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CONTRACEPTIVE DYNAMICS FOLLOWING HIV TESTING

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Contraceptive Dynamics Following HIV Testing

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Preface

The Demographic and Health Surveys (DHS) Program is one of the principal sources of international data on fertility, family planning, maternal and child health, nutrition, mortality, environmental health, HIV/AIDS, malaria, and provision of health services.

One of the objectives of The DHS Program is to analyze DHS data and provide findings that will be useful to policymakers and program managers in low- and middle-income countries. DHS Analytical Studies serve this objective by providing in-depth research on a wide range of topics, typically including several countries and applying multivariate statistical tools and models. These reports are also intended to illustrate research methods and applications of DHS data that may build the capacity of other researchers.

The topics in the DHS Analytical Studies series are selected by The DHS Program in consultation with the U.S. Agency for International Development.

It is hoped that the DHS Analytical Studies will be useful to researchers, policymakers, and survey specialists, particularly those engaged in work in low- and middle-income countries.

Sunita Kishor

Director, The DHS Program

Abstract

This study uses Demographic and Health Survey (DHS) data to investigate how receipt of HIV test results influences subsequent contraceptive behavior. In five countries (Kenya, Lesotho, Malawi, Zambia, and Zimbabwe), we analyze the effect of HIV testing during antenatal care on adoption of contraception following birth. In two of the countries (Lesotho and Zimbabwe), we also examine (a) adoption and (b) discontinuation of contraception among women who did not experience a birth in the past 24 months and for whom the option of an HIV test occurs outside of the context of antenatal care. We use longitudinal contraceptive calendar data to estimate hazard models of a change in contraceptive behavior, using as covariates (1) HIV status as determined by biomarker testing at the time of the survey and (2) women's self-reported HIV testing experience.

In Kenya only, HIV-positive women have a longer duration to adopting contraception following birth compared with HIV-negative women. This relationship is not found elsewhere, nor is HIV status associated with the hazard of adopting or discontinuing contraception among women without a birth in the past 24 months.

In Lesotho, Zambia, and Zimbabwe, women who receive HIV test results during antenatal care have a shorter expected time to adopting contraception, regardless of HIV status, but not in Kenya or Malawi. Among women without a birth in the past 24 months, those who receive HIV test results have a shorter expected time to adopting contraception in Zimbabwe, but there is no statistical difference in Lesotho. Experience with HIV testing does not influence discontinuation of contraception.

Executive Summary

Policies and programs addressing the reproductive health needs of HIV-positive women encourage contraceptive use as a key intervention for reducing unintended pregnancy and preventing vertical transmission of the virus. Women living in countries with high HIV prevalence, however, have some of the highest levels of unmet need for family planning, suggesting that access to and adoption of contraception following HIV diagnosis remain important global health priorities.

A large body of literature focusing on contraceptive use dynamics among HIV-positive women suggests extensive heterogeneity across regional, cultural, and programmatic contexts. Nonetheless, many of these studies indicate differences in contraceptive use between HIV-positive and HIV-negative women. One area of research that remains less well explored is how learning one's status alters contraceptive use patterns. To date, few studies have investigated the causal impact of receipt of test results on contraceptive use dynamics, such as uptake, method mix, discontinuation, and failure.

This study uses Demographic and Health Survey (DHS) data from five countries (Kenya, Lesotho, Malawi, Zambia, and Zimbabwe) to investigate how receipt of HIV test results during antenatal care (ANC) influences adoption of contraception following birth. In Lesotho and Zimbabwe this study also examines (a) adoption and (b) discontinuation of contraception among women who did not experience a birth in the past 24 months and for whom the option of an HIV test occurs outside of the context of ANC. We use longitudinal contraceptive calendar data to estimate hazard models of a change in contraceptive behavior, using as covariates (1) HIV status as determined by biomarker testing at the time of the survey and (2) women's self-reported HIV testing experience.

Using this longitudinal study design, the only significant relationship between contraceptive use and HIV status found in multivariate analysis is among women in Kenya who gave birth in the 24 months preceding the survey. Among these, HIV-positive women have a 53 percent greater expected time to adopting a contraceptive method following birth compared with HIV-negative women, net of other factors. This relationship is not found elsewhere, nor is HIV status associated with adopting or discontinuing contraception among women without a birth in the past 24 months.

There is more evidence from these analyses to suggest that exposure to HIV testing is associated with shorter expected durations to contraceptive adoption among women with a recent birth and among other non-users of contraception at the time of HIV testing. In Lesotho, Zambia, and Zimbabwe, women who have had an HIV test and received results during ANC have shorter expected times to adopting a contraceptive method following birth. In addition, in Zimbabwe, but not Lesotho, having had an HIV test and received results is also associated with a shorter time to adopting contraception among women who did not have a birth in the previous 24 months.

As with HIV status, HIV testing experience is not associated with discontinuing contraception among women who were using contraception at the start of the observation period, net of other factors.

For the most part the results presented here confirm and extend those of the only previous study that assessed differences by HIV status in how knowing one's HIV status affects contraceptive practices. We found almost no significant differences between HIV-positive and HIV-negative women in contraceptive patterns following HIV testing.

The new finding that in four of the five study countries HIV testing experience is associated with quicker adoption of contraception offers tentative support for the conclusion that interaction with health services appears to facilitate contraceptive use, rather than HIV status or knowledge of HIV status per se.

However, further exploration is warranted of how HIV status and HIV testing experience are related to interactions with other health services, fertility intentions, and attitudes toward contraception, as well as contraceptive behavior.

1. Introduction

Policies and programs addressing the reproductive health needs of HIV-positive women encourage contraceptive use as a key intervention for reducing unintended pregnancy and preventing vertical transmission of the virus (Halperin et al. 2009; Mazzeo et al. 2012; Reynolds et al. 2006). Women living in countries with high prevalence of HIV, however, have some of the highest levels of unmet need for family planning (Wilcher et al. 2009), suggesting that access to and adoption of contraception following HIV diagnosis remain important global health priorities.

A large body of literature focusing on contraceptive use dynamics among HIV-positive women suggests extensive heterogeneity across regional, cultural, and programmatic contexts. Nonetheless, many of these studies indicate differences in contraceptive use between HIV-positive and HIV-negative women. One area of research that remains less well explored is how learning one's HIV status impacts or alters contraceptive use patterns. This study employs Demographic and Health Survey (DHS) data from five countries to investigate how receipt of HIV status may alter contraceptive use dynamics.

One of the primary reasons contraceptive use might differ between HIV-positive and HIV-negative women following testing and knowledge of their HIV status is that HIV-positive women may, at least temporarily, revise their fertility preferences downward. Alternately, women who learn that they are HIV-positive may revise their fertility preferences upward if they: are concerned with avoiding stigma, by demonstrating their continued ability to bear a child; become concerned with their legacy; seek to secure a relationship that has become vulnerable to dissolution; or would like to fulfill childbearing desires before their health deteriorates (Cooper et al. 2007; Erhabor et al. 2012; Nattabi et al. 2009; Yeatman 2009a).

Longitudinal studies allowing for comparison of fertility preferences pre- and post-diagnosis generally support the former notion, that HIV-positive women are more likely to revise their fertility preferences downward (Bonnenfant et al. 2012; Hoffman et al. 2008; Keogh et al. 2012; Yeatman 2009b). For example, among women receiving HIV voluntary counseling and testing (VCT) in Malawi, the proportion of women reporting a desire for future children declined one week after diagnosis (from 33 percent to 15 percent), and then remained constant over the course of the year (Hoffman et al. 2008). In a longitudinal study of women receiving antenatal care in Tanzania, Keogh and colleagues (2012) found no change in short-term postpartum fertility preferences, but a downward adjustment measured 15 months after HIV diagnosis. In Malawi, Yeatman (2009b) found a downward revision of fertility preferences following HIV diagnosis, but only among women who perceived a low likelihood of infection.

Other studies comparing fertility desires between HIV-positive and HIV-negative women provide further support for differences by HIV status after receiving test results. For example, among those receiving results from VCT clinics in Rwanda, HIV-positive men and women were six times more likely to report wanting to stop childbearing compared with HIV-negative individuals (Heys et al. 2009). Likewise, among couple VCT clients in Ethiopia, women in serodiscordant relationships were 10 to 11 times more likely to no longer desire children following diagnosis compared with women in HIV-negative concordant relationships (Bonnenfant et al. 2012). Cross-sectional studies also provide some evidence of differences by HIV status. A multi-country analysis using nationally representative DHS data found that, in five of the eight countries studied, HIV-positive women who knew their status were significantly less likely to want no more children compared with HIV-negative women who knew their status (Bankole et al. 2011).

HIV-positive women face common family planning barriers shared by all women of reproductive age. For example, women enrolled in a prevention of mother-to-child HIV transmission trial in Western Kenya often cited partner's approval and support as key determinants of intention to use family planning (Akelo et al. 2013). In addition, in India women not using contraception following HIV diagnosis cited lack of contraceptive counseling, low acceptability of non-condom contraception, and partner's involvement (Chakrapani et al. 2011). In Soweto, South Africa, qualitative evidence suggests that HIV-positive women may not use contraceptives because of concerns about side effects, body image, and being amenorrheic (Laher et al. 2009). Similarly, in a qualitative study of people living with HIV in two Uganda clinics, patients indicated concerns about complications and the cost of some family planning methods (Wanyenze et al. 2013).

HIV-positive women may face even greater barriers to family planning use than other women of reproductive age. HIV-positive women may avoid health services as a way to avoid HIV stigma and to limit inadvertent disclosure of their HIV status (Church and Mayhew 2009). New expenses related to the cost of HIV treatment, care, and support could divert resources away from spending on contraceptive methods or visits to family planning providers, although this remains less well-explored in the literature. HIV-positive women may also avoid use of hormonal contraception because of fears related to interactions with antiretroviral therapies or disease progression (Mbonye et al. 2012; Todd et al. 2011).

Alternatively, women who access HIV testing services may be more likely to use contraception because they access services that supply it. This effect may represent a self-selection process to the extent that women who are more likely to access HIV testing or use ANC services that offer HIV testing are the same women who are more likely to access other types of health care, including family planning services. HIV testing may also facilitate interactions with family planning services if contraception is promoted in the course of HIV test counseling, if direct referrals are made for family planning services, or if HIV testing and family planning services are integrated. This effect may be related to the act of testing for HIV and thus hold true for women regardless of HIV status, or it may be accentuated for women who test positive for HIV and are referred for ART treatment and general preventative health services, and thus have more engagement with health services, including family planning.

