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Effect of a Family Planning Program on Long-Acting Reversible Contraceptive Use in HIV-Negative Single Mothers: Results From a Prospective Cohort Study in Zambia

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Abstract

Effect of a Family Planning Program on Long-Acting Reversible Contraceptive Use in HIV-Negative Single Mothers: Results From a Prospective Cohort Study in Zambia

By Jessica Li

Introduction: Long-acting reversible contraception (LARC) use in developing countries remains remarkably low. We implemented a family planning (FP) program which integrates counseling and education with access to LARC methods among HIV-negative Zambian single mothers (SM). This study evaluates how fertility intentions affect LARC utilization in this population. Our primary outcome was LARC use throughout study participation. We also estimated rates of LARC uptake, LARC discontinuation and incident pregnancy within this cohort.

Methodology: As part of a prospective cohort study on HIV incidence in high-risk women, we recruited 521 HIV-negative SM between the ages of 18-45 years (median age 22, IQR 20-25 years) in Lusaka and Ndola, Zambia. Participants were followed every three months for up to five years. At each visit, participants who were not pregnant and who were not already using a LARC or permanent contraceptive method were offered a LARC method. Data was collected on demographic factors, sexual behavior and sexual and reproductive history. Multivariable logistic regression was used to model baseline fertility intentions with LARC use.

Results: 518 Zambian SM were enrolled, and 57 women did not return for any follow-up visits. There was a significant increase in LARC use during the study. At baseline, 93/518 (18%) of participants were using a LARC method, and 99 women initiated LARC during the study, leading to 151/461 (33%) total LARC users at the end of follow-up (p-value < 0.0001). Women who did not desire any more children in Ndola were more likely to use a LARC method after adjusting for other confounders (aPOR = 2.02, p-value = 0.0094). During follow-up, 37/183 (20%) of LARC users discontinued their method, and women who desired future children at baseline were more likely to discontinue (p-value = 0.0071). There were 59 incident pregnancies in 461 women (8.98 per 100-women years).

Discussion: This study demonstrates that an integrated FP program can successfully increase LARC use among SM, who are disproportionately affected by high rates of unintended pregnancy. It is imperative that FP interventions target SM in developing countries to overcome obstacles in reproductive health.

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INTRODUCTION

The unmet need for family planning (FP) is defined by the gap between women's reproductive intentions and their contraceptive behavior, i.e. the failure to use contraception despite an expressed desire to avoid childbearing (1, 2). Machiyama, et. al (2) has proposed a causal framework for the reasons behind the unmet need for family planning (Figure 1), which involves: inconsistent fertility goals, generic disapproval of preventing pregnancy (i.e. social and cultural acceptability), method-specific barriers (including side effects and access to contraceptive methods), perceived low risk of pregnancy, and partner influence.

Method-specific barriers have frequently been a FP obstacle in developing countries. Clinical trials, cohort studies and analytic models have established that long-acting reversible contraception (LARC) – specifically the intrauterine device (IUD) and implant - are the most effective and cost-efficient contraceptive methods (3-5). Unfortunately, LARC usage in developing countries remains remarkably low, as many women are typically limited to oral or injectable methods and still have difficulty obtaining these methods (6). In a longitudinal study among women ages 16-50 years old in Lusaka, Zambia, only 9% of women reported using a LARC method in 2011, accounting for a small fraction of all Zambian women using modern contraception methods (7).

The Zambia Emory HIV Research Project (ZEHRP) has focused on resolving the problem of method-specific barriers by educating health care providers and offering LARC methods to Zambian clients (8, 9). As part of a prospective cohort study on HIV incidence and risk factors in sexually active unmarried women, ZEHRP integrated HIV testing and risk reduction counseling with FP counseling and immediate access to LARC methods among HIV-negative single mothers (SM) in Lusaka and Ndola, Zambia. The primary purpose of this manuscript is to describe the association between baseline fertility intentions and LARC use within this cohort of Zambian SM. We analyzed all baseline data and follow-up data to quantify

LARC use throughout the study. As secondary outcomes, we assessed rates of LARC uptake, LARC discontinuation and incident pregnancy. The results from this study will help improve the design and implementation of future FP initiatives to promote consistent and effective contraceptive use.

BACKGROUND

Unintended Pregnancy

Although the global total fertility rate (TFR) - the average number of births a woman has in her lifetime - has declined from more than 5 children in 1950 to 2.5 children in 2017 (10), unintended pregnancy remains a significant public health challenge. Preventing unintended pregnancy can reduce maternal and child mortality, abortion rates and poverty while improving socioeconomic status, access to education and gender equity (11). Despite progress in ongoing reproductive health policy and research, it is estimated that 222 million women in low- and middle-income countries experience an unmet need for modern contraception (12), and approximately 14 million unintended pregnancies occurring annually in sub-Saharan Africa (13). Zambia distinctly has one of the highest TFRs in the world, estimated to be 5.04 in 2015 - twice the global TFR (10). However, 41% of these pregnancies are unplanned, with the average Zambian woman giving birth to about one more child than she desires (14). A 2010 household survey of reproductive-aged women in Zambia determined that 20% of women had at least one unintended pregnancy and 5% of women had at least one abortion in the previous five years (15).

LARC Use

Primary causes of unintended pregnancy are the lack of access to contraceptive methods and reliance on short-term contraceptive methods, such as oral contraceptive pills (OCP), depo-medroxyprogesterone (DMPA) injectables and condoms (13, 16), which require user adherence on a daily or quarterly basis. Compounded with the unpredictable supply in low-income countries, short-term methods are much less effective at preventing pregnancy than LARC methods. Estimated 1-year failure rates among women with typical-use are 15% for condoms, 8% for OCPs, 3% for DMPA, and <1% for the IUD and implant (17, 18).

There has been an international effort to reduce reproductive health disparities in developing nations by increasing access to contraception and to long-term methods in particular

(19). Existing evidence demonstrates that community health workers significantly improve contraceptive use and sexual education in low-income countries (20). Fertility goal-based counseling among HIV-discordant couples in Rwanda and Zambia motivated clients to uptake LARC methods as well (8). Other FP interventions have promoted LARC methods to HIV-positive women in order to prevent mother-to-child HIV transmission (8, 21). Recently, a global partnership known as Family Planning 2020 (FP2020) has invested in expanding universal access to contraceptives. The Zambian government joined the FP2020 initiative with a goal of increasing modern contraceptive prevalence among married Zambian women to 58 percent by 2020 (22).

Identifying predictors of LARC use and LARC uptake are necessary to increase the efficacy of FP programs. Previous studies demonstrate that older age, being widowed or divorced/separated and having a greater number of living children are significantly associated with increased LARC use (23-26). Other studies document that younger age, past contraceptive use and joint decision making with a partner are associated with increased LARC uptake (8, 27, 28). LARC users are also less likely to use condoms or report dual method use after initiation of LARC (26, 29, 30). A cross-sectional survey in Zambia found that younger women and women with lower levels of education were more likely to report LARC use (7). However, another cross-sectional study in Ethiopia identified that women with less education, lower literacy and no occupation were more likely to utilize LARC (31). A multi-country analysis found that although wealthy women in Latin American and Caribbean countries are more likely to use LARC methods, poorer women are more likely to use LARC methods in Bangladesh and India (32).

Vulnerable Populations

Although these interventions have successfully increased LARC method use and overall modern contraceptive prevalence, many studies are conducted primarily among couples or women in monogamous relationships (8, 21, 24, 33). However, unmarried women are disproportionately affected by high rates of unintended pregnancy and the associated

consequences (34). Unintended pregnancy can lead to obstetric complications, poor psychosocial outcomes and deepened poverty, which increase existing burdens on reproductive health in low-income nations (35). These problems are magnified among SM, who often cannot rely on a partner for emotional or financial support. Furthermore, local health care provider bias creates another impediment to equal access, as providers may refuse to offer hormonal contraception to unmarried women (36, 37). It is imperative that more FP programs devote time and resources to SM to address these issues.

Fertility Intentions

Although fertility intentions are an interesting predictor for contraceptive practices, several studies illustrate a complex relationship between a woman's stated reproductive desires and actual contraceptive practices (38-40). Bankole and Westoff define reproductive attitudes using three measures: the ideal number of children, reproductive intentions and the planning status of the last birth (38). These measures are often subject to variability and inconsistencies in fertility surveys and can distort the relationship between fertility intentions and pregnancy (e.g. a woman rationalizing an undesired pregnancy as wanted after giving birth) (38).

The expected correlation between negative fertility intentions and increased contraceptive practices is also well-documented. A longitudinal study across urban regions of sub-Saharan Africa has shown increased modern contraceptive use among women who wish to stop childbearing (41). Studies also suggest that women who want no more children may be more motivated to attain their fertility goals than women who desire future children, because the former are more likely to use contraception and thus have lower fertility rates (42, 43). However, other research in low-income countries found that many women accept an unintended pregnancy as a small problem or no problem (39, 40). This may be due to ambivalent or inconsistent fertility desires (39) or a cultural widespread acceptance of unintended pregnancies (40). Discrepancies between fertility goals and contraceptive practices are usually attributed to fluctuating fertility

desires, which may be determined by a variety of other factors, including age, partnership status, health status, and financial security (23, 44, 45).

