													
	Parity / Living Children	Higher	B (+)	NS			NS		NS		B (-)		NS	NS		NS	NS		NS		
	Maternal Employment/Occupation	Yes (vs. No/Homemaker)		M (-)	NS		NS	NS	NS	M (-)			NS		NS	B (+)	B (+)		NS	NS	M (-)
	Maternal Education	Higher	M (-)		NS			NS	NS	NS	B (+)			M (+)	NS	NS	NS		B (+)	NS	M (+)
	Residence	Urban (vs. Rural)								NS						B (+)			B (-)		
	Religion	Christrian (vs. Muslim)							B (+)	NS						NS		NS	NS	NS	
	Ethnicity	*varies by country*							NS									NS		NS	
Partner Characteristics	Paternal Age	Higher															NS				
	Paternal Education	Higher									NS					NS	NS		B (+)		
	Paternal Employment	Yes (vs. No)																	NS		
Socioeconomic Status	Socioeconomic Status (overall)	Higher	NS	NS					M (-)		M (+)		NS	NS							
	Monthly Income	Higher			NS					NS		M (-)				B (+)			B (+)		
	Running water in home	Yes (vs. No)		NS	NS								NS								
	Electricty in home	Yes (vs. No)		NS	NS								NS								
	Refrigeration in home	Yes (vs. No)			B (+)																
	Radio/TV in home	Yes (vs. No)																	B (+)		
	Food security	Yes (vs. No)		NS									NS								
Mental Health	Prenatal depression	Yes (vs. No)						M (-)													
	Postpartum depression	Yes (vs. No)		M (-)				NS					NS								
	Experience of IPV	Yes (vs. No)		NS									NS	M (-)							
	Psychological distress	Yes (vs. No)		NS									NS								
	PTSD / Trauma exposure	Yes (vs. No)		NS									NS								
	Alcohol risk or use	Yes (vs. No)		NS									M (-)				NS			M (-)	
	Tobacco use	Yes (vs. No)																		M (-)	
Disclosure of HIV status	To Husband/Father	Yes (vs. No)	B (-)		NS					M (+)				M (+)		M (+)				M (+)	NS
	To Family	Yes (vs. No)	B (-)		NS					NS						M (+)				M (+)	
	To Friends	Yes (vs. No)			NS											M (+)				M (+)	
HIV Experience & Care	Couple Discordance	Yes (vs. No)												NS							
	Previous experience with HIV & Breastfeeding	Yes (vs. No)	NS		NS						NS	NS									
	CD4 cell count	Higher					M (-)		NS												
	Adherence to ART	Yes (vs. No)							M (+)	NS									NS		NS
	Time of HIV diagnosis	Before (vs. During ANC)		M (+)									NS								NS
Maternal Health Care	Planned pregnancy	Yes (vs. No)		NS									NS								
	ANC Attendance	Early and/or No of Visits										M (+)				M (+)	NS		M (+)	NS	
	Infant feeding counseling by health worker	Yes (vs. No)			M (+)						B (+)	M (+)				B (+)	B (+)		NS	M (+)	
	Gestational age	Higher		NS									NS								
	Place of delivery	Facility (vs. home)	NS						NS	M (+)						B (+)	NS	M (+)	M (+)	NS	
	Type of delivery	Vaginal (vs. C-section)		NS					NS				NS				NS		NS	NS	
	Skilled Birth Attendance	Yes (vs. No)							M (+)												
	Complications during delivery	Yes (vs. No)																	NS		
	Postnatal care	Yes (vs. No)														M (+)				NS	
	Time of BF initiation	Since Delivery															NS				
Infant Characteristics	Birth weight	Higher		NS			NS						NS				NS				
	Gender	M (vs. F)		NS									NS			NS	NS		NS	NS	
	Prophylaxis	Yes (vs. No)							B (+)										B (+)		
	HIV-status	Negative					M (+)												NS		
Knowledge	Knowledge about HIV and/or breastfeeding	Higher or Yes (vs. No)			NS	B (+)									M (+)	M (+)	M (+)			M (+)	
Intention	Intention to EBF	Yes (vs. No)						NS													
	Timing of feeding decision	Before (vs. After Delivery)	NS		NS			NS													
Attitudes	Attitude (overall)	Positive towards EBF	M (-)			B (+)										M (+)					
	Belief: Infant will not acquire HIV through breast milk	Yes (vs. No)			M (+)							NS									
	Belief: HIV transmission can be prevented with ART	Yes (vs. No)			M (+)																
Social Norms	Social Norms (overall)	Positive towards EBF	M (+)																		
	Fear of Stigmatization	Yes (vs. No)										M (+)									
	Spouse Influence	Yes (vs. No)			B (+)							NS									
	Family Influence	Yes (vs. No)			B (-)							NS									
Perceived Behavioral Control	Perceived Behavioral Control (overall)	Positive towards EBF	M (+)																		
	Insufficient milk or other breast health problems	Yes (vs. No)								M (-)							NS				
	Confidence in safe preparation of formula	Yes (vs. No)			M (-)																

NS = Not significant
B (+) = Significant, positive association in bivariate analysis
M (+) = Significant, positive association in multivariate analysis
B (-) = Significant, negative association in bivariate analysis
M (-) = Significant, negative association in multivariate analysis