To date, few studies have investigated the causal impact of receipt of test results on contraceptive use dynamics, such as uptake, method mix, discontinuation, and failure. Using data collected prospectively as part of a randomized control trial of the diaphragm for HIV prevention in South Africa and Zimbabwe, Blanchard and colleagues found that, among newly diagnosed women, a majority (65 percent) had no change in contraceptive status, while 17 percent switched to more effective methods (e.g. from condoms to injectables) and 18 percent switched to less effective ones (Blanchard et al. 2011). These patterns, however, did not significantly differ by HIV status.

In a prospective cohort study of women presenting to family planning, sexually transmitted infection, or voluntary counseling and testing clinics in Malawi, Hoffman et al. (2008) found that contraceptive use increased from 38 percent before HIV diagnosis to 52 percent one week later, but declined to 46 percent by 12 months. The study did not include HIV-negative women for comparison. Lastly, a subanalysis of a prospective study on hormonal contraception and HIV acquisition in Uganda, Zimbabwe, and Thailand found an uptake of hormonal contraception six months after diagnosis among women not using contraception at baseline (i.e. 0 to 25 percent), and low discontinuation (1.5 percent) among those who were using hormonal contraception at the time of diagnosis (Nanda et al. 2011). This study also did not include a comparison group of HIV-negative women.

Some studies have also tried to assess changes in contraceptive use via structured questionnaires, which capture HIV-positive individuals' contraceptive use prior to their diagnosis. Using this study design, Chakrapani et al. (2011) found that contraceptive uptake, including dual use, increased significantly among recently diagnosed Indian women, with condom use increasing from 11 percent to 92 percent and dual use increasing from 5 percent to 30 percent. Likewise, among HIV-positive women in Vietnam, overall contraceptive use increased from 63 percent before diagnosis to 89 percent afterward, and reported condom use increased from 39 percent to 87 percent (Chi et al. 2012).

The literature reviewed above is limited to studies using non-representative cohorts of women. Thus, it is unclear if the observed patterns are representative of the general population. However, cross-sectional evidence from representative population surveys investigating the relationship between HIV status and contraceptive use indicates different patterns across countries. In the multi-country study reviewed above, the authors found no statistically significant association in current contraceptive use by HIV status in six of the eight countries (Bankole et al. 2011). In the two countries with significant findings, HIV-positive women in Lesotho were less likely to use contraception, but in Rwanda were more likely to use it. The observed patterns of contraceptive use are also likely to interact with demand for contraception. Using DHS data, Johnson and colleagues (2009) found that in three out of the four countries studied, HIV-positive women who likely knew their status were more likely to want to limit childbearing by using contraception. Also, among women using contraception, HIV-positive women were more likely to use condoms.

These studies reveal existing gaps in our understanding of the relationship between HIV status and contraceptive use, and highlight the need for analyses using nationally representative data. The aim of this study, therefore, is to assess contraceptive use dynamics following receipt of test results, using nationally representative data from recent DHS surveys in five countries in sub-Saharan Africa—Kenya, Lesotho, Malawi, Zambia, and Zimbabwe. Specifically, we use a semi-longitudinal design and contraceptive calendar data to compare contraceptive uptake and discontinuation between recently diagnosed HIV-positive and HIV-negative women.

2. Methods

2.1. Data

DHS surveys are nationally representative, population-based household surveys that employ standardized questionnaires and protocols for the collection of biomarker data, increasingly including HIV serostatus. This study uses DHS survey data from five countries in which HIV prevalence among women is greater than 4 percent and for which the most recent survey includes HIV testing and the contraceptive calendar. The included surveys are: Kenya 2008-09, Lesotho 2009, Malawi 2010, Zambia 2007, and Zimbabwe 2010-11. All five surveys interviewed women of reproductive age (15-49), regardless of marital status (currently, formerly, or never-married). Response rates among eligible women range from 93.3 percent in Zimbabwe to 97.9 percent in Lesotho.

We use two HIV-related measures: first, HIV status at the time of the survey bio-medically confirmed through DHS biomarker testing; and second, a self-reported measure of testing and receipt of results. We use self-reported date of most recent HIV test as an assumed date of learning one's current HIV status.

DHS contraceptive calendar data provide a longitudinal window in which to examine use and discontinuation of contraception over time. We analyze changes in contraceptive behavior within two groups of women: (1) women who have had a birth in the 24 months preceding the survey, for whom the opportunity to have an HIV test occurs during pregnancy; and (2) women who have neither had a birth in the 24 months preceding the survey nor were pregnant 24 months before the survey, and thus for whom the option of having an HIV test occurs outside the context of pregnancy-related care. For the first group, we examine uptake of a contraceptive method following the most recent birth. We examine the influence on adopting a contraceptive method of HIV status and of having had an HIV test and received the results during pregnancy.

We investigate two aspects of contraceptive dynamics among the second group. First, we examine adopting a contraceptive method among women who were not initially using contraception 24 months preceding the survey. Next, we examine discontinuation of contraception among women who were using a contraceptive method 24 months preceding the survey. For each, we compare the contraceptive behavior of women who are HIV-positive with those who are HIV-negative, and those who have had an HIV test and received the results with those who have not.

2.1.1. Contraceptive calendar

Calendar data are complete month-by-month retrospective histories of episodes of contraceptive use or non-use, as well as pregnancies, births, and terminations, that occur in the five years preceding the survey. In several surveys additional columns collect data on reason for discontinuation of contraception or changes in marital status. Data are recorded hierarchically in case of two events occurring in the same month. Terminations supersede pregnancies, which supersede contraceptive use. Methods of contraception are recorded according to their level of efficacy (ICF International 2012; Trussell 2011; WHO/RHR and JHU/CCP 2011). As such, dual method use (of a barrier and a hormonal method) is not recorded; only the most effective method is captured.

2.1.2 HIV biomarker testing in the DHS

DHS surveys follow a standard DHS protocol for anonymous, informed, and voluntary HIV testing of survey respondents. In some surveys, HIV testing is conducted in every household (Zambia, Zimbabwe). In others, it is collected in every second household (Kenya, Lesotho) or third household (Malawi). Blood spots for HIV testing are collected on filter paper from a finger prick and are then transported to a laboratory. The laboratory protocol is typically based on an initial ELISA test and a retest of all positive samples with a second ELISA. Between 5 to 10 percent of samples that are negative on the first ELISA test are retested. For samples with discordant results on the two ELISA tests, a third ELISA or a Western Blot is performed. Respondents do not receive the results of the survey's blood test, but are instead referred to available voluntary testing and counseling services. The protocol for HIV testing undergoes ethical reviews in survey countries and in the United States. Response rates for HIV testing in study countries range from 77.1 percent in Zambia to 93.6 percent in Lesotho. In all countries, our analytic samples are restricted to those women who were offered and consented to HIV biomarker testing and for whom valid testing of dried blood spots yielded valid (not indeterminate) results.

2.1.3. Sampling

DHS surveys use a two-stage clustered sampling technique. In the first sampling stage, the country is stratified into regions from which census-based enumeration areas are selected with probability proportional to size. Urban areas and less populous areas are typically oversampled in this first stage. A mapping and household listing exercise is carried out in each selected enumeration area. In the second sampling stage, households are randomly selected from the household list within each selected enumeration area.

A sampling weight is applied, which accounts for both sampling probability and non-response. In this case, we apply the weight that accounts for sample selection and non-response for HIV biomarker testing. Additionally, we use the complex survey (svy) commands available within Stata 13 to account for the clustered sampling design and estimate robust standard errors.

The sample of women interviewed in study countries ranges from 7,146 in Zambia to 23,020 in Malawi, and the sample of women with valid HIV biomarker test results ranges from 3,641 in Kenya to 7,313 in Zimbabwe. This study conducts separate analyses on two segments of this population. The first analyses are restricted to women who have had a birth in the 24 months preceding the survey and consented to survey HIV biomarker testing, in all five study countries (analytic sample #1). For these women, we examine contraceptive behavior following their most recent birth. The second set of analyses is restricted to women who have not had a birth in the 24 months preceding the survey nor were pregnant 24 months preceding the survey and who consented to an HIV biomarker test, in the Lesotho and Zimbabwe surveys (analytic sample #2). Further restricting our analyses to women for whom data are complete on all variables in our analytical models, our analytical samples are as described below.

Table 1. Analytic samples

	Weighted number of women age 15-49					
			Analytic sample #1	Analytic sample #2		
				Who did not have a birth in the previous 24 months and were not pregnant 24 months prior to the survey and HIV biomarker tested		
	Interviewed	HIV biomarker tested[1]	Who had a birth in the previous 24 months and HIV biomarker tested	Not using contraception[2]	Using contraception[2]	Total
Kenya 2008-09	8,444	3,641	1,006	na	na	na
Lesotho 2009	7,624	3,778	794	2,076	904	2,980
Malawi 2010	23,020	7,091	2,437	na	na	na
Zambia 2007	7,146	5,502	2,023	na	na	na
Zimbabwe 2010-11	9,171	7,313	2,003	3,320	1,973	5,293

[1] Consented to HIV biomarker testing via dried blood spot during the DHS survey

[2] At 24 months prior to the survey

2.1.4. Structure of the data set

In the contraceptive calendar women may report multiple episodes of contraceptive use or non-use, or other reproductive events. We create a contraceptive events dataset wherein each episode is composed of person-months from start of observation until conclusion of the episode (failure) or time of interview (censoring).

The period of observation for this study is the 24 months preceding the survey, for both analytical samples. We limit our analysis to this period because the closer to the time of the survey, the more likely the results of the HIV biomarker test conducted as a part of the DHS survey are to be the same as the results a woman has received at her most recent HIV test. In all five countries a majority of women who had an HIV test in the DHS also have had an HIV test within the preceding 24 months.

In the first analytic sample of women who gave birth in the past 24 months, women enter observation in the month of their most recent birth, with all women being non-users of contraception. The period of observation continues until the woman takes up a contraceptive method, or until the date of interview (censoring). We link this episode of observation with data on the woman's preceding pregnancy. Specifically, we link information on whether the woman had antenatal care (ANC) and whether she had an HIV test and received results during ANC[1].