These discrepancies have prompted FP researchers to investigate variables associated with fertility intentions. A longitudinal study among HIV-positive South African women determined that decreased FP knowledge, talking to a provider about future pregnancy and increased male involvement were associated with positive fertility intentions (46). A study in Kenya found that HIV-positive, older, poorer and less educated women are more likely to desire no more children and are also more likely to use contraception (47). However, there was a greater reduction in contraceptive use over time among the HIV-positive women, which also resulted in a greater proportion of unintended and mistimed pregnancies in the HIV-positive study population (47). Another qualitative study in Kenya has proposed that the discordance between a woman's fertility desires and hesitation to use contraception may be due to partner disapproval and fear of side effects (48).

Contraceptive Method Discontinuation

In addition to conflicting fertility intentions, another critical problem driving the unmet need for FP is contraceptive method discontinuation (2, 49). The major concern with method discontinuation is the failure to transition to another contraceptive method or sporadic contraceptive use and subsequent unintended pregnancy. In a study of low-income minority women using DMPA, the cumulative unintended pregnancy rate by nine months post-discontinuation was 20% (50). LARC methods are expected to have lower rates of discontinuation because of ease of accessibility (e.g. not needing to obtain a monthly prescription or visit a clinic). A 2018 randomized trial among U.S. women ages 18-29 found that at the 24-month time point, 64% of LARC users continued their method and the cumulative unintended pregnancy rate was 4% (51).

The 2015 Demographic and Health Survey analyses conducted among married Zambian women between the ages of 15-49 report that within the first year of use, 25% discontinue using injectables, 34% of women discontinue using other modern methods (pill, condoms), 4% of women discontinue using implants and 7% discontinue using IUDs (52). Although LARC retention is considerably better than other modern contraceptive methods, these discontinuation rates are still unacceptably high. More than half of the Zambian women discontinuing their LARC method are still in need of a good contraceptive method, and discontinue mainly due to side effects/health concerns (52). Other reasons for discontinuation include the desire to become pregnant or method failure.

These findings were also demonstrated in a previous ZEHRP study that promoted FP methods to heterosexual couples in Lusaka (33). Women downgraded to less effective methods due to self-reported side effects, but 24% of those who discontinued LARC methods had an unknown reason or did not report a reason (33). Other research in sub-Saharan African has reported that contraceptive use is reduced due to individual misperceptions about pregnancy risk (i.e., the erroneous belief that women are infertile after pregnancy) and increased by male partner support of using contraceptive methods (53, 54). A qualitative study in Ghana showed that the stage of a relationship affects contraceptive use; women in supportive relationships are more likely to continue methods despite side effects (55). Whether the causes of method switching stem from health reasons, lack of education or partner influence, it is important to elucidate a comprehensive summary for LARC discontinuation so that FP interventions can be safely and efficiently implemented.

METHODS

The purpose of this study was to evaluate LARC use among HIV-negative Zambian SM who were participating in a prospective cohort study that took place in Lusaka and Ndola, Zambia, included FP counseling.

Aim 1: To estimate the association between fertility intent at baseline and prevalence of LARC use, and to assess whether this association differed by city, Lusaka and Ndola. Fertility intent is defined by two levels: 1) desire more children, 2) desire no more children.

Aim 2: Among baseline non-LARC users, compare the proportions of LARC uptake and compare the time to LARC uptake by baseline fertility intent. Fertility intent is defined by two levels: 1) desiring children within 3 years, 2) desiring to delay childbearing > 3 years/stop childbearing.

Aim 3: Among all LARC users, compare the proportions of LARC discontinuation and compare the time to LARC discontinuation by baseline fertility intent. Fertility intent is defined by three levels: 1) desiring children within 3 years, 2) desiring to delay childbearing > 3 years, 3) desire to stop childbearing.

Aim 4: Among all SM, to compare the proportions of incident pregnancy and compare the time to incident pregnancy by LARC retention. LARC retention is defined by 3 levels: 1) discontinue LARC, 2) retain LARC, 3) never use LARC.

Study Participants

From 2012-2017, the Zambia Emory HIV Research Project (ZEHRP) recruited a cohort of 521 SM from the Zambian Maternal Child Health Department to study HIV incidence and risk factors. SM who had previously tested negative for HIV during antenatal care and were not currently pregnant were referred from infant vaccination services in government clinics. Individuals meeting the following criteria were eligible for study participation: unmarried/single HIV-negative, sexually active females, between the ages of 18-45 years old, who are able and willing to provide informed consent, willing to complete interviewer administered questionnaires and available for follow-up for the duration of the study. Any woman who was married, HIV-positive or with indeterminate rapid test results was excluded from the study. Three Zambian SM were excluded at baseline due to ineligibility, and the remaining 518 women were enrolled in our study.

Study Design

We had two study sites – Lusaka and Ndola, Zambia. All women came for a baseline visit (Month 0) where demographic and behavioral information on HIV risk factors were collected. Questions included age, marital status, education and literacy, sexual and reproductive history, condom and contraceptive use, fertility goals and alcohol use. Each participant was also tested for HIV and received risk reduction and FP counseling. Gynecologic exams and screening and treatment of sexually transmitted infections (STIs) were performed if indicated. These procedures were repeated at each follow-up visit, which occurred at Months 1, 3 and quarterly thereafter for up to a maximum of five years. At each visit participants who were not pregnant or already using a LARC or permanent contraceptive method were offered a LARC method (specifically the copper IUD or Jadelle implant). We employed fertility-goal based counseling (8); although FP counseling and LARC methods were offered to all eligible participants, those women who wished to stop or delay childbearing at least three years were encouraged to uptake

LARC. HIV-positive women were counseled and referred to the nearest government clinic for antiretroviral therapy. Further details regarding SM recruitment and enrollment, the integrated reproductive health program and HIV/STI treatment has been published elsewhere (56).

Outcome Measures

All data were entered into the ZEHRP database on Microsoft Access, anonymized and exported to SAS (SAS® Studio, 2018) for analysis. For Aim 1, our outcome of interest was LARC use (yes/no, either on the day of enrollment or at a subsequent visit). LARC use was self-reported and confirmed at the research site or with LARC method placement performed at the research site. For Aim 2, our outcome was LARC uptake (yes/no and time to event) among baseline non-LARC users. LARC uptake was defined by a baseline non-LARC user switching to a LARC method either at the baseline visit or a subsequent visit. For Aim 3, our outcome was LARC discontinuation (yes/no and time to event) among all LARC users. LARC discontinuation was either self-reported and confirmed at the research site or with removal performed at the research site. For Aim 4, our outcome was incident pregnancy (yes/no and time to event), either self-reported and/or confirmed via pregnancy test at the research site. Only first event for uptake or discontinuation was reported; multiple switches between LARC methods (i.e. a woman adopting LARC for a second time after removal) were not included in analysis.

Statistical Analysis

With a sample size of 518, we could detect a 15% increase in LARC use with 99.99% power at a significance level of 0.05. We tested the hypothesis that LARC method use will be higher after FP counseling compared to baseline use with McNemar's test for correlated proportions. We analyzed all baseline variables to describe associations with both LARC use and baseline fertility intent, including demographics (e.g. age, income, education, literacy), recent sexual history (e.g. age at first sexual intercourse, condom use), risk behaviors (e.g. alcohol use), and other aspects of reproductive health (e.g. vaginal itching or discharge, STIs). We created a

missing category for any missing data, and only women who had answered all questions on the baseline survey regarding both contraceptive use and fertility intentions were included in our analysis.

Descriptive statistics were calculated for baseline characteristics of interest and stratified by baseline fertility intention and by city (Table 1a-c), as well as by LARC use (Table 2a-c). We compared women who used a LARC method at baseline or at any point during longitudinal follow-up to women who never used a LARC method at any point during the study. Differences in demographic and behavioral variables stratified by fertility intention and between LARC users and non-users were compared using Pearson's chi square test for independence or Fisher's test for categorical variables and t-tests for continuous variables. We initially stratified fertility intent in three levels: women desiring children in three years, women desiring children after three years and women desiring no more children.

All variables with $p < 0.05$ with confidence intervals outside of the null were considered significant. We created bivariate logistic regression models of LARC use with covariates significant with both the primary exposure and primary outcome and with other covariates that are associated with LARC use in the literature and likely to confound the relationship between fertility intention and LARC use (23-25, 47). Interaction terms were included to assess different associations between predictor and outcome by city (Lusaka vs. Ndola).

After assessing for variable multicollinearity using standard variance decomposition and condition index cutoffs, we built multivariable models using a backwards elimination strategy. Non-significant variables and interaction terms (p-value ≥ 0.05) were removed one-by-one until reaching the full model. The full multivariable model only included SM who had been sexually active in the past year. We excluded non-LARC users who did not return for any follow-up visits, women who were prevented from adopting LARC due to positive pregnancy status and women

who adopted a permanent contraceptive method (bilateral tubal ligation (BTL) or hysterectomy) from our descriptive analyses, bivariate and multivariable models.;

Kaplan-Meier curves were created to estimate the differences for: time to LARC uptake stratified by baseline fertility intent (Aim 2), time to LARC discontinuation stratified by baseline fertility intent (Aim 3), and incident pregnancy stratified by LARC retention (Aim 4). We also calculated proportions for all the above outcomes.

Individual Interviews

Four individual interviews were conducted with SM after the parent study on HIV incidence and risk factors was complete. These women had a LARC method removed during study follow-up. The purpose of these interviews was to ascertain specific reasons for method discontinuation, which were not consistently recorded during data collection in the parent study. These interviews also gave SM a chance to elaborate on their personal experiences with LARC methods and allow ZEHRP to improve FP counseling for clients. The interviews were based on an interview guide that was developed for this study. The main questions were: Why did you switch to a LARC method? What were some things you liked about your LARC method and what did you not like? Why did you have your LARC removed? Would you consider using a LARC method (either implant or IUD) again?

A pilot interview was conducted with one SM to test the interview guide, and as no changes were made, this interview was included in the dataset. A nurse conducted all the interviews in Bemba with English translation at the ZEHRP Ndola study site, and notes were taken in English by author JLL during the interview. Each interview lasted between 10-20 minutes. The interviews were digitally recorded and replayed and reviewed by the interviewers but not transcribed. Any additional information from the recordings were added to the notes. This data was reflected on and brought together as themes to summarize qualitative content and formulate possible hypotheses regarding LARC discontinuation.

Ethics

This study is approved by the Emory Institutional Review Board and the University of Zambia Biomedical Research Ethics Committee. All procedures, including counseling, informed consent and surveys, were administered in English and Nyanja or Bemba, the predominant local languages in Lusaka and Ndola. The participants were informed that their participation was voluntary, that their confidentiality would be preserved and that they had the right to withdraw from the study at any time. All participants gave their written informed consent to participate.

RESULTS

Baseline Characteristics

Out of 518 Zambian SM who completed a baseline visit, 348 of our participants came from Ndola and 170 came from Lusaka. There were 57 women who did not return for any follow-up visits. Reasons for loss to follow-up include not being eligible for the study (e.g. HIV seroconversion, got married) or lack of interest in participating in the study. 95% of women in Ndola had at least one follow-up visit, compared to 81% in Lusaka (p-value < 0.0001). Of the remaining 461 women who had at least one follow-up visit, the median follow-up time was 18 months (IQR 12-27 months) and the median age at enrollment was 22 (IQR 20-25 years). At the baseline visit, no clients had reproductive health complaints and only three women received a gynecological exam.

Aim 1: Fertility Goals and LARC Use

In our analysis, we excluded six women who were prevented from adopting a LARC method due to positive pregnancy status, one woman who received a BTL during follow-up and 54 non-LARC users who lacked a follow-up visit. We included the six baseline users who did not return for follow-up and three women who adopted an implant at the baseline visit but who did not return for follow-up because we were able to confirm definitive LARC use. Two additional women were excluded due to missing data about fertility intentions on the baseline questionnaire. Due to a small sample size of SM desiring children in three years in Lusaka (Table 1b), we collapsed on positive baseline fertility intentions and analyzed the exposure dichotomously in our model (Table 4).

Women who did not want any more children were more likely to reside in Lusaka, to be older, divorced/separated, better educated, more capable of understanding English, have more living children and less likely to have received money/goods for their first sexual encounter. LARC users were more likely to reside in Ndola, to be younger, less educated, understand no

English, have experienced anxiety about financial support during their most recent pregnancy, and less likely to always use a condom during sexual intercourse. For a full summary of significant baseline characteristics between baseline fertility goals and LARC use please see Tables 1a-c and 2a-b respectively**.**

Only 21 (16%) of SM in Lusaka expressed positive fertility goals at baseline, compared to 273 (83%) women in Ndola (p-value < 0.0001). Women who wished to stop childbearing had a greater prevalence odds of LARC method use (cPOR = 1.39, p-value = 0.0819). This association was statistically significant in Ndola (cPOR = 2.22, p-value < 0.001) but not in Lusaka (cPOR = 1.04, p-value = 0.9364). The difference in LARC use in Ndola persisted after adjusting for monthly income by city, financial anxiety and condom use (aPOR = 2.02, p-value = 0.0094), as shown in Table 4**.**

Aim 2: LARC Uptake

There was a significant increase in LARC use from baseline to endline (p-value <0.0001). At baseline, 93/518 (18%) participants were using a LARC method, six of whom were lost to follow-up. Three of the 93 baseline LARC users had IUDs and the other 90 had implants. Of the remaining 425 non-LARC users at baseline, 28 women used oral contraceptives, 139 women used injectables and 258 women had no contraceptive method (condoms only). Out of 370 baseline non-LARC users, 99 (27%) initiated a LARC method during the study (23.44 per 100 women years). Four of these women chose an IUD and 95 chose an implant for their first uptake event. At the baseline visit, 27 women adopted an implant, three of whom were lost to follow-up. An additional 72 women adopted LARC during follow-up in the study, leading to 151/461 (33%) total LARC users at the end of follow-up. Figure 2 illustrates LARC use throughout our study.

Stratified by fertility intent, the proportions for LARC uptake were: 9/51 (18%) of women who desired children in three years, 40/149 (27%) of women who desired children after

three years and 50/168 (30%) of women who desired no more children. Figure 3 depicts a Kaplan-Meier curve of LARC uptake stratified by two levels of baseline fertility intentions (log-rank p-value = 0.0850). We combined women who wished to stop childbearing and women who wished to delay childbearing at least three years, since ZEHRP encouraged these clients to uptake LARC. Our analysis for LARC uptake excludes 93 baseline LARC users, 54 women who did not use a LARC method and did not return for follow-up, one woman who had a BTL, and six women who requested a LARC method but were ineligible due to positive pregnancy tests.

Aim 3: LARC Discontinuation and Method Switching

Out of 183 total LARC users, 38 switched contraceptive methods (only accounting for first event of method switching). One woman upgraded from an implant to an IUD, so a total of 37/183 (20%) LARC users (all implant) discontinued their method (12.53 per 100 women-years). Stratified by baseline fertility intent, the proportion of method discontinuation for all LARC users were: 5/11 (45%) for women desiring children in three years, 20/72 (28%) for women desiring children after three years and 12/95 (13%) for women who desired no more children.

Figure 4 depicts a Kaplan-Meier curve of time to LARC removal starting from time of insertion, stratified by baseline fertility intentions. This curve demonstrates that SM who desired children within three years discontinued their method earlier than SM who wished to stop or delay childbearing at least three years (log-rank p-value 0.0164). Both baseline LARC users and LARC adopters were included in this analysis, while all non-LARC users, one woman with a BTL and all women lacking a follow-up visit were excluded.

Among those who removed their implant, 18 (49%) were baseline users and 19 (51%) had adopted LARC during the study. Prolonged menses or heavy bleeding was the most common self-reported reason for LARC discontinuation. Other reasons included weight changes and desired future pregnancy, but we could not verify a reason for 11 (30%) individuals. Fourteen women switched from the implant to injectables, one switched from the implant to OCPs and

twenty switched from the implant to condoms only. We could not account for one woman due to loss to follow-up from HIV seroconversion.

The general picture from the interviews were that women discontinued LARC methods either due to side effects or desire for future pregnancy. Women who discontinued due to side effects downgraded to a less effective method. All participants understood that short-term methods of modern contraception (OCPs, injectables and condoms only) are not as effective as LARC methods, but they were biased and hesitant to try the IUD.

Aim 4: Incident Pregnancy

Among 461 women, 57 (12%) women became pregnant, and there were 59 incident pregnancies (8.98 per 100 women-years). One woman was pregnant at baseline, and she did not uptake LARC after her baby was delivered. An additional 56 women became pregnant during follow-up, including two women who were pregnant twice. The proportions for incident pregnancy stratified by LARC retention were: 6/146 (4%) for those who retained LARC, 12/37 (32%) for those who discontinued LARC and 39/277 (14%) for those who never used LARC. All incident pregnancy events in women who retained LARC methods occurred before the woman initiated a LARC method.

Figure 5 depicts the KM curve of time to the first pregnancy event throughout the study, stratified by LARC retention, confirming that women who retain LARC have the lowest pregnancy rate (log rank p-value 0.0002). The median time to pregnancy from the baseline visit was 12 months. All 57 women lacking a follow-up visit and one woman with a BTL were excluded from this analysis.

Of the 56 pregnant women, 11 became pregnant after discontinuing their LARC method, and six women chose to uptake LARC after delivery. Nine pregnancies (15%) occurred in women using OCPs, 18 (31%) in women using injectables, 24 (41%) in women using condoms only and two (3%) in a woman using a Jadelle implant (Figure 6). Time of conception for six (10%) of the

pregnancies were missing. Of the pregnancies that occurred in women using injectables and implant, we were unable to determine whether these were the result of method failure or provider/user failure.

DISCUSSION

Fertility Intentions and LARC Use

Our study confirms that LARC methods are an attractive and feasible option for Zambian women, and integrating HIV prevention with FP services can increase LARC use in Zambian SM. These results also support previous implications on the benefits of integrating reproductive health services, which has been a successful model for the design and implementation of FP services in low-resource settings (21). Our study examined the relationship between baseline fertility intentions and LARC use of HIV-negative Zambian SM. After adjusting for confounders, the desire to stop childbearing was associated with increased LARC use in Ndola, which supports other research demonstrating a positive correlation between negative fertility intentions and modern contraceptive use (41-43). Unlike previous studies, our model is specific to LARC methods, which are superior and more effective methods than short-term contraceptives. Our results confirm that fertility intentions are associated with LARC use, LARC uptake and LARC discontinuation.

The difference in the relationship between fertility intentions and LARC use by city warrants further exploration. Although our final model found a correlation between positive fertility intentions and LARC use in Lusaka, this association was insignificant. This result could be due to baseline demographic differences between cities that affect contraceptive decision-making. For example, compared to SM in Ndola, SM in Lusaka were more likely to report always using a condom and to have used a condom for first sexual encounter. These women may perceive themselves at a lower risk for pregnancy and not in need of a LARC method. The contradictory association between fertility intentions and LARC use in Lusaka may also be influenced by unmeasured community level factors, but nonetheless, this discrepancy highlights the necessity for continuing FP research in these communities.