For the second analytic sample, we examine the episode of contraceptive use or non-use occurring at the start of the observation period 24 months preceding the survey. Women enter observation exactly 24 months before the survey, and continue until their contraceptive status (use or non-use) changes, or until the date of interview (censoring). For Lesotho and Zimbabwe only, we are able to link to this episode data on the timing, in months, of the most recent HIV test. Thus, for each woman, we observe not only whether or not she had an HIV test during that episode of contraceptive use or non-use, but also when she had an HIV test and by how many months it precedes a change, if any, in her contraceptive behavior.

[1] In Zimbabwe, the measure captures women who had an HIV test during ANC or during delivery.

2.2. Analytical Strategy

After presenting descriptive data in the next section (Results), we take advantage of the longitudinal nature of the calendar data to conduct a series of hazard models on the two analytic samples. With the first analytic sample of women who have had a birth in the 24 months preceding the survey, we analyze the hazard of adopting a method of contraception following their most recent birth, using HIV status and receipt of results of an HIV test during ANC or delivery as our key covariates in Model 1.

We divide the second analytic sample of women who have not had a birth in the 24 months preceding the survey nor were pregnant at the start of the period of observation into two categories: (1) women who are not using contraception at the start of the observation period and (2) women who are contraceptive users at the start of the observation period. For women in the first category, our analytical model (Model 2) is similar to the group of women who have had a birth (Model 1). We analyze the relative hazard of adopting a method of contraception in the observation period, using HIV status and whether or not the women received results from an HIV test prior to adopting contraception (or censoring) as key covariates. For women in the second category, we analyze in Model 3 the relative hazard of discontinuing contraception during the observation, given women's HIV status and whether or not women received results from an HIV test prior to discontinuation (or censoring).

The first two hazard models (Models 1 and 2) predicting the adoption of contraception are lognormal accelerated failure time (AFT) hazard models with the baseline survival function (t_j) estimated by:

$$S_0(t_j) = 1 - \Phi\left(\frac{\ln t_j - \beta_0}{\sigma}\right)$$

Where Φ represents the cumulative distribution function with a Gaussian (normal) distribution and where t_j is measured in months (Cleves et al. 2010). As with other accelerated failure time models, the covariates' effects accelerate or decelerate the time to failure by a factor of $\exp(-x_j\beta_x)$ such that:

$$S(t_j|x_j) = S_0\{\exp(-x_j\beta_x)t_j\}$$

Therefore, results are reported as the time ratios, or exponentiated coefficients, to ease interpretation (Allison 1995; Box-Steffensmeier and Jones 2004). Lognormal hazard models are fully parametric, maximum likelihood models in which the scale of the lognormal-distributed baseline hazard is estimated with σ (Allison 1995; Box-Steffensmeier and Jones 2004). Hazards are not assumed to be proportional. One benefit of the lognormal model is that the hazard function increases and then decreases (Cleves et al. 2010), which reflects the process identified in other research on adoption of contraception (e.g., Blanchard et al. 2011). This model is selected as the best fit for the baseline hazard from among other AFT and proportional hazard models on the basis of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), which is consistently lowest in all study countries.

The final model (Model 3), which models a different process than that in the first two models (contraceptive discontinuation rather than adoption), is estimated using a Gompertz hazard model of the form:

$$h(t|x_j) = h_0(t)\exp(x_j\beta_x)$$

We also report results of this model as the exponentiated coefficients, or hazard ratios, to ease interpretation. The Gompertz model assumes a baseline hazard as follows:

$$h_0(t) = \exp(\gamma t)\exp(\beta_0)$$

In which the shape parameter, γ, indicates an increasing hazard over time if positive and a hazard that decreases over time if negative. Gompertz hazard models are fully parametric proportional models estimated using maximum likelihood procedures and assume hazards are proportional across groups (Allison 1995; Cleves et al. 2010). All covariates are tested for violations of the proportional hazards property using Schoenfeld's residuals (Grambsch and Therneau 1994; Schoenfeld 1982). We selected this model among other parametric models on the basis of its low AIC and BIC and find that a Gompertz-distributed hazard represents the process of discontinuation, which differs from the process of adoption of contraception, better than does the lognormal baseline hazard.

Ties in failure times in all three models are handled using Breslow's approximation (Breslow 1974). All models are conducted for each study country separately. A pooled model, in which each survey was equally weighted, was tested. However, a variable denoting country was significant and non-proportional in all models, suggesting that both the baseline hazard and relative hazard of failure (adopting or discontinuing contraception) differs in each survey. The results of the separate hazard models presented in the next section confirm that a pooled model is not appropriate, as they indicate that the significance, magnitude, and, in some cases, direction of the coefficients vary by survey.

2.3. Measures

As mentioned above, the outcome of our analytical models is a change in contraceptive behavior (from non-user to user or from user to non-user) and our principal covariates of interest are women's HIV status and whether and when women have received the results of a recent HIV test, indicating likely knowledge of her current HIV status.

Contraceptive use (failure variable)—Model 1 (among women who have had a birth in the previous 24 months) and Model 2 (among women who have not had a birth in the previous 24 months and are not pregnant at the start of observation) both model the adoption of a contraceptive method among women who are initially non-users of contraception. Therefore, the failure variable is defined as use of a contraceptive method.

Conversely, Model 3 models the discontinuation of contraception among women who are initially users of contraception at the start of the observation period and so the failure variable is defined as the cessation of contraceptive use. Contraceptive users who stop using one method of contraception in order to switch to another method of contraception are not considered to have discontinued use. Sequential episodes of two or more different methods of contraception are measured as a single episode as a contraceptive user. Up to a one-month interruption between methods is permitted. Therefore, discontinuation is defined as discontinuing the use of a contraceptive method without adopting another method of contraception for two or more successive months.

For all models, contraceptive use is defined as using any method of contraception, whether traditional or modern, and non-use of contraception is defined as using neither a traditional nor a modern method.

Time variable—Analytical time (t) is measured linearly in single-month increments and extends from 24 months preceding the survey until failure or interview in Models 2 and 3 and from the month of most recent birth until failure or interview in Model 1. The time of interview (censoring) and of the end of an episode of contraceptive use/non-use (failure) are recorded in century month codes (CMC), such that analytical time is calculated as the difference between these and the CMC for the start of the observation period.

HIV status—Current HIV status is determined by the biomarker testing performed as part of the DHS survey and is coded 0 to indicate HIV-negative and 1 to indicate HIV-positive. Women who consent to survey biomarker testing do not receive the results of this test. HIV status refers to women's HIV status at the time of the survey, which may or may not be the same as the results of an HIV test received earlier.

HIV testing experience—DHS surveys collect data from all women on the most recent HIV test and, from women who report a birth in the five[2] years preceding the survey only, on HIV testing through ANC during the most recent pregnancy as well as any HIV test they may have had since the time they were tested during pregnancy. Although women may test for HIV multiple times in their lives, the DHS does not collect data on any earlier testing experience beyond the most recent HIV test, with the exception related to testing during and since ANC, described above.

A dichotomous variable is created from two questions regarding (1) whether women have had an HIV test and (2) whether they received the results. Women who meet both conditions are coded 1 on this variable. Women who have either not had an HIV test or have had an HIV test but did not receive the results are coded 0. Two variations of this measure—a fixed-time version and a time-varying version—are developed for use with each of our two analytic samples.

HIV testing experience during ANC (fixed-time)—For the first analytical sample (women who have had a birth in the previous 24 months) used in Model 1, this indicator variable refers to women who have had an HIV test during ANC[3]. There are no women in the analysis who have had an HIV test since their most recent birth. As such, this is a fixed-time variable that precedes the observation period.

HIV testing experience (time-varying)—For women in the second analytic sample, this variable refers to testing during the period of observation. This variable, and therefore this analytic sample, is developed only for the Lesotho and Zimbabwe surveys as these are the only surveys that record the timing of most recent HIV test in discrete months[4], which is necessary to link the time of the HIV test with the timing of the episode of contraceptive behavior. The variable is time-varying and coded as 0 for each month a woman does not have an HIV test and receive results in the time between the start of the observation period (24 months preceding the survey) and the month in which her episode of contraceptive behavior ends in failure[5] or, if no failure is observed, by the time of the survey. It is coded as 1 in the month a woman has an HIV test and receives the results. The variable is then coded 1 for each subsequent month in the observation period until failure or time of interview. Women who have had an HIV test and received results, but after the conclusion of her episode of contraceptive behavior, are coded as 0, as temporal sequencing prevents this test from influencing her adoption or discontinuation of contraception.

Knowledge of family planning—A score is calculated to represent the woman's level of knowledge of family planning. This variable is an additive index, ranging from 0 to 3, based on the woman's knowledge at the time of the survey of male condoms, oral contraceptive pills, and injectables. Pills and injectables are among the three most commonly used contraceptive methods in four of five study countries. In Malawi, injectables are the most commonly used method, but use of pills lags behind female sterilization.

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[2] We restrict our analysis to women who have a birth in the 24 months, not five years, preceding the survey or, for women not reporting a birth in this period, to the 24 months preceding the survey.

[3] In Zimbabwe, this variable refers to women who were tested for HIV during ANC or during delivery.

[4] The other three surveys ask when was the last time the respondent was tested, but records the response in three broad categories: less than 12 months ago, 12-23 months ago, or two or more years ago.

[5] Failure is defined as adoption of a contraceptive method among initial non-users of contraception in Model 2, and as discontinuation of contraception among initial contraceptive users in Model 3.

Place of delivery—This categorical variable is used only in Model 1. It captures whether the place of delivery for the woman's most recent birth was a home, a medical facility, or "other", with home delivery being the reference category.

Age—Woman's age at the start of the observation period is included in all models as a covariate. This variable is calculated as the difference between the CMC for the start of the observation period (i.e., date of each woman's most recent birth for analytic sample #1 and 24 months preceding the date of interview for analytic sample #2) and CMC for date of birth. It is expressed in whole and partial years.

Education—Woman's education is measured as the number of years of schooling completed at the time of the survey.

Parity—A continuous variable captures the number of births a woman has had by the start of the observation period. For women in Model 1, this includes the most recent birth that immediately precedes the episode under analysis.

Place of residence—A dichotomous variable captures whether the woman lives in a rural area or urban area at the time of the survey.

Household wealth quintile—DHS calculates standard household wealth quintiles based on factor analysis of material asset items (Filmer and Pritchett 2001; Rutstein 2008; Rutstein and Johnson 2004). This measure captures relative wealth within the country at the time of the survey for the household in which the woman resides. While wealth quintile is measured at the time of the survey and not at the start of the observation period, wealth, particularly when measured by assets, is a more stable measure of socioeconomic status than measures based on income or consumption.