After adjusting for the difference between cities, our final model showed baseline negative fertility intent in Ndola, lack of monthly income in Ndola, experiencing financial anxiety with most recent pregnancy and inconsistent condom use as predictive of overall LARC use. This model included two discrete variables of financial insecurity, which supports findings in Bangladesh and India that demonstrate poorer women are more likely to use LARC methods (32). Women who have experienced financial anxiety may have a greater incentive to use LARC methods (31), possibly because they recognize the added negative ramifications an unintended pregnancy could have on their financial status. However, lack of income was only associated with LARC use in Ndola, and results in Lusaka were inconclusive. Ugaz, et al.'s study (32) determined that the relationship between wealth and LARC use may vary by region, and our findings support the need for more investigation into this relationship. Our model also suggests that financial anxiety is a more generalizable predictor of LARC use than income, as the relationship between financial anxiety and LARC use was not influenced by city.

Our final model also corresponds with previous research demonstrating that LARC use is associated with inconsistent condom use (29, 30). This emphasizes the importance of counseling about the benefits of dual protection when implementing FP interventions in countries with a higher HIV incidence. This is particularly relevant for our study population, who may have multiple sexual partners or partners in non-monogamous relationships.

In concordance with past studies, LARC use was more prevalent among older and less educated women (25, 26, 31), but both variables were insignificant in our final model. This suggests fertility intentions may be a better predictor than either age or education alone. In contrast to previous research, number of living children was not associated with LARC use (31). This may be due to the lack of variability within our cohort; the majority of SM only had one living child.

IUD vs. Implant Use

Only 7/183 (4%) of LARC users in our population chose an IUD instead of an implant. Our qualitative data determined that Zambian SM still believe many myths and misconceptions about the IUD, which is concerning given the long-term counseling provided in our study. This signals a need to redirect our efforts in provider education and training to counsel about the IUD. The myths and misconceptions about the IUD perpetuated in our cohort corroborate similar studies in the literature and highlight the quest for the best methodology for IUD education and provision in developing countries (36, 57-59).

The literature attributes the large preferential gap in IUDs to provider bias, lack of provider training in IUD placement and lack of access to IUDs (36, 57, 59). A systematic review has found that implant uptake in developing countries far exceeds IUD uptake and is in part due to both provider and clients' negative perceptions about the IUD (58). The weak evidence for effective IUD promotional programs can make stakeholders question whether it is still practical to even offer the IUD, rather than focus all FP efforts on increasing access to contraceptive implants instead. However, taking into account the lower cost of the copper IUD, the low rate of IUD discontinuation and the benefits of offering a non-hormonal alternative to women who experience contraceptive side effects, we recommend that FP programs continue to encourage and offer the IUD in low-income countries. It is worth investigating Cleland's proposal to invest in national advocacy of IUDs through government clinics, which may be more successful than international FP promotions (58).

LARC Method Discontinuation

Although we were unable to ascertain all reasons for method discontinuation, it is noteworthy that women who desired to delay childbearing at baseline were also more likely to discontinue LARC compared to women who did not desire any more children at baseline. This evidence demonstrates the efficacy of our FP counseling and is reassuring that SM are correctly

using LARC methods to help them meet their fertility goals. However, it is also important to note that other women discontinued due to side effects from the implant and downgraded to less effective methods. This makes it even more critical that providers be trained to counsel on the IUD and offer it as a viable non-hormonal alternative to avoid side effects but still promote consistent contraceptive use.

Our individual interviews elicited important information that partner preferences and cultural/societal expectations can also influence LARC discontinuation. In both interviews, the women removed their implant despite not having the financial means to support their living children because they were encouraged by someone else to have another child. This aligns with previous research stating that reproductive decision-making is often a joint effort and it is necessary for FP programs to take cultural and male partner influences into account (2, 8, 28). Although ZEHRP has successfully promoted LARC method use in cohabiting couples (8, 33), our findings indicate that non-cohabiting couples would equally benefit from promotion of LARC methods.

Incident Pregnancy

Although the proportion of incident pregnancy was higher for women who discontinued LARC methods than for women who never used LARC methods, it is probable that this is due to difference in fertility intentions for the two groups. A portion of our clients who discontinued their LARC method cited the desire to become pregnant as reason for removal and were thus using contraception to achieve their fertility goals. We did not quantify incident pregnancy as unintended or desired and were not able to accurately evaluate this outcome.

Because of the discrepancy between our results and the known efficacy of hormonal injectables (17, 18), it is important to mention that we did not administer DMPA at our study site. We relied on clients' self-report for number of months pregnant, as well as government documents to confirm that they received their injectable. Therefore, it was not possible to

ascertain clear numbers for exact time of conception or whether clients were using their short-term contraceptive consistently and accurately. Of the two women who became pregnant while using the implant, these could be the result of LARC failure. However, one woman had her implant inserted by ZEHRP nurses at the baseline visit, and it is also probable that she was already pregnant but too early for detection via urine pregnancy test at time of insertion.

Strengths and Limitations

Previous FP research in sub-Saharan Africa has focused on heterosexual couples or HIV-positive clients (8, 21, 33, 60, 61). Our project was implemented in HIV-negative SM, who are having unprotected non-marital sex and are at high risk for both HIV and unintended pregnancy. This is a primary strength of our study, as we are able to address secondary prevention of HIV and primary prevention of unintended pregnancy simultaneously in a vulnerable population. Our study also models the association between baseline fertility intentions and LARC use, whereas previous research has generalized analysis of fertility intentions with any modern contraceptive use (38-43, 60, 61). Since LARC methods are known to be more effective at pregnancy prevention, our model has greater implications for the broad issue of the unmet need for FP, and it is rational to use our findings for fertility-goal based counseling and encouraging LARC use in the future.

Our study population had a higher percentage of LARC users at baseline than previous demographic surveys in Zambia reported (7), and we do not know this population's prior experience with FP counseling. It is possible that these SM had already heard about LARC in their community because of ZEHRP's previous LARC promotions to cohabiting couples (8, 62, 63). After conducting couples' voluntary counseling and HIV testing for many years, ZEHRP has a well-known presence in Lusaka and Ndola. However, their impact on Zambians' contraceptive use outside of their study populations has not been measured. The higher number of baseline

LARC users could also indicate that our cohort takes a more proactive role in their health care, which could create a source of positive bias in overall LARC use.

One limitation of this study is our analysis of fertility intentions solely at baseline. Due to the open cohort design of the parent study, we had large amounts of missing data and unequal sample sizes at various time points and were limited in our ability to do a longitudinal analysis of fertility intentions with LARC use. Since we know that fertility intentions can change over time and are affected by a number of dynamic factors, including age and financial status (23, 44, 45), analyzing fertility goals longitudinally would produce a more comprehensive model of LARC use. In addition, our data may not be robust enough to explain the complexity of the relationship between LARC use and fertility intention by city differences, and our findings also may not be generalizable to rural regions of Zambia .

Another limitation is our assessment of fertility intentions, which we quantified only as timing of childbearing and not the number of total children desired, which may also impact overall fertility goals (64). In addition, although we were able to describe the significance of cultural and male partner influence on LARC discontinuation through interviews, this data was never quantified to fit into our model. Lastly, we did not categorize incident pregnancy as unintended vs. wanted pregnancies, so it could be argued that we do not know the true effect our FP intervention has upon preventing unintended pregnancy. However, it is reasonable to assume that our study population has lower rates of unintended pregnancy than expected, since the proportion of pregnant women in our cohort (12%) is lower than the estimated 20% of Zambian women who have an unintended pregnancy (67). Moreover, given the known effectiveness of LARC methods, we believe that overall increased LARC use is an acceptable measure for meeting FP goals, particularly since individual pregnancy desires may change once a mistimed or originally unplanned pregnancy occurs (65, 66).

Future directions for building upon this research include analyzing the relationship between fertility intentions and LARC use or LARC uptake longitudinally, as well as analyzing the effect partner preferences has on this association. We also intend to analyze fertility intentions and LARC use in HIV-negative Zambian female sex workers, another ZEHRP study population who received integrated FP counseling (56). We were unable to evaluate the association between fertility intentions and LARC discontinuation due to our small sample size of women who had their LARC method removed. However, this would be an interesting question for future studies as method discontinuation definitely contributes to the unmet need for FP (2).

Our findings suggest that a desire to stop childbearing is associated with a higher prevalence of LARC use and rate of LARC retention in Zambian SM. This contributes to the literature on reducing the unmet need for family planning in low-income countries and for SM in particular. Given the preventable nature of unintended pregnancy and the immense negative effects unintended pregnancy can have on SM, our research provides additional basis for advocating LARC methods within this population. We recommend that LARC methods continue to be promoted in developing countries, particularly to high-risk women wishing to limit or delay fertility. By increasing FP education and access to LARC methods for SM, we can aid international FP efforts to ensure the overall health and empowerment of women.