Marital status—A marital status variable measures whether the woman has ever been married (currently married or formerly married) or has never been married at the time of the survey.

3. Results

3.1. Descriptive Results

3.1.1. Contraceptive use and HIV prevalence in study countries

Table 2 describes contraceptive prevalence, by method type and specific method, among all women age 15-49 in the study countries. In all five countries, the majority of women do not currently use any method of contraception. Current use of contraception ranges from 30 percent in Zambia to 41 percent in Zimbabwe. Current use of modern methods follows a similar pattern and makes up the majority of all contraceptive use in the study countries. The pill is the most commonly used method of contraception in Zimbabwe (27 percent) and Zambia (7 percent). Injectables are the most commonly used method of contraception in Malawi (19 percent), Kenya (15 percent), and Lesotho (13 percent). The male condom is the second most commonly used method in Lesotho (10 percent), the only country in which use exceeds 5 percent. Female sterilization is used less frequently than pills or injectables, except in Malawi, where female sterilization is the second most commonly used method (8 percent). Other modern methods are even less frequently used.

Current use of traditional methods, while low overall, is highest in Zambia (5 percent). In Kenya the dominant traditional method is periodic abstinence, and withdrawal in the other four study countries.

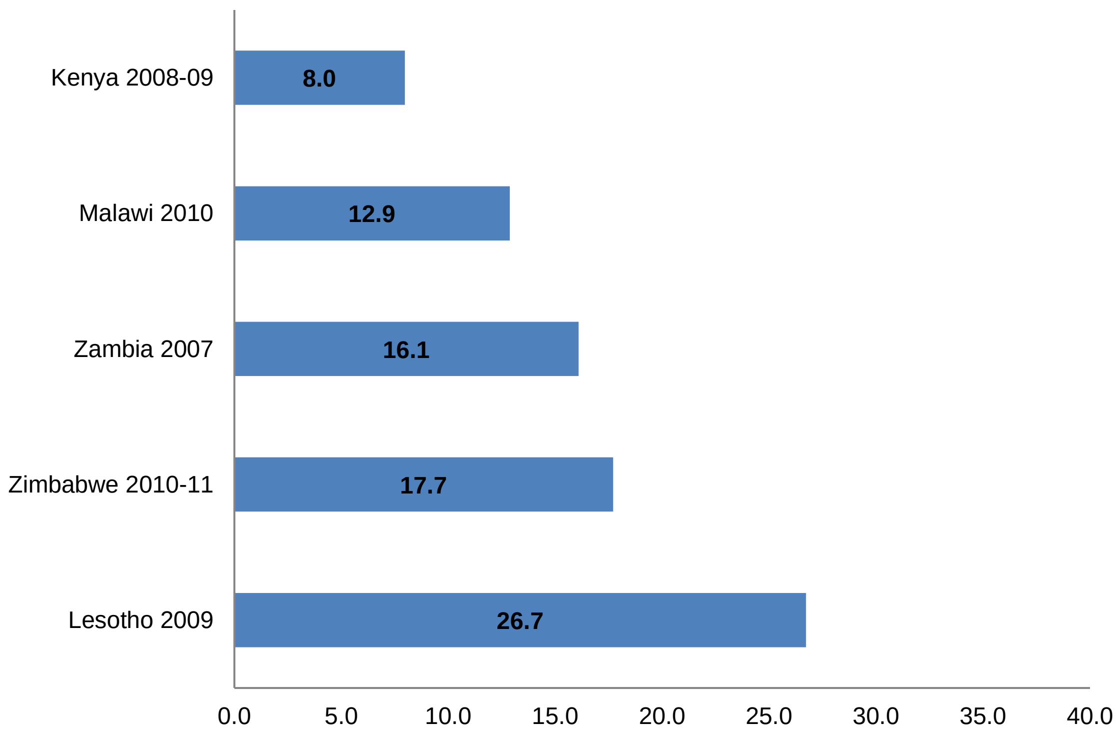
Table 2. Current use of contraception among all women age 15-49 in study countries

			Modern methods						Traditional methods				
	Not currently using	Any method	Any modern method	Female sterili-zation	Pill	Inject-ables	Male condom	Other modern methods[1]	Any traditional method	Periodic Abstinence	Withdrawal	Other traditional methods	Number of women
Kenya 2008-09	68.0	32.0	28.0	3.2	4.7	14.8	2.6	2.7	4.1	3.2	0.4	0.4	8,444
Lesotho 2009	64.1	35.9	34.9	1.7	7.8	13.4	10.4	1.5	1.1	0.1	0.5	0.5	7,624
Malawi 2010	64.6	35.4	32.6	7.5	1.9	19.2	2.7	1.3	2.8	0.6	1.2	0.9	23,020
Zambia 2007	70.1	29.9	24.5	1.4	7.4	6.2	5.0	4.5	5.3	0.9	3.6	0.9	7,146
Zimbabwe 2010-11	58.7	41.3	40.5	0.9	27.3	6.1	3.5	2.8	0.8	0.1	0.6	0.1	9,171

[1] Includes: male sterilization, IUD, implant, female condom, and lactational amenorrhea method (LAM)

Figure 1 shows estimates of HIV prevalence among women age 15-49 in the study countries. HIV prevalence ranges from 8 percent in Kenya to 27 percent in Lesotho.

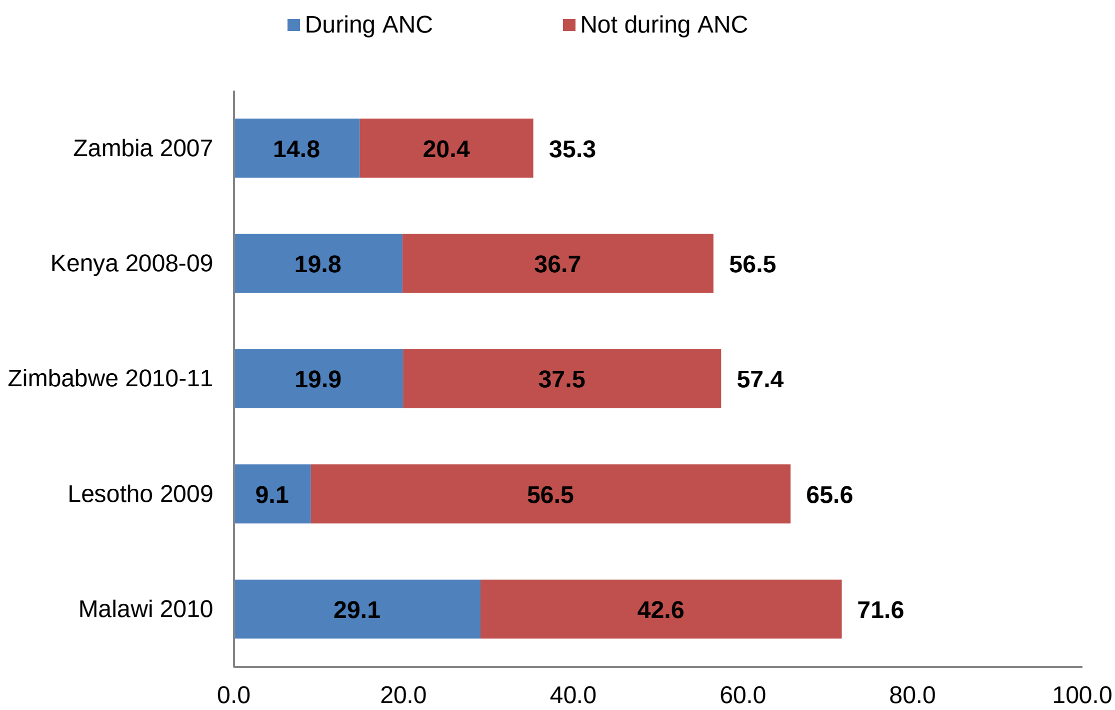
Figure 1. HIV prevalence among women age 15-49



3.1.2. Patterns of HIV testing during ANC and outside of ANC

Figure 2 presents the proportion of women who have ever had an HIV test, either during ANC or outside of ANC. In Zambia, approximately 35 percent of women have ever had an HIV test, while in Malawi about double that proportion have had an HIV test. Lesotho has the highest proportion of women obtaining an HIV test outside of ANC and the lowest proportion having an HIV test during ANC. Kenya and Zimbabwe are similar to one another in overall levels of women ever testing for HIV and in the proportions testing during ANC and outside of ANC.

Figure 2. Percent of women 15-49 ever tested for HIV and received results



3.1.3. Timing of HIV testing

Table 3 shows the patterns of HIV testing in greater detail, for all women (analytic samples 1 and 2 combined). In every study country a substantially larger proportion of women have had an HIV test within the past 24 months than were tested more than 24 months ago. In Zimbabwe the proportion recently receiving a test is two and a half times the proportion receiving a test more than 24 months ago, and in Lesotho more than ten-fold.

Nearly all women who have tested for HIV received the test results. In Zambia a cumulative 4 percent of women have ever had an HIV test but not received the results; this proportion is even lower in the other study countries. The proportion of women who have ever had an HIV test and received their results ranges from 35 percent in Zambia to 72 percent in Malawi. The proportion of women who have had an HIV test and received their results in the 24 months preceding the survey ranges from 28 percent in Zambia to 52 percent in Lesotho.

Table 3. Percentage of women ever tested for HIV by timing of most recent test and receipt of results

	Ever tested						Never tested	
	Last tested in past 24 months		Last tested 24+ months ago		Timing unknown[1]			
	Received results of last test	Did not receive results	Received results of last test	Did not receive results	Received results of last test	Did not receive results	Percent never tested for HIV	Number of women
Kenya 2008-09	43.2	1.4	13.3	0.4	0.0	0.2	41.6	8,444
Lesotho 2009	51.9	1.8	4.9	0.3	8.8	0.8	31.4	7,624
Malawi 2010	39.5	0.4	6.9	0.2	25.2	0.8	26.9	23,020
Zambia 2007	28.0	3.1	7.2	0.9	0.1	0.1	60.6	7,146
Zimbabwe 2010-11	42.4	1.6	15.0	0.7	0.0	0.0	40.3	9,171

[1] In Lesotho and Malawi, this category includes all women who gave birth in the past 2 years and whose most recent test was during ANC. These women were not asked about the timing of their HIV test.

Table 4 presents patterns of ANC and of HIV testing during ANC among women who have had a birth in the 24 months preceding the survey (analytic sample 2). The proportion of women who received no ANC during their most recent pregnancy ranges from 2 percent in Malawi to 13 percent in Zimbabwe. The proportion of women with a birth in the previous 24 months who did not have an HIV test as a part of ANC exceeds 45 percent in Lesotho and Zambia, but is less than 20 percent in the other three countries.

In Lesotho and Zambia a little more than 40 percent of women who have had a birth in the previous 24 months have had an HIV test and received the results during ANC. This figure approaches three quarters of women with a recent birth in Kenya and Zimbabwe, and is highest in Malawi (87 percent). As with the general population, the majority of these women have received the results of their HIV test. The proportion of women in the sample group who have had an HIV test but not received the results during ANC reaches 5 percent in Zambia, and is approximately 2 percent in the other four study countries, levels slightly higher than among the general population.

Table 4. HIV testing during ANC among women who had a birth in the past 24 months

	Received results of last test during ANC[1]	Did not receive results of last test during ANC	Not tested during ANC	Did not receive ANC	Number of women[2]
Kenya 2008-09	74.0	2.0	16.5	7.4	2,264
Lesotho 2009	43.0	1.9	46.9	8.1	1,606
Malawi 2010	86.6	2.1	9.5	1.8	7,724
Zambia 2007	40.3	5.2	51.8	2.7	2,631
Zimbabwe 2010-11	73.2	2.1	12.3	12.5	2,448

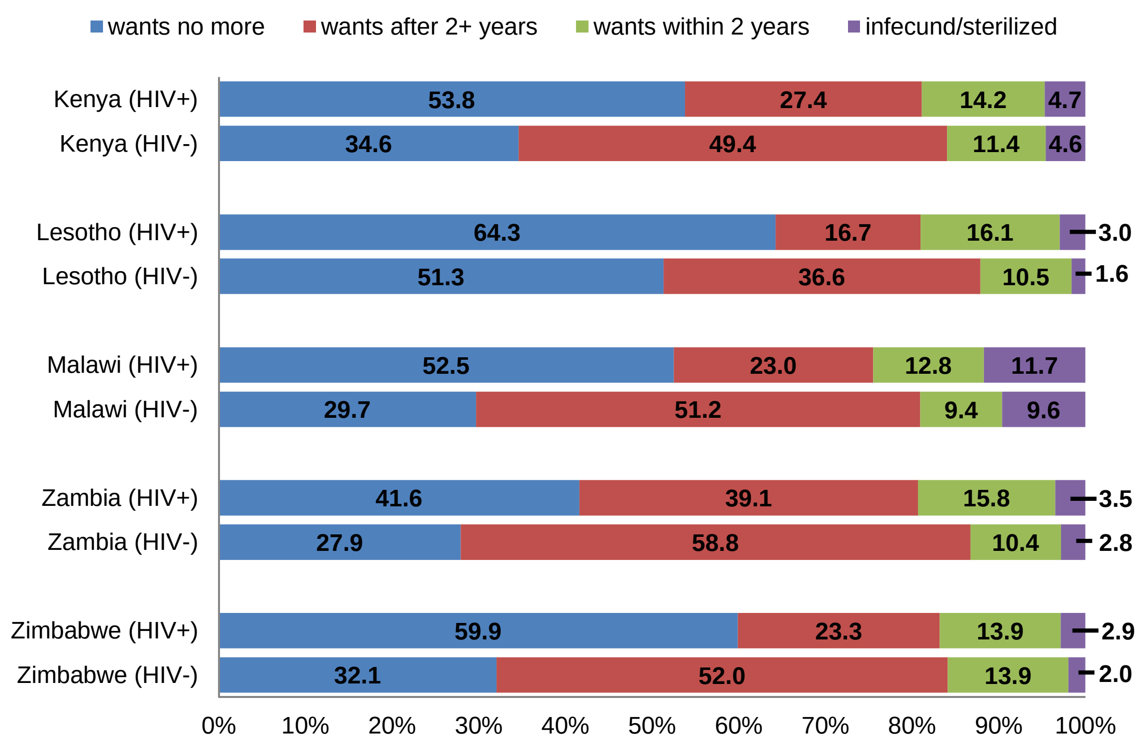
[1] In Zimbabwe, this includes women tested during ANC or during delivery

[2] This number differs from the analytical sample because not all women who had a birth in the past 24 months were offered or consented to HIV biomarker testing during the DHS survey

3.1.4. Fertility intentions by HIV status and HIV testing experience

Women learning their HIV status may change their contraceptive behavior because their fertility intentions change. Fertility intentions are not included in this study's multivariate hazard models because they lie on the causal pathway between the explanatory variables of interest and the outcomes of interest. Their relationship is explored in bivariate analysis: Figure 3 presents current fertility intentions among women age 15-49 in the study countries, by HIV status, and Figure 4 presents fertility intentions by history of HIV testing.

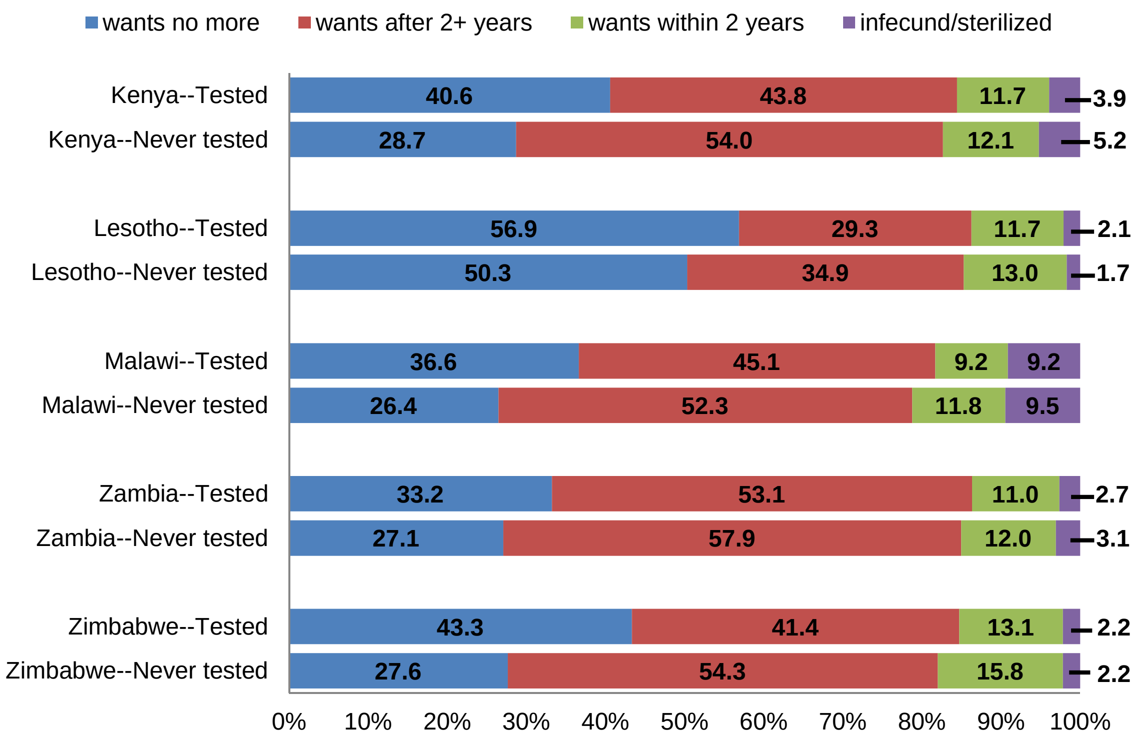
Figure 3. Current fertility intentions among women age 15-49, by HIV status



As Figure 3 shows, in no study country are there are meaningful differences between women who are HIV-positive and HIV-negative in the proportion who are infecund or have been sterilized, and differences in the proportion who want a child within 24 months are small. However, there are differences by HIV status in the distribution of women who want a child after 24 months or more and in the distribution of women who want no more children. In all five countries the proportion of HIV-positive women who want a child after two or more years is smaller, and the proportion of women who want no more children is larger, than among HIV-negative women. These differences are largest in Zimbabwe, where 60 percent of HIV-positive women want no more children, nearly double the 32 percent among HIV-negative women.

Similarly, Figure 4 indicates that the proportions who are infecund or sterilized and who want a child within 24 months do not differ by prior HIV testing experience. However, there are differences in the proportion of women who want a child after 24 months or more and in the proportion who want no more children. Similar to differences by HIV status, a greater proportion of women who have had an HIV test in the past want no more children, and a smaller proportion want to delay having a child for 24 months or more, compared with women who have never had an HIV test. Again, these differences are greatest in Zimbabwe.

Figure 4. Current fertility intentions among women age 15-49, by history of HIV testing



3.1.5. Sample profile

Table 5 provides a descriptive profile of all interviewed women in study countries as well as the specific analytic samples used in this study. Compared with the full sample of women (and, in Lesotho and Zimbabwe, compared with the second analytic sample), prevalence of HIV is lower among women in the first analytic sample, that is, women who have had a birth in the previous 24 months. These differences are virtually undetectable in Kenya.

A larger proportion of women in the first analytic sample have had an HIV test and received the results compared either with women in the full sample or with the analytic sample of women who have not had a birth in the past 24 months. The difference is roughly 20 percentage points in all of the study countries except Zambia, where the difference is 9 percentage points. This finding suggests the important contribution of receiving ANC to the provision of HIV testing in the study countries.