REFERENCES

1. Organization WH. Unmet need for family planning [electronic article]. Advance Access: 1/23/19.
2. Machiyama K, Casterline JB, Mumah JN, et al. Reasons for unmet need for family planning, with attention to the measurement of fertility preferences: protocol for a multi-site cohort study. *Reprod Health* 2017;14(1):23.
3. Hubacher D, Spector H, Monteith C, et al. Long-acting reversible contraceptive acceptability and unintended pregnancy among women presenting for short-acting methods: a randomized patient preference trial. *Am J Obstet Gynecol* 2017;216(2):101-9.
4. Winner B, Peipert JF, Zhao Q, et al. Effectiveness of long-acting reversible contraception. *N Engl J Med* 2012;366(21):1998-2007.
5. Trussell J, Hassan F, Lowin J, et al. Achieving cost-neutrality with long-acting reversible contraceptive methods. *Contraception* 2015;91(1):49-56.
6. Organization WH. Family Planning/Contraception Fact Sheet [electronic article]. Advance Access: 1/23/19.
7. Hancock NL, Chibwesha CJ, Stoner MC, et al. Temporal Trends and Predictors of Modern Contraceptive Use in Lusaka, Zambia, 2004-2011. *Biomed Res Int* 2015;2015:521928.
8. Khu NH, Vwalika B, Karita E, et al. Fertility goal-based counseling increases contraceptive implant and IUD use in HIV-discordant couples in Rwanda and Zambia. *Contraception* 2013;88(1):74-82.
9. Wall KM, Vwalika B, Haddad L, et al. Impact of long-term contraceptive promotion on incident pregnancy: a randomized controlled trial among HIV-positive couples in Lusaka, Zambia. *J Acquir Immune Defic Syndr* 2013;63(1):86-95.
10. Roser M. Fertility Rate [electronic article]. Advance Access: 1/23/19.
11. Wall KM, Haddad L, Vwalika B, et al. Unintended pregnancy among HIV positive couples receiving integrated HIV counseling, testing, and family planning services in Zambia. *PLoS One* 2013;8(9):e75353.
12. Darroch JE, Singh S. Trends in contraceptive need and use in developing countries in 2003, 2008, and 2012: an analysis of national surveys. *Lancet* 2013;381(9879):1756-62.
13. Hubacher D, Mavranezouli I, McGinn E. Unintended pregnancy in sub-Saharan Africa: magnitude of the problem and potential role of contraceptive implants to alleviate it. *Contraception* 2008;78(1):73-8.
14. Institute G. Unsafe Abortion in Zambia. *In Brief*: Guttmacher Institute, 2009:1-4.
15. Bankole A, Keogh S, Akinyemi O, et al. Differences in unintended pregnancy, contraceptive use and abortion by HIV status among women in Nigeria and Zambia. *Int Perspect Sex Reprod Health* 2014;40(1):28-38.
16. E Z. Reducing Unintended Pregnancy and Unsafely Performed Abortion Through Contraceptive Use [electronic article]. Advance Access: 1/23/19.
17. Trussell J. Contraceptive efficacy. *Arch Dermatol* 1995;131(9):1064-8.
18. Trussell J. Contraceptive Efficacy. In: Hatcher R, Trussell J, Nelson AL, Cates W, Stewart FH, et al., ed. *Contraceptive Technology, 19th revised edition*. New York: Ardent Media, 2007.
19. Mbizvo MT, Phillips SJ. Family planning: choices and challenges for developing countries. *Best Pract Res Clin Obstet Gynaecol* 2014;28(6):931-43.
20. Scott VK, Gottschalk LB, Wright KQ, et al. Community Health Workers' Provision of Family Planning Services in Low- and Middle-Income Countries: A Systematic Review of Effectiveness. *Stud Fam Plann* 2015;46(3):241-61.

21. Collins L U, Doupe A. Inter-Agency Task Team for Prevention and Treatment of HIV Infection in Pregnant Women Mothers and Their Children. Preventing HIV and Unintended Pregnancies: Strategic Framework 2011–2015. . UNFPA, 2012.
22. FP2020. Zambia Commitment Maker Since 2012. Family Planning 2020; 2017. (https://www.familyplanning2020.org/zambia). (Accessed January 27 2019).
23. Ajong AB, Njotang PN, Kenfack B, et al. Contraceptive method mix and preference: A focus on long acting reversible contraception in Urban Cameroon. *PLoS One* 2018;13(8):e0202967.
24. Mayhew SH, Colombini M, Kimani JK, et al. Fertility intentions and contraceptive practices among clinic-users living with HIV in Kenya: a mixed methods study. *BMC Public Health* 2017;17(1):626.
25. Teferra AS WA. Determinants of long acting contraceptive use among reproductive age women in Ethiopia: Evidence from EDHS 2011. . *Sci J Public Heal* 2015;3(1):143-9.
26. Walsh-Buhi ER, Helmy HL. Trends in long-acting reversible contraceptive (LARC) use, LARC use predictors, and dual-method use among a national sample of college women. *J Am Coll Health* 2018;66(4):225-36.
27. Austad K, Shah P, Rohloff P. Correlates of long-acting reversible contraception uptake among rural women in Guatemala. *PLoS One* 2018;13(6):e0199536.
28. Kalra N, Ayankola J, Babalola S. Healthcare provider interaction and other predictors of long-acting reversible contraception adoption among women in Nigeria. *Int J Gynaecol Obstet* 2019;144(2):153-60.
29. Bernard C, Zhao Q, Peipert JF. Dual method use among long-acting reversible contraceptive users. *Eur J Contracept Reprod Health Care* 2018;23(2):97-104.
30. Cushman LF, Romero D, Kalmuss D, et al. Condom use among women choosing long-term hormonal contraception. *Fam Plann Perspect* 1998;30(5):240-3.
31. Shiferaw K, Musa A. Assessment of utilization of long acting reversible contraceptive and associated factors among women of reproductive age in Harar City, Ethiopia. *Pan Afr Med J* 2017;28:222.
32. Ugaz JI, Chatterji M, Gribble JN, et al. Is Household Wealth Associated With Use of Long-Acting Reversible and Permanent Methods of Contraception? A Multi-Country Analysis. *Glob Health Sci Pract* 2016;4(1):43-54.
33. Haddad L, Wall KM, Vwalika B, et al. Contraceptive discontinuation and switching among couples receiving integrated HIV and family planning services in Lusaka, Zambia. *AIDS* 2013;27 Suppl 1:S93-103.
34. Leerlooijer JN, Bos AE, Ruiter RA, et al. Qualitative evaluation of the Teenage Mothers Project in Uganda: a community-based empowerment intervention for unmarried teenage mothers. *BMC Public Health* 2013;13:816.
35. Hall KS, Kusunoki Y, Gatny H, et al. Social discrimination, stress, and risk of unintended pregnancy among young women. *J Adolesc Health* 2015;56(3):330-7.
36. Schwandt HM, Speizer IS, Corroon M. Contraceptive service provider imposed restrictions to contraceptive access in urban Nigeria. *BMC Health Serv Res* 2017;17(1):268.
37. Sieverding M, Schatzkin E, Shen J, et al. Bias in Contraceptive Provision to Young Women Among Private Health Care Providers in South West Nigeria. *Int Perspect Sex Reprod Health* 2018;44(1):19-29.
38. Bankole A, Westoff CF. The consistency and validity of reproductive attitudes: evidence from Morocco. *J Biosoc Sci* 1998;30(4):439-55.
39. Speizer IS. Using strength of fertility motivations to identify family planning program strategies. *Int Fam Plan Perspect* 2006;32(4):185-91.
40. Speizer IS, Irani L, Barden-O'Fallon J, et al. Inconsistent fertility motivations and contraceptive use behaviors among women in Honduras. *Reprod Health* 2009;6:19.

41. OlaOlorun F, Seme A, Otupiri E, et al. Women's fertility desires and contraceptive behavior in three peri-urban communities in sub Saharan Africa. *Reprod Health* 2016;13:12.
42. Westoff CF BA. Trends in the demand for family limitation in developing countries. *Int Fam Plan Perspect* 2000;26(2):56-62.
43. V. A. Fraught with ambivalence: Reproductive intentions and contraceptive choices in a sub-saharan fertility transition. . *Popul Res Policy Rev* 2005;24(6):617-45.
44. Dube AL, Baschieri A, Cleland J, et al. Fertility intentions and use of contraception among monogamous couples in northern Malawi in the context of HIV testing: a cross-sectional analysis. *PLoS One* 2012;7(12):e51861.
45. Thomson KA, Dhanireddy S, Andrasik M, et al. Fertility desires and preferences for safer conception strategies among people receiving care for HIV at a publicly-funded clinic in Seattle, WA. *AIDS Care* 2018;30(1):121-9.
46. Peltzer K, Sifunda S, Mandell LN, et al. Fertility intentions of prenatal and postpartum HIV-positive women in primary care in Mpumalanga province, South Africa: a longitudinal study. *HIV AIDS (Auckl)* 2018;10:9-17.
47. Kimani J, Warren C, Abuya T, et al. Family planning use and fertility desires among women living with HIV in Kenya. *BMC Public Health* 2015;15:909.
48. Keesara S, Juma PA, Harper CC, et al. Barriers to postpartum contraception: differences among women based on parity and future fertility desires. *Cult Health Sex* 2018;20(3):247-61.
49. Rucinski KB, Powers KA, Schwartz SR, et al. Longitudinal patterns of unmet need for contraception among women living with HIV on antiretroviral therapy in South Africa. *PLoS One* 2018;13(12):e0209114.
50. Davidson AR, Kalmuss D, Cushman LF, et al. Injectable contraceptive discontinuation and subsequent unintended pregnancy among low-income women. *Am J Public Health* 1997;87(9):1532-4.
51. Hubacher D, Spector H, Monteith C, et al. Not seeking yet trying long-acting reversible contraception: a 24-month randomized trial on continuation, unintended pregnancy and satisfaction. *Contraception* 2018;97(6):524-32.
52. Staveteig S ML, Winter R. . Uptake and Discontinuation of Long-Acting Reversible Contraceptives (LARCs) in Low-Income Countries. DHS Analytical Studies, 2015,
53. Brunie A, Tolley EE, Ngabo F, et al. Getting to 70%: barriers to modern contraceptive use for women in Rwanda. *Int J Gynaecol Obstet* 2013;123 Suppl 1:e11-5.
54. Anguzu R, Tweheyo R, Sekandi JN, et al. Knowledge and attitudes towards use of long acting reversible contraceptives among women of reproductive age in Lubaga division, Kampala district, Uganda. *BMC Res Notes* 2014;7:153.
55. Osei IF MS, Biekro L, Collumbien M. Fertility Decisions and Contraceptive Use at Different Stages of Relationships: Windows of Risk Among Men And Women in Accra. *International Perspectives on Sexual and Reproductive Health* 2014;40(3):135-43.
56. Kilembe W IM, Sharkey T, Wall K, Parker R, Choongo M, Himukumbwa C, Tichacek A, Malama K, Visoiu AM, Price M, Laufer D, Chomba E, Allen S. Single Mothers and Female Sex Workers in Zambia Have Similar Risk Profiles and Require Targeted and Tailored Reproductive Health Services. *Submitted* 2019.
57. Aziz M, Ahmed S, Ahmed B. Attitudes of physicians providing family planning services in Egypt about recommending intrauterine device for family planning clients. *Sex Reprod Healthc* 2017;14:64-8.
58. Cleland J, Ali M, Benova L, et al. The promotion of intrauterine contraception in low- and middle-income countries: a narrative review. *Contraception* 2017;95(6):519-28.
59. Gutin SA, Mlobeli R, Moss M, et al. Survey of knowledge, attitudes and practices surrounding the intrauterine device in South Africa. *Contraception* 2011;83(2):145-50.