Table 5. Profile of women age 15-49 and of analytic samples: Percent distribution and means of selected characteristics

	Kenya		Lesotho			Malawi		Zambia		Zimbabwe		
	All women n=8,444	Analytic sample #1 n=1,006	All women n=7,624	Analytic sample #1 n=794	Analytic Sample #2 n=2,980	All women n=23,020	Analytic sample #1 n=2,427	All women n=7,146	Analytic sample #1 n=2,023	All women n=9,171	Analytic sample #1 n=2,003	Analytic Sample #2 n=5,293
HIV status[1]												
HIV-positive	8.1	8.1	26.7	24.6	27.3	12.8	9.7	15.9	12.3	17.7	13.6	19.2
HIV-negative	91.9	91.9	73.3	75.4	72.7	87.2	90.3	84.1	87.7	82.3	86.4	80.8
HIV testing												
Tested and received results	56.5	79.9	65.6	84.6	59.6	71.6	90.5	35.3	43.6	57.4	80.3	50.3
Knowledge of family planning												
Mean score (0-3)	2.66	2.76	2.75	2.83	2.72	2.81	2.92	2.70	2.84	2.79	2.92	2.76
Place of delivery for most recent birth[2]												
Home	53.1	53.1	36.9	39.5	na	21.4	18.9	49.0	51.3	32.4	35.1	na
Medical facility	46.8	46.6	61.1	57.7	na	76.1	78.0	50.5	48.3	66.3	63.4	na
Other	0.2	0.3	2.0	2.8	na	2.5	3.1	0.5	0.4	1.3	1.5	na
Marital status												
Never married	31.2	11.0	34.3	14.5	39.8	19.7	2.8	26.0	8.8	24.0	4.9	30.1
Ever married	68.8	89.0	65.7	85.5	60.2	80.3	97.2	74.0	91.2	76.0	95.1	69.9
Currently married	54.2	76.9	52.3	78.1	46.0	58.7	76.1	60.9	82.5	59.4	82.5	50.9
Currently living together	4.1	5.2	0.8	0.4	0.8	8.7	11.2	0.7	0.8	2.8	3.8	2.5
Divorced	4.4	1.8	7.5	3.9	8.4	3.6	1.2	4.4	1.6	6.1	1.4	8.3
Widowed	1.3	0.7	0.9	0.3	1.0	4.9	4.7	6.0	4.0	3.7	2.9	4.1
Separated	4.8	4.4	4.2	2.7	4.0	4.4	4.0	2.0	2.2	4.1	4.6	4.0

(Continued...)

Table 5. – *Continued*

	Kenya		Lesotho			Malawi		Zambia		Zimbabwe		
	All women n=8,444	**Analytic sample #1 n=1,006**	**All women n=7,624**	**Analytic sample #1 n=794**	**Analytic Sample #2 n=2,980**	**All women n=23,020**	**Analytic sample #1 n=2,427**	**All women n=7,146**	**Analytic sample #1 n=2,023**	**All women n=9,171**	**Analytic sample #1 n=2,003**	**Analytic Sample #2 n=5,293**
Parity												
Mean number of children born	2.7	3.4	1.8	2.4	1.7	3.1	3.6	3.0	3.9	2.1	2.6	2.0
Age												
15-19	20.8	8.8	23.4	15.6	25.4	21.7	11.1	22.0	11.6	21.2	12.9	24.4
20-24	20.3	31.3	20.4	35.0	17.2	19.8	30.0	19.2	26.2	20.1	31.3	15.7
25-29	17.2	27.0	16.3	22.1	13.6	19.1	27.1	19.1	27.0	18.4	28.3	14.8
30-34	14.3	19.2	12.9	15.2	12.2	14.1	15.0	14.8	18.7	14.1	15.1	13.3
35-39	10.4	9.0	10.0	9.0	11.0	11.0	10.9	10.5	11.1	11.5	8.8	12.5
40-44	9.1	3.9	8.6	2.5	10.3	7.5	4.8	7.9	4.5	8.0	2.9	10.0
45-49	7.8	0.9	8.4	0.7	10.2	6.8	1.0	6.6	0.9	6.8	0.7	9.2
Education												
Mean years of schooling completed	7.9	7.4	8.1	7.6	8.1	5.4	5.0	6.4	5.6	9.0	8.8	8.9
Place of residence												
Urban	25.4	20.9	33.7	23.2	35.2	18.7	15.7	42.1	29.5	38.7	23.2	34.5
Rural	74.6	79.1	66.3	76.8	64.8	81.3	84.3	57.9	70.5	61.3	76.8	65.5
Household wealth quintile												
Lowest	16.5	25.2	14.1	22.0	12.7	18.5	20.3	17.4	23.3	16.9	24.6	16.6
Second	17.6	20.9	15.6	19.8	15.7	18.8	21.8	18.0	22.5	17.4	22.5	18.1
Middle	19.1	14.3	17.4	18.8	17.7	19.6	22.2	17.9	21.0	18.3	20.4	19.6
Fourth	20.6	18.8	24.9	23.2	25.4	19.6	16.5	21.9	18.5	22.6	19.3	21.5
Highest	26.3	20.7	28.0	16.2	28.4	23.4	19.1	24.9	14.6	24.8	13.2	24.1

(Continued...)

Table 5. – *Continued*

	Kenya		Lesotho			Malawi		Zambia		Zimbabwe		
	All women n=8,444	**Analytic sample #1 n=1,006**	**All women n=7,624**	**Analytic sample #1 n=794**	**Analytic Sample #2 n=2,980**	**All women n=23,020**	**Analytic sample #1 n=2,427**	**All women n=7,146**	**Analytic sample #1 n=2,023**	**All women n=9,171**	**Analytic sample #1 n=2,003**	**Analytic Sample #2 n=5,293**
Employment status												
Currently employed	58.9	57.2	45.7	41.3	46.4	72.8	72.5	54.3	56.4	42.4	36.8	43.5
Not currently employed	41.1	42.8	54.3	58.7	53.6	27.2	27.5	45.7	43.6	57.6	63.2	56.5

[1] Calculated on the subsample of women who underwent HIV biomarker testing during the DHS survey. Weighted n's are: Kenya 3,641, Lesotho 3,778, Malawi 7,090, Zambia 5,499, and Zimbabwe 7,313

[2] Calculated on the subsample of women who have had a birth in the past five years. Weighted n's are: Kenya 3,973, Lesotho 2,984, Malawi 13,664, Zambia 4,136, Zimbabwe 4,426

[3] Analytic sample #1 consists of women age 15-49 who had a birth in the previous 24 months and were offered and consented to HIV biomarker testing during the DHS survey

[4] Analytic sample #2 consists of women age 15-49 who did not have a birth in the previous 24 months, were not pregnant 24 months prior to the survey and who consented to HIV biomarker testing during the DHS survey

The analytic samples differ from the full sample in other ways as well. Women who have had a birth in the past 24 months score higher on family planning knowledge and have more children, on average, but have fewer years of schooling than among all women age 15-49. A higher proportion of women with a birth in the past 24 months are currently married and a higher proportion live in rural areas. In all countries except Zambia, a lower proportion of women with a birth in the past 24 months are currently employed compared with the full sample. Also, a higher proportion of women with a birth in the past 24 months are age 20-34, and a higher proportion are in the lowest two and middle household wealth quintiles. These patterns are remarkably consistent across all study countries.

In Lesotho and Zimbabwe the second analytic sample (women who have not had a birth in the past 24 months and were not pregnant 24 months preceding the survey) more closely resembles the full sample of women than does the first analytic sample.

3.2. Model 1—Postpartum Adoption of Contraception among Women with a Recent Birth

Table 6 presents results of a multivariate model predicting expected time to adopting a contraceptive method among women who have had a birth in the 24 months preceding the survey (Model 1). Results are presented in time ratios, such that a positive time ratio (TR>1) corresponds to greater expected time to adopting contraception, while a negative time ratio (TR<1) implies a shorter expected time.

For each of the five countries, a number of women adopted postpartum contraception during the study observation period. In Kenya, 1,006 women contributed 9,842 person-months of observation, during which 403 began using contraception. In Lesotho, 794 women contributed 7,332 person-months, and 406 of these women adopted a contraceptive method during the observation period. Among Malawi's 2,427 women who contributed 21,300 person-months of observation, 1,312 women began using a postpartum contraceptive method in the observation period. In Zambia, during the 17,699 person-months of observation contributed by 2,023 women, 1,088 women adopted some form of contraception. In Zimbabwe 2,003 women contributed 12,445 months of observation, during which 1,498 women adopted a postpartum contraceptive method.

Table 6. Model 1: Time ratios predicting adoption of contraception following birth, among women age 15-49 who have had a birth in the previous 24 months

	Kenya n=1,006 women (9,842 person-months)		Lesotho n=794 women (7.332 person-months)		Malawi n=2,427 women (21,300 person-months)		Zambia n=2,023 women (17,699 person-months)		Zimbabwe n=2,003 women (12,445 person-months)	
	Time ratio	**95% CI**	**Time ratio**	**95% CI**	**Time ratio**	**95% CI**	**Time ratio**	**95% CI**	**Time ratio**	**95% CI**
HIV status (ref=HIV-negative)										
HIV-positive	1.53 *	(1.06, 2.21)	0.85	(0.68, 1.05)	1.20	(0.98, 1.47)	1.16	(0.97, 1.39)	1.10	(0.98, 1.24)
HIV test (ref=no test/results)										
Had HIV test and received results during ANC[1]	0.87	0.64,1.18	0.68 **	(0.54, 0.86)	0.90	(0.77, 1.06)	0.84 *	(0.73, 0.97)	0.79 ***	(0.69, 0.90)
Knowledge of family planning index	0.70 **	(0.54, 0.90)	0.84	(0.62, 1.14)	0.70 **	(0.56, 0.87)	0.76 ***	(0.66, 0.88)	0.73 ***	(0.63, 0.86)
Place of delivery (ref=home delivery)										
Medical facility	0.90	(0.68, 1.19)	0.82	(0.64, 1.04)	1.02	(0.90, 1.17)	0.83 *	(0.72, 0.97)	0.90 *	(0.80, 1.00)
Other	0.91	(0.14, 6.01)	1.11	(0.53, 2.32)	1.16	(0.87, 1.56)	1.14	(0.39, 3.31)	1.41 *	(1.00, 1.99)
Married (ref=never married)										
Ever-married	0.67	(0.41, 1.08)	0.64	(0.40, 1.02)	0.54 ***	(0.38, 0.76)	0.48 ***	(0.38, 0.62)	0.43 ***	(0.34, 0.55)
Parity	1.10	(1.00, 1.22)	1.07	(0.98, 1.18)	0.99	(0.95, 1.04)	0.97	(0.92, 1.02)	1.02	(0.97, 1.08)
Age (at start of observation period)	0.98	(0.95, 1.02)	1.00	(0.97, 1.02)	1.00	(0.98, 1.01)	1.02 *	(1.00, 1.04)	1.00	(0.98, 1.01)
Completed years of schooling	0.95 *	(0.91, 0.99)	1.00	(0.96, 1.04)	0.96 ***	(0.94, 0.97)	1.01	(0.99, 1.04)	0.99	(0.97, 1.01)
Residence (ref=urban)										
Rural	1.04	(0.80, 1.34)	1.07	(0.79, 1.46)	1.16	(0.95, 1.43)	0.93	(0.77, 1.14)	0.96	(0.84, 1.10)

(Continued...)