60. Bankole A, Biddlecom AE, Dzekedzeke K. Women's and men's fertility preferences and contraceptive behaviors by HIV status in 10 sub-Saharan African countries. *AIDS Educ Prev* 2011;23(4):313-28.
61. Hoffman IF, Martinson FE, Powers KA, et al. The year-long effect of HIV-positive test results on pregnancy intentions, contraceptive use, and pregnancy incidence among Malawian women. *J Acquir Immune Defic Syndr* 2008;47(4):477-83.
62. Stephenson R, Vwalika B, Greenberg L, et al. A randomized controlled trial to promote long-term contraceptive use among HIV-serodiscordant and concordant positive couples in Zambia. *J Womens Health (Larchmt)* 2011;20(4):567-74.
63. Wall KM, Kilembe W, Nizam A, et al. Promotion of couples' voluntary HIV counselling and testing in Lusaka, Zambia by influence network leaders and agents. *BMJ Open* 2012;2(5).
64. Miller WB PD. Behavioral intentions: Which ones predict fertility behavior in married couples? . *J Appl Soc Psychol* 1995;25(6):530-55.
65. Aquilino ML, Losch ME. Across the fertility lifespan: desire for pregnancy at conception. *MCN Am J Matern Child Nurs* 2005;30(4):256-62.
66. Shreffler KM, Greil AL, Mitchell KS, et al. Variation in pregnancy intendedness across U.S. women's pregnancies. *Matern Child Health J* 2015;19(5):932-8.

TABLES AND FIGURES

Table 1a: Baseline Variables by Fertility Intent, all Zambia (n=461)

	Children in 3 years (n=59)		Children after 3 years (n=184)		p-value* In 3 years vs. after 3 years	No children (n=218)		p-value* desire children vs. no children
	n or mean	% or SD	n or mean	% or SD		n or mean	% or SD	
LARC Use					0.0997			0.0815
Yes	17	29%	75	41%		100	46%	
No	42	71%	109	59%		118	54%	
Age (Years)	21.6	3.9	21.9	3.2	0.6038	25.2	5.8	<0.0001
City					0.2638			<0.0001
Ndola	56	95%	166	90%		107	49%	
Lusaka	3	5%	18	10%		111	51%	
Education Level					0.0521			0.0043
None	11	19%	14	8%		17	8%	
Primary	32	54%	115	63%		105	48%	
Secondary/College	16	27%	55	30%		96	44%	
Local Literacy					0.0091			0.0119
Easily/With difficulty	41	69%	156	85%		155	71%	
None at all	18	31%	28	15%		63	29%	
Understands English					0.2921			0.0233
Easily/With difficulty	32	54%	114	62%		153	70%	
None at all	27	46%	70	38%		65	30%	
Receives Monthly Income					0.0841			0.8755
No	50	85%	135	74%		168	77%	
Yes	9	15%	48	26%		50	23%	
Number of Living Children	1.3	0.7	1.4	0.7	0.2885	2.2	1.6	<0.0001
Age at First Sex (Years)	15.8	1.9	16.2	2	0.1873	17.4	2.4	<0.0001
Received Money/Goods for First Sex					0.2549			0.0355
Yes	23	39%	57	31%		51	23%	
No	36	61%	127	69%		167	77%	
Financial Anxiety With Last Pregnancy					0.1475			0.4952
Yes	33	56%	83	45%		111	51%	
No	26	44%	101	55%		107	49%	
Age at Birth of First Child (Years)	18.4	2.3	18.8	2.2	0.2522	19.6	3.5	0.0004
Condom Use in Last 12 Months					0.6746			0.4138
Always	6	11%	16	9%		14	8%	
Not always	47	89%	155	91%		172	92%	
Contraceptive Method					0.4828			0.0023
OCPs	2	3%	10	5%		14	6%	
Injectable	20	34%	68	37%		44	20%	
LARC (Implant or IUD)	8	14%	35	19%		50	23%	
None/other/condoms only	29	49%	71	39%		110	50%	
Time to LARC Uptake (Months)	11.1	1.0	3.4	6.0	0.1188	4.4	4.9	0.913
LARC Discontinuation					0.2381			0.0071
Yes	5	9%	20	11%		12	6%	
No	11	19%	52	29%		83	39%	
Never Used LARC	42	72%	109	60%		118	55%	

**Two-tailed t-test for continuous variables, chi-square test for categorical variables with cell count greater than 5, Fisher's exact test for categorical variables with 20% of expected cell counts less than 5.*

Table 1b: Baseline Variables by Fertility Intent, Lusaka (n=132)

	Children in 3 years (n=3)		Children after 3 years (n=18)		p-value* In 3 years vs. after 3 years	No children (n=111)		p-value* desire children vs. no children
	n or mean	% or SD	n or mean	% or SD		n or mean	% or SD	
LARC Use					0.5211			0.9363
Yes	0	0%	7	39%		38	34%	
No	3	100%	11	61%		73	66%	
Age (Years)	26.7	5.5	21.6	2.6	0.0142	25.6	5.5	0.0123
Education Level					1			1
None	0	0%	0	0%		2	1%	
Primary	1	17%	5	14%		36	16%	
Secondary/College	2	33%	13	36%		73	33%	
Local Literacy					1			0.0946
Easily/With difficulty	3	100%	15	83%		75	68%	
None at all	0	0%	3	17%		36	32%	
Understands English					1			0.6873
Easily/With difficulty	3	100%	16	89%		102	92%	
None at all	0	0%	2	11%		9	8%	
Receives Monthly Income					0.4887			0.5447
No	2	67%	15	83%		83	75%	
Yes	1	33%	3	17%		28	25%	
Number of Living Children	1	0	1.1	0.2		1.8	1.3	<0.0001
Age at First Sex (Years)	18.7	1.15	18.2	2.07	0.8935	17.9	2.51	0.4679
Received Money/Goods for First Sex					1			0.2924
Yes	0	0%	2	11%		29	26%	
No	3	100%	16	89%		82	74%	
Financial Anxiety With Last Pregnancy					0.0263			0.1298
Yes	3	100%	4	22%		57	51%	
No	0	0%	14	78%		54	49%	
Age at Birth of First Child (Years)	19.7	2.1	20.3	2.3	0.6134	20.0	3.3	0.7532
Condom Use in Last 12 Months					0.4052			0.1059
Always	1	50%	3	19%		9	9%	
Not always	1	50%	13	81%		93	91%	
Contraceptive Method					1			0.8086
OCPs	0	0%	0	0%		6	5%	
Injectable	0	0%	3	17%		12	11%	
LARC (Implant or IUD)	0	0%	2	11%		15	14%	
None/other/condoms only	3	100%	13	72%		78	70%	
Time to LARC Uptake (Months)			3.8	6.4		4.7	5.9	0.7651
LARC Discontinuation					1			0.1394
Yes	0	0%	2	12%		2	2%	
No	0	0%	4	24%		31	29%	
Never Used LARC	3	100%	11	65%		73	69%	

**Two-tailed t-test for continuous variables, chi-square test for categorical variables with cell count greater than 5, Fisher's exact test for categorical variables with 20% of expected cell counts less than 5.*

Table 1c: Baseline Variables by Fertility Intent, Ndola (n=329)