Table 6. – *Continued*

	Kenya n=1,006 women (9,842 person-months)		Lesotho n=794 women (7.332 person-months)		Malawi n=2,427 women (21,300 person-months)		Zambia n=2,023 women (17,699 person-months)		Zimbabwe n=2,003 women (12,445 person-months)	
	Time ratio	**95% CI**	**Time ratio**	**95% CI**	**Time ratio**	**95% CI**	**Time ratio**	**95% CI**	**Time ratio**	**95% CI**
Household wealth index (ref=lowest)										
Second	0.83	(0.57, 1.22)	0.84	(0.57, 1.24)	1.00	(0.85, 1.18)	1.52 ***	(1.25, 1.84)	0.96	(0.83, 1.11)
Middle	0.73	(0.48, 1.09)	0.77	(0.54, 1.09)	0.98	(0.84, 1.14)	1.56 ***	(1.28, 1.90)	1.00	(0.87, 1.15)
Fourth	0.82	(0.53, 1.25)	0.65 *	(0.44, 0.95)	0.94	(0.79, 1.12)	1.32 *	(1.06, 1.65)	0.92	(0.78, 1.08)
Highest	0.61	(0.37, 1.02)	0.67	(0.42, 1.08)	1.10	(0.90, 1.34)	1.17	(0.89, 1.53)	0.88	(0.74, 1.04)
Employment status (ref=not currently employed)										
Currently Employed	0.74 **	(0.60, 0.92)	0.89	(0.73, 1.08)	0.94	(0.82, 1.07)	0.94	(0.83, 1.06)	1.02	(0.92, 1.12)
constant	144.21 ***	(45.35, 458.60)	37.13 ***	(10.92, 126.27)	58.14 ***	(23.73, 142.48)	27.13 ***	(12.99, 56.66)	42.30 ***	(23.04, 77.70)
σ (sigma)	1.06	(0.96, 1.16)	1.08	(1.01, 1.16)	0.93	(0.89, 0.97)	1.04	(0.99, 1.08)	0.89	(0.86, 0.93)

Note: Results are from lognormal accelerated failure time hazard models. Data are weighted and adjusted to account for the complex survey design and robust standard errors estimated. Figures are time ratios. Numbers in parentheses are 95% confidence intervals.

***p≤ 0.001; **p≤ 0.01; *p≤ 0.05; † p≤0.10

[1]HIV test occurred during ANC. For Zimbabwe, HIV test occurred during ANC or delivery.

3.2.1. HIV status, experience of HIV testing during ANC, and the postpartum adoption of contraception

For four of the five countries studied (Lesotho, Malawi, Zambia, and Zimbabwe), there is no significant relationship between HIV serostatus and the expected time of adopting a postpartum contraceptive method, after adjusting for other covariates. In Kenya however, HIV-positive women have a 53 percent longer expected time to adopting a contraceptive method following birth compared with HIV-negative women.

In Lesotho, Zambia, and Zimbabwe, women who have had an HIV test and received results during ANC or delivery have a shorter expected time of adopting a contraceptive, regardless of HIV serostatus. In Kenya and Malawi, having had an HIV test and receiving results during ANC does not influence the expected time to adopting a contraceptive method.

3.2.2. Other covariates and the postpartum adoption of contraception

The most consistent association with expected time of adopting a contraceptive method after birth appears to be with the knowledge of family planning index. For all countries except Lesotho, a one-unit increase in the family planning knowledge index score is associated with a 24 to 30 percent shorter expected time to contraceptive adoption in the postpartum period. Marital status is also significant in three out of the five countries studied (Malawi, Zambia, and Zimbabwe), such that ever married women have significantly shorter expected times to contraceptive adoption compared with never married women.

There are no strong patterns across countries with other covariates in the model. Women who delivered at a medical facility have shorter expected contraceptive adoption times in Zambia and Zimbabwe compared with women who delivered at home, but there are no significant differences in Kenya, Lesotho, and Malawi. Completed years of schooling are related to timing of contraceptive adoption in two countries—Kenya and Malawi—with each additional year of schooling associated with a decrease in the time to adopting a postpartum method.

In Zambia age is related to timing of contraceptive use following birth such that a one-unit increase in age at the start of the observation period is associated with 2 percent longer expected time to adopting a contraceptive method. Wealth quintile is highly predictive of time to contraceptive adoption in Zambia, with the middle three wealth quintiles (i.e. second, middle, fourth) all associated with greater expected time to contraceptive use. In Lesotho, however, women in the fourth wealth quintile have a shorter than expected time to contraceptive use. In Kenya currently employed women also have shorter times to contraceptive adoption following birth. Parity and residence are not significantly associated with duration of adopting a contraceptive in any of the countries.

3.3. Model 2—Adoption of Contraception among Women without a Recent Birth

Table 7 presents the results of a similar analysis to Model 1, but the sample has changed: the analytic sample for this model is women who have not had a birth in the 24 months preceding the survey and who were not pregnant at 24 months preceding the survey (Model 2). Because the women in this sample have not given birth in the two-year observation period, any HIV test they may have had occurred outside of the context of antenatal care, which is the context of HIV testing for women included in Model 1.

Of the 2,980 women analyzed in Lesotho, 2,076 were not using contraception at the start of the observation period and 904 were contraceptive users. In Zimbabwe, 3,320 of the 5,293 women in the analytic sample were not initially using contraception, while 1,973 women were using contraception when the observation period began.

For those women who were not contraceptive users at the start of the observation period, Model 2 (Table 7) presents the results of a lognormal accelerated failure time model predicting the hazard of adopting a method of contraception between this time point and the time of the survey. Results are reported in time ratios. In Lesotho, 2,076 women contributed a cumulative 46,681 person-months of observation. During this time, 392 of the 2,076 women adopted some form of contraception. In Zimbabwe, 3,320 women contributed a total 81,587 person-months of observation and 386 women adopted a method of contraception during the observation period.

Table 7. Model 2: Time ratios predicting adoption of contraception among women age 15-49 who have not had a birth in the previous 24 months

	Lesotho n=2,076 (46,681 person-months)		Zimbabwe n=3,320 (81,587 person-months)	
	Time ratio	**95% CI**	**Time ratio**	**95% CI**
HIV status (ref=HIV-negative)				
HIV-positive	0.90	(0.69, 1.17)	1.00	(0.80, 1.26)
HIV test (ref=no test/results)				
Had HIV test and received results[1]	0.86	(0.57, 1.29)	0.42 ***	(0.28, 0.62)
Knowledge of family planning index	0.54 ***	(0.44, 0.66)	0.46 ***	(0.34, 0.62)
Married (ref=never married)				
Ever-married	0.43 ***	(0.31, 0.59)	0.22 ***	(0.17, 0.29)
Parity	0.84 ***	(0.76, 0.92)	0.73 ***	(0.68, 0.79)
Age (at start of observation period)	1.06 ***	(1.04, 1.09)	1.08 ***	(1.06, 1.10)
Completed years of schooling	0.98	(0.93, 1.03)	0.96 *	(0.92, 0.99)
Residence (ref=urban)				
Rural	1.07	(0.74, 1.56)	1.24	(0.92, 1.68)
Household wealth index (ref=lowest)				
Second	0.83	(0.60, 1.15)	1.31	(0.97, 1.76)
Middle	0.76	(0.54, 1.05)	1.26	(0.92, 1.72)
Fourth	0.80	(0.54, 1.16)	0.99	(0.70, 1.39)
Highest	0.64 *	(0.42, 0.97)	1.31	(0.87, 1.96)
Employment status (ref=not currently employed)				
Currently Employed	0.68 **	(0.54, 0.86)	0.82 *	(0.68, 1.00)
constant	339.93 ***	(102.39, 1,128.62)	790.58 ***	(254.67, 2,454.29)
σ (sigma)	1.48	(1.35, 1.64)	1.49	(1.37, 1.64)

Note: Results are from lognormal accelerated failure time hazard models. Data are weighted and adjusted to account for the complex survey design and robust standard errors estimated. Figures are time ratios. Numbers in parentheses are 95% confidence intervals.

***p≤ 0.001; **p≤ 0.01; *p≤ 0.05; † p≤0.10

[1]HIV test occurred during the period of observation.

3.3.1. HIV status, experience of HIV testing, and adoption of contraception

After controlling for other covariates, HIV status does not influence the expected time to adopting contraception in either Lesotho or Zimbabwe. This finding is consistent with results of Model 1 predicting adoption of contraception among postpartum women in these countries.

In Zimbabwe, women who have an HIV test and receive the results during the observation period have a 58 percent shorter expected time to adopting contraception than women who do not, but there is no statistical difference in Lesotho. These results are consistent with Model 1 results in Zimbabwe, but not in Lesotho, where testing experience has a significant association with the earlier adoption of contraception among postpartum women.

3.3.2. Other covariates and the adoption of contraception

In both Lesotho and Zimbabwe, knowledge of family planning, ever being married, higher parity, and current employment are all associated with a shorter time to adopting contraception, after controlling for other covariates. Each unit increase in the family planning knowledge index reduces the expected time to adoption of contraception by roughly half, while ever having been married is associated with a time to adoption that is 57 percent lower in Lesotho and 73 percent lower in Zimbabwe. Each one-year increase in age is associated with a six to eight percent longer expected time to adopting contraception. The pattern with respect to household wealth and education is not clear, with only women in the highest wealth quintile having a shorter expected time to adopting contraception compared with women in the lowest wealth quintile in Lesotho, but not Zimbabwe, and each additional year of schooling contributing to a four percent shorter duration to adoption of contraception in Zimbabwe only.

3.4. Model 3—Discontinuation of Contraception

As in Model 2, the analysis presented in Model 3 examines women who have not had a birth in the previous 24 months nor who were pregnant at the start of the observation period. Unlike Model 2, however, Model 3 examines the subset of this sample of women who were using contraception at the start of the observation period and uses a hazard model predicting discontinuation of contraception. A Gompertz hazard model, in which hazards are proportional across groups, is used for this purpose, as the process of discontinuation is better represented by a Gompertz-distributed baseline hazard than by a lognormal baseline hazard. Table 8 reports the results as hazard ratios.

In Lesotho, the sample is composed of 904 women, who contribute a total of 18,074 person-months of observation. Of the 904 initial contraceptive users, 238 discontinued using contraception over the observation period. In Zimbabwe, 1,973 women contribute 45,215 person-months of observation, and 634 discontinued contraception at some point during the observation period.