	Children in 3 years (n=56)		Children after 3 years (n=166)		p-value* In 3 years vs. after 3 years	No children (n=107)		p-value* desire children vs. no children
	n or mean	% or SD	n or mean	% or SD		n or mean	% or SD	
LARC Use					0.1579			0.0008
Yes	17	30%	68	41%		62	58%	
No	39	70%	98	59%		45	42%	
Age (Years)	21.4	3.6	21.9	3.3	0.2771	25.8	6.1	<0.0001
Education Level					0.0653			0.6439
None	11	20%	14	8%		15	14%	
Primary	31	55%	110	66%		69	64%	
Secondary/College	14	25%	42	25%		23	21%	
Local Literacy (Bemba or Nyanja)					0.0052			0.2234
Easily/With difficulty	38	68%	141	85%		80	75%	
None at all	18	32%	25	15%		27	25%	
Understands English					0.343			0.1037
Easily/With difficulty	29	52%	98	59%		51	48%	
None at all	27	48%	68	41%		56	52%	
Receives Monthly Income					0.0492			0.4891
No	48	86%	120	73%		85	79%	
Yes	8	14%	45	27%		22	21%	
Number of Living Children	1.3	0.7	1.5	0.7	0.2282	2.5	1.8	<0.0001
Age at First Sex (Years)	26	100%	49	100%	0.8103	39	100%	0.0002
Received Money/Goods for First Sex					0.2819			0.0088
Yes	23	42%	55	33%		22	21%	
No	32	58%	111	67%		85	79%	
Financial Anxiety With Last Pregnancy					0.4388			0.8161
Yes	30	54%	79	48%		54	50%	
No	26	46%	87	52%		53	50%	
Age at Birth of First Child (Years)	18.3	2.3	18.6	2.1	0.3984	19.3	3.7	0.0535
Condom Use in Last 12 Months					0.7771			0.4259
Always	5	10%	13	8%		5	6%	
Did not always use a condom	46	90%	142	92%		79	94%	
Contraceptive Method					0.4292			0.0227
OCPs	2	4%	10	6%		8	7%	
Injectable	20	36%	65	39%		32	30%	
LARC (Implant or IUD)	8	14%	33	20%		35	33%	
None/other/condoms only	26	46%	58	35%		32	30%	
Time to LARC Uptake (Months)	10	11.1	3.4	6.1	0.1172	4.1	3.9	0.9233
LARC Discontinuation					0.3212			0.0005
Yes	11	20%	48	29%		52	49%	
No	5	9%	18	11%		10	9%	
Never Used LARC	39	71%	98	60%		45	42%	

**Two-tailed t-test for continuous variables, chi-square test for categorical variables with cell count greater than 5, Fisher's exact test for categorical variables with 20% of expected cell counts less than 5.*

Table 2a: Baseline Variables by LARC Use, all Zambia (n=461)

	LARC Use (n=192)		No LARC Use (n=269)		
	n or mean	% or SD	n or mean	% or SD	p-value*
Fertility Intent					0.0590
Yes, children after 3 years	75	39%	109	41%	
Yes, children in 3 years	17	9%	42	16%	
No more children	100	52%	118	44%	
Age (Years)	22.9	4.8	23.8	5.2	0.0708
City					0.0371
Ndola	147	77%	182	68%	
Lusaka	45	23%	87	32%	
Education Level					0.0030
None	27	14%	15	6%	
Primary	106	55%	146	54%	
Secondary/College	59	31%	108	40%	
Local Literacy (Bemba or Nyanja)					0.8933
Easily/With difficulty	146	76%	206	77%	
None at all	46	24%	63	23%	
Understands English					0.0074
Easily/With difficulty	111	58%	188	70%	
None at all	81	42%	81	30%	
Receives Monthly Income					0.2241
No	152	80%	201	75%	
Yes	39	20%	68	25%	
Number of Living Children	1.8	1.3	1.8	1.3	0.9539
Age at First Sex (Years)	16.4	2.0	16.9	2.4	0.0215
Received Money/Goods for First Sex					0.7629
Yes	56	29%	75	28%	
No	136	71%	194	72%	
Financial Anxiety With Last Pregnancy					0.0481
Yes	105	55%	122	45%	
No	87	45%	147	55%	
Age at Birth of First Child (Years)	18.8	2.8	19.4	3.0	0.0335
Condom Use in Last 12 Months					0.0180
Always	8	5%	28	12%	
Did not always use a condom	159	95%	215	88%	
Contraceptive Method					<0.0001
OCPs	6	3%	20	7%	
Injectable	27	14%	105	39%	
LARC (Implant or IUD)	93	48%	0	0%	
None/other/condoms only	66	34%	144	54%	

**Two-tailed t-test for continuous variables, chi-square test for categorical variables with cell count greater than 5, Fisher's exact test for categorical variables with 20% of expected cell counts less than 5.*

Table 2b: Baseline Variables by LARC Use in Lusaka (n=132)

	LARC Use (n=45)		No LARC Use (n=87)		
	n or mean	% or SD	n or mean	% or SD	p-value*
Fertility Intent					0.6254
Yes, children after 3 years	7	16%	11	13%	
Yes, children in 3 years	0	0%	3	3%	
No more children	38	84%	73	84%	
Age (Years)	23.3	4.6	24.9	5.6	0.1104
Education Level					0.5514
None	1	1%	1	0%	
Primary	16	9%	26	7%	
Secondary/College	28	16%	60	17%	
Local Literacy (Bemba or Nyanja)					0.6021
Easily/With difficulty	33	73%	60	69%	
None at all	12	27%	27	31%	
Understands English					0.5089
Easily/With difficulty	40	89%	81	93%	
None at all	5	11%	6	7%	
Receives Monthly Income					0.1854
No	31	69%	69	79%	
Yes	14	31%	18	21%	
Number of Living Children	1.8	1.3	1.7	1.3	0.7598
Age at First Sex (Years)	17.3	1.8	18.2	2.6	0.0223
Received Money/Goods for First Sex					0.0186
Yes	16	36%	15	17%	
No	29	64%	72	83%	
Financial Anxiety With Last Pregnancy					0.2424
Yes	25	56%	39	45%	
No	20	44%	48	55%	
Age at Birth of First Child (Years)	19.1	1.9	20.5	3.5	0.0042
Condom Use in Last 12 Months					0.3741
Always	3	7%	10	13%	
Did not always use a condom	40	93%	67	87%	
Contraceptive Method					<0.0001
OCPs	1	2%	5	6%	
Injectable	3	7%	12	14%	
LARC (Implant or IUD)	17	38%	0	0%	
None/other/condoms only	24	53%	70	80%	

**Two-tailed t-test for continuous variables, chi-square test for categorical variables with cell count greater than 5, Fisher's exact test for categorical variables with 20% of expected cell counts less than 5.*

Table 2c: Baseline Variables by LARC Use in Ndola (n=329)

	LARC Use (n=147)		No LARC Use (n=182)		
	n or mean	% or SD	n or mean	% or SD	p-value*
Fertility Intent					0.0014
Yes, children after 3 years	68	46%	98	54%	
Yes, children in 3 years	17	12%	39	21%	
No more children	62	42%	45	25%	
Age (Years)	22.8	4.8	23.3	4.8	0.3963
Education Level					0.0192
None	26	18%	14	8%	
Primary	90	61%	120	66%	
Secondary/College	31	21%	48	26%	
Local Literacy (Bemba or Nyanja)					0.4606
Easily/With difficulty	113	77%	146	80%	
None at all	34	23%	36	20%	
Understands English					1
Easily/With difficulty	71	48%	107	59%	
None at all	76	52%	75	41%	
Receives Monthly Income					0.0226
No	121	83%	132	73%	
Yes	25	17%	50	27%	
Number of Living Children	1.8	1.3	1.8	1.3	0.8487
Age at First Sex (Years)	16.2	2.0	16.3	2.1	0.5885
Received Money/Goods for First Sex					0.2591
Yes	40	27%	60	33%	
No	107	73%	122	67%	
Had Financial Anxiety With Last Pregnancy					0.1118
Yes	80	54%	83	46%	
No	67	46%	99	54%	
Age at Birth of First Child (Years)	18.7	3.1	18.8	2.5	0.6305
Condom Use in Last 12 Months					0.0337
Always	5	4%	18	11%	
Did not always use a condom	119	96%	148	89%	
Contraceptive Method					<0.0001
OCPs	5	3%	15	8%	
Injectable	24	16%	93	51%	
LARC (Implant or IUD)	76	52%	0	0%	
None/other/condoms only	42	29%	74	41%	

**Two-tailed t-test for continuous variables, chi-square test for categorical variables with cell count greater than 5, Fisher's exact test for categorical variables with 20% of expected cell counts less than 5.*

Table 3. Bivariate Logistic Regression Models of LARC Use Among Zambian SM (n=461)

	cPOR[a]	LL[b]	UL[c]	p-value
Baseline Fertility Intent				
Yes, more children	*ref*	-	-	-
No more children	1.39	0.96	2.02	0.0819
Baseline Fertility Intent				
No more children vs. Yes. more children in Lusaka	1.04	0.39	2.80	0.9364
No more children vs. Yes, more children in Ndola	2.22	1.39	3.55	0.0009
	cPOR[a]	**LL[b]**	**UL[c]**	**p-value**
Baseline Age (per one year increase)	0.96	0.93	1.00	0.0722
City				
Lusaka	*ref*	-	-	-
Ndola	1.56	1.03	2.38	0.0377
Education by City				
Primary vs. Secondary/College in Lusaka	1.32	0.61	2.84	0.4800
None vs. Secondary/College in Lusaka	2.14	0.13	35.51	0.5948
Primary vs. Secondary/College in Ndola	1.16	0.69	1.97	0.5788
None vs. Secondary/College in Ndola	2.88	1.3	6.34	0.0089
Understands English				
Easily/With difficulty	*ref*	-	-	-
None at all	1.69	1.15	2.49	0.0076
Monthly Income by City				
No vs. Yes in Lusaka	0.58	0.26	1.31	0.1880
No vs. Yes in Ndola	1.83	1.07	3.15	0.0277
Number of Living Children	1.00	0.87	1.16	0.9537
Age at First Sex by City				
Age at first sex per one year increase in Lusaka	0.84	0.71	1	0.0447
Age at first sex per one year increase in Ndola	0.97	0.87	1.09	0.5873
Received Money/Goods for First Sex by City				
Yes vs. No in Lusaka	2.65	1.16	6.05	0.0209
Yes vs. No in Ndola	0.76	0.47	1.22	0.2597
Had Financial Anxiety With Last Pregnancy				
No	*ref*	-	-	-
Yes	1.45	1.00	2.11	0.0485
Age at Birth of First Child by City				
Age per one year increase in Lusaka	0.84	0.73	0.87	0.0196
Age per one year increase in Ndola	0.98	0.91	1.06	0.6223
Condom Use in Last 12 Months by City				
Not always vs. Always in Lusaka	1.99	0.52	7.66	0.3172
Not always vs. Always in Ndola	2.89	1.04	8.03	0.0411

[a]*Crude prevalence odds ratio*

[b]*Lower limit for 95% confidence interval (CI)*

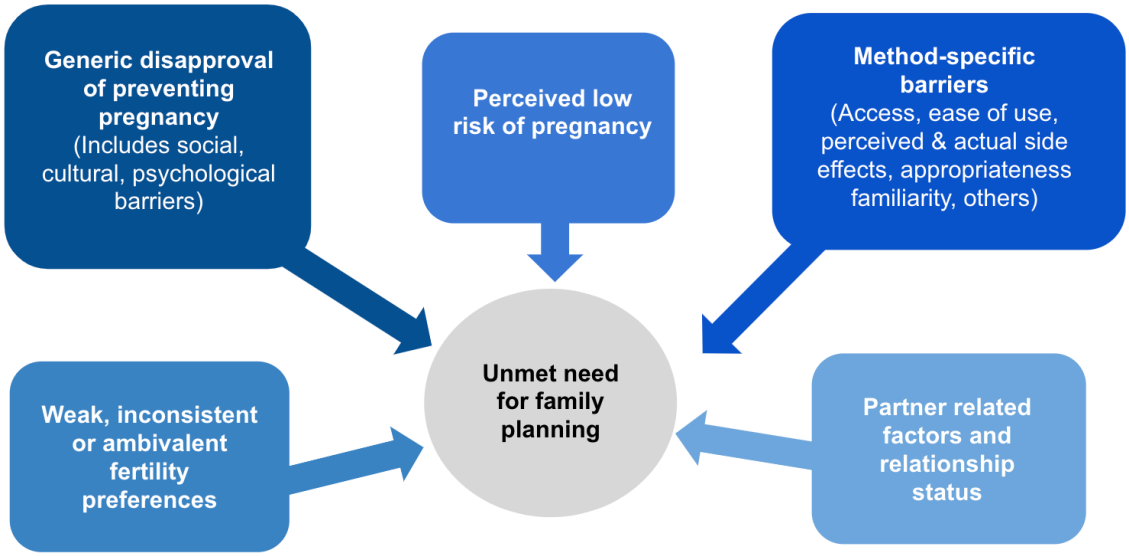
[c]*Upper limit for 95% confidence interval (CI)*

Table 4. Multivariable Logistic Regression Model of LARC Use Among Zambian SM (n=409)

	95% CI			
	aPOR[a]	**LL[b]**	**UL[c]**	**p-value**
Baseline Fertility Intent by City				
No more children vs. Yes, more children in Lusaka	0.88	0.30	2.67	0.8451
No more children vs. Yes, more children in Ndola	2.02	1.88	3.42	0.0094
Receives Monthly Income by City				
No vs. Yes in Lusaka	0.44	0.18	1.05	0.0633
No vs. Yes in Ndola	2.08	1.34	3.84	0.0182
Had Financial Anxiety With Last Pregnancy				
No	*ref*	-	-	-
Yes	1.67	1.10	2.52	0.0151
Condom Use in Last 12 Months				
Always	*ref*	-	-	-
Not always	2.55	1.10	5.94	0.0296

[a]*Adjusted prevalence odds ratio*
[b]*Lower limit for 95% confidence interval (CI)*
[c]*Upper limit for 95% confidence interval (CI)*

Figure 1. Causal Framework for the Reasons for Unmet Need for Family Planning



Adapted from "Reasons for unmet need for family planning, with attention to the measurement of fertility preferences: protocol for a multi-site cohort study," by Machiyama, K., et al. *Reproductive Health*. 2017;14(1):23. Licensed under a Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/).

Figure 2. LARC Use in Zambian SM Throughout Study

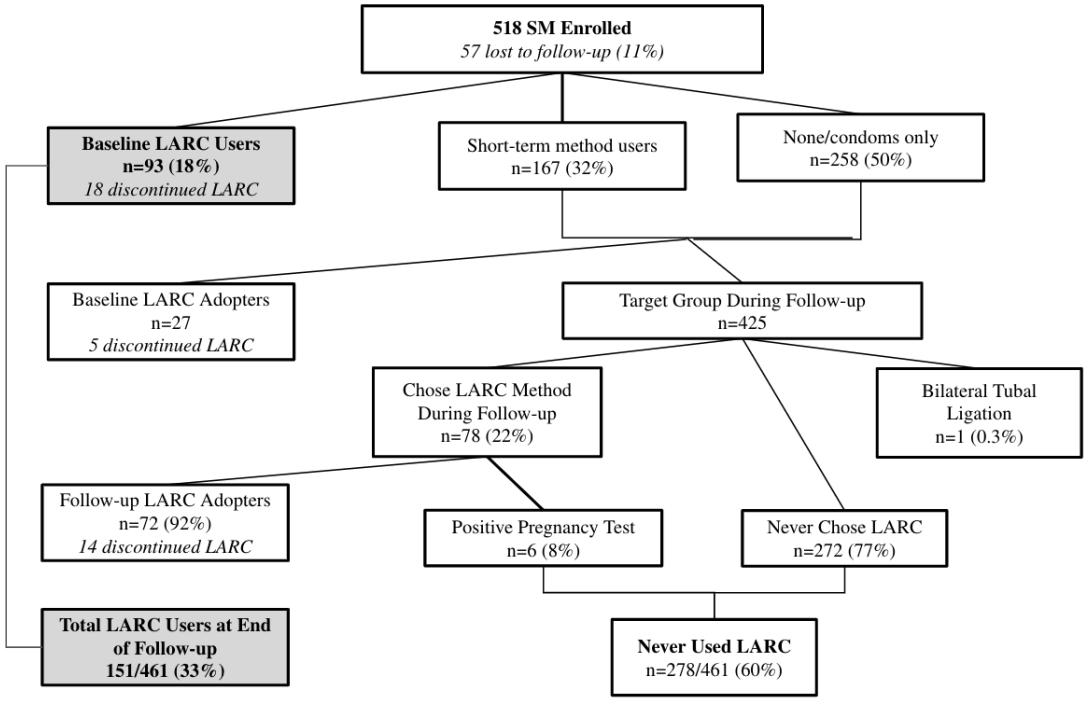
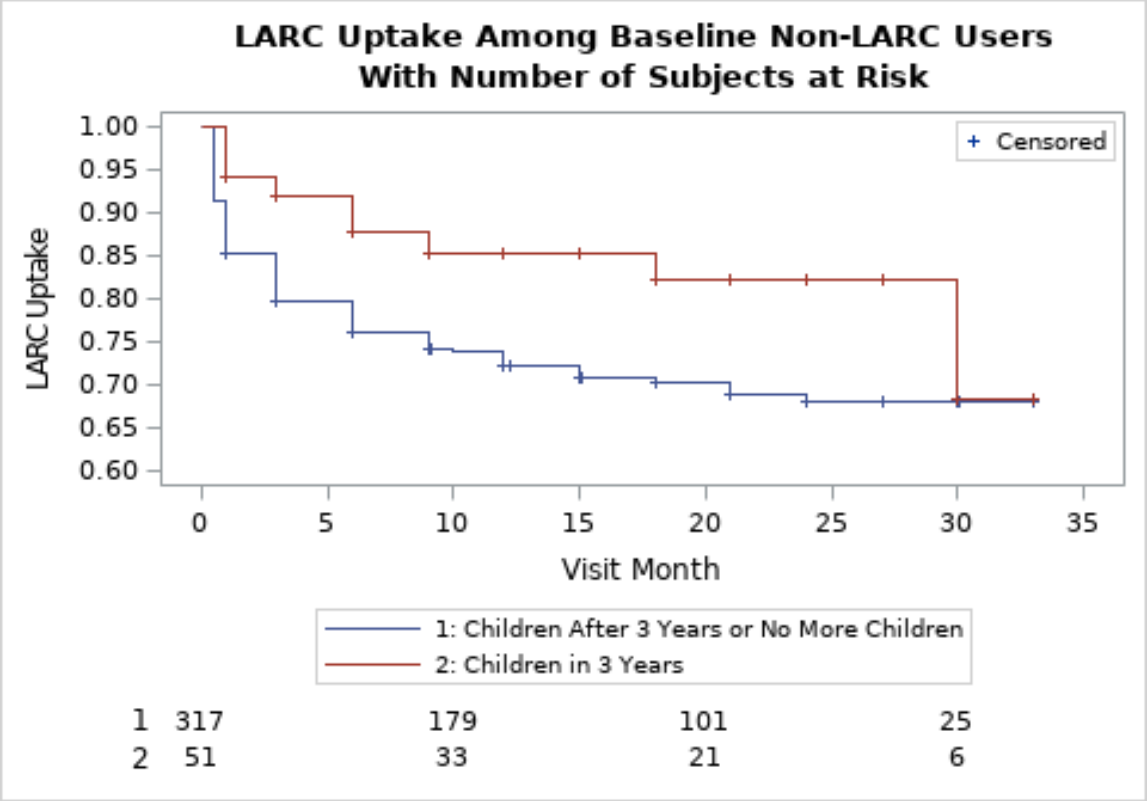