Table 8. Model 3: Hazard ratios predicting discontinuation of contraception among women age 15-49 who have not had a birth in the previous 24 months

	Lesotho n=904 women (18,074 person-months)		Zimbabwe n=1,973 women (45,215 person-months)	
	Hazard ratio	**95% CI**	**Hazard ratio**	**95% CI**
HIV status (ref=HIV-negative)				
HIV-positive	0.85	(0.63, 1.16)	0.90	(0.73, 1.12)
HIV test (ref=no test/results)				
Had HIV test and received results[1]	0.94	(0.66, 1.33)	0.99	(0.77, 1.26)
Knowledge of family planning index	0.80	(0.62, 1.03)	1.12	(0.81, 1.55)
Married (ref=never married)				
Ever-married	1.02	(0.66, 1.56)	1.24	(0.81, 1.89)
Parity	0.96	(0.81, 1.14)	0.93	(0.86, 1.01)
Age (at start of observation period)	0.96 **	(0.93, 0.99)	0.97 ***	(0.95, 0.98)
Completed years of schooling	1.01	(0.95, 1.07)	1.00	(0.97, 1.03)
Residence (ref=urban)				
Rural	1.15	(0.76, 1.73)	1.05	(0.84, 1.30)
Household wealth index (ref=lowest)				
Second	0.80	(0.41, 1.54)	0.89	(0.69, 1.15)
Middle	0.55 *	(0.33, 0.93)	0.96	(0.74, 1.24)
Fourth	0.77	(0.45, 1.32)	0.71 *	(0.51, 0.98)
Highest	0.66	(0.36, 1.21)	0.67 *	(0.47, 0.94)
Employment status (ref=not currently employed)				
Currently Employed	1.42 *	(1.01, 2.01)	0.95	(0.80, 1.13)
constant	0.01 ***	(.003, .055)	0.004 ***	(.001, .013)
γ (gamma)	0.13	(0.10, 0.16)	0.15	(0.14, 0.17)

Note: Results are from Gompertz proportional hazard models. Data are weighted and adjusted to account for the complex survey design and robust standard errors estimated. Figures are hazard ratios. Numbers in parentheses are 95% confidence intervals.

***p≤ 0.001; **p≤ 0.01; *p≤ 0.05; † p≤0.10

[1]HIV test occurred during the period of observation.

3.4.1. Factors influencing discontinuation of contraception

As with Model 2, any experience with HIV testing among women in Model 3 occurs outside of the context of antenatal care and is measured between the onset of the observation period and the time of discontinuation (failure) or time of interview (censoring). Neither women's HIV status nor their experience with HIV testing seems to influence discontinuation of contraception among women who were using contraception at the start of the observation period in Lesotho or Zimbabwe.

In both countries, age has a negative association with the hazard of discontinuation: in Lesotho, with each one year increase in age at the start of observation, women's hazard of discontinuation is reduced by 4 percent, and in Zimbabwe by 3 percent. Employment status also is associated with discontinuation in Lesotho only, such that women who are currently employed have a 42 percent greater hazard of discontinuing contraception. As with adoption of contraception, the role of wealth in discontinuation is not straightforward. In Lesotho, women in the middle household wealth quintile only, and in Zimbabwe, women in the two highest quintiles, have lower hazards of discontinuing contraception compared with women in the lowest household wealth quintile.

4. Limitations

This study uses monthly calendar data on HIV testing, births, and use (or non-use) of contraception to place each of these events in proper temporal sequence and to analyze time to event. By taking a longitudinal perspective, rather than the cross-sectional approach to which researchers are typically restricted, we are able to gain additional insight into the relationships between testing and learning one’s HIV status on the one hand and contraceptive behavior on the other. Nevertheless, this study is not without weaknesses that limit the conclusions from these analyses.

First and foremost among the study’s limitations is the assumption we make about women’s HIV status. We are forced to assume that the HIV status at the time women have an HIV test and receive the results is the same HIV status as determined by biomarker testing at the time of DHS survey. However, it is possible that a small proportion of women who were HIV-negative at the time of their most recent HIV test may have seroconverted by the time of the survey and are, therefore, mistakenly classified as HIV-positive. We restrict the period of analysis to the 24 months preceding the survey to reduce this error, as the likelihood of divergent HIV status at the time of the most recent HIV test and the time of the survey increases the longer the time between the two measures. This type of misclassification error would lead us to underestimate the true effect of women’s HIV status on their contraceptive behavior.

Second, certain covariates that vary over time are only measured at the time of the survey and are treated in the analysis as if they are fixed-time covariates. We do not have retrospective values on employment status, household wealth quintile, residence, and level of family planning knowledge, all of which may have changed since the start of the observation period. Some of these measures may be relatively stable over short periods of time, such as household wealth quintile, while others may fluctuate more over time.

In this analysis, we assume that the date of most recent HIV test is equivalent to the date of learning one’s HIV status. This assumption may be violated if women knew their status prior to their most recent HIV test. This assumption is most likely to be violated in Model 1 in countries where HIV testing is part of the standard ANC protocol, as is increasingly common[6]. It is possible that some women who already know their HIV status, regardless of whether that status is HIV-positive or HIV-negative, were retested for HIV during ANC as part of standard ANC care. It is also possible that some women included in Models 2 and 3 had tested for HIV prior to their most recent test. If the most recent HIV test result is the same as a previous test result, the date of the most recent HIV test would not necessarily represent the date of women’s learning their HIV status.

If our assumption is violated, we may misestimate strength of any associations between learning one’s HIV status and subsequent changes in contraceptive behavior. The extent to which and even the direction in which we misestimate this effect may further depend on the HIV status of repeat testers. For example, some women who were diagnosed as HIV-negative on an earlier HIV test may be motivated to retest if they have become dubious of their continued HIV-negative status out of self-perceived risk of infection. For these women, receiving even confirmatory results on the most recent HIV test could be akin to learning one’s HIV status for the first time, and thus this assumption would not be violated. For women who are found to be HIV-positive on an earlier test and on the most recent HIV test, however, this assumption would most certainly be violated. The degree of the misestimation of the effect of learning one’s HIV status on contraceptive behavior would depend both on how many women receive concordant results upon retesting and on the proportion who are HIV-positive.

[6] See Staveteig et al. (2013) for a discussion of trends in HIV testing, generally, and HIV testing in ANC, specifically.

Finally, we use an HIV testing variable that is time-varying, capturing its reported value at each month during the period of observation and preceding failure (adoption of contraception in Model 2 and its discontinuation in Model 3) or censoring. However, our measurement of these values is imperfect. Data on the time of the HIV test, in Lesotho and Zimbabwe, come from a survey question worded, “How many months ago was your most recent HIV test?” and recorded in months. A frequency distribution of this measure shows heaping on months 12 and 24, suggestive of displacement from adjacent months. The full extent of this measurement error and the implications for conclusions from these analyses are unknown.

5. Conclusions and Discussion

Using a longitudinal study design, we find limited evidence of an association between women's HIV serostatus and subsequent contraceptive use dynamics. The only significant relationship with HIV status that emerges in multivariate analysis is among women in Kenya who gave birth in the 24 months preceding the survey, with HIV-positive women having a 53 percent longer expected time to adopting a contraceptive method following birth compared with HIV-negative women.

For the most part, the results presented here confirm and extend those of the only previous study that assessed differences by HIV status in the causal impact of knowing one's status on contraceptive practices (Blanchard et al. 2011). As with the paper by Blanchard et al., we find almost no significant differences in contraceptive patterns following HIV testing between HIV-positive and HIV-negative women. Direct comparisons with other previous studies that that have analyzed changes in contraceptive use following receipt of results are not suitable due to differences in study design; these studies typically employ within-individual study designs, essentially comparing contraceptive use before and after diagnosis, and do not include HIV-negative individuals (Hoffman et al. 2008; Nanda et al. 2011).

There is more evidence from these analyses to suggest that exposure to HIV testing is associated with shorter expected durations to contraceptive adoption among women who have recently had a birth and among other non-users of contraception at the time of HIV testing. In Lesotho, Zambia, and Zimbabwe, women who have had an HIV test and received results during ANC have shorter expected times to adopting a contraceptive method following birth. In addition, in Zimbabwe but not Lesotho, having had an HIV test and receiving results is also associated with a shorter time to adopting contraception among women who did not have a birth in the previous 24 months (Model 2).

Taken together, the relatively weak evidence with regard to HIV status and somewhat stronger evidence for HIV testing experience offer tentative support for the conclusion that it is possibly interaction with health services that facilitates contraceptive use, rather than HIV status or knowledge of that status per se. This conclusion would be consistent with the rather lackluster findings on discontinuation of contraception: for women who have already made use of some form of health services to obtain contraception initially, interaction with HIV testing services may not offer additional support beyond that received from family planning services to improve adherence to their contraceptive method over time. However, further investigation into this question is warranted.

This study presents novel findings using nationally representative data from five countries in sub-Saharan Africa. Nonetheless, the present data, taken together with other nationally representative studies, do not yet fully explain the HIV-contraception relationship. A further exploration of fertility intentions, while not a primary focus of the current study, may shed light on the interrelated processes of contraceptive motivation and use. However, difficulties related to measurement of fertility intentions, especially the rarity of prospective measures in nationally representative data, may preclude a deeper understanding of the impact of HIV testing on fertility-related behavior.

A further area of exploration is to consider access to and use of antiretroviral therapy (ART), as it may interact with fertility intentions and contraceptive use (Bankole et al. 2014). The directionality of these possible interactions remains poorly understood. For example, in a study among women in Soweto, South Africa, use of ART was associated with contraceptive use (Kaida et al. 2010). On the contrary, in one study of women on ART in peri-urban Uganda, contraceptives were not used because of perceived drug interactions, along with fear of side effects and partner disapproval (Mbonye et al. 2012). Fears of interactions with ART as well as general disease progression were also found in a multi-country qualitative study (Todd et al. 2011). The increased provision and adoption of ART across several programmatic and regional contexts may influence future contraceptive use patterns following HIV testing. Therefore, future studies should consider the effects of ART on the HIV-contraception relationship. Lastly, another area of inquiry, related to both changing fertility intentions and new concerns about side effects or drug interactions, is to explore how desired attributes of contraception and method mix may change upon learning that one is HIV-positive.

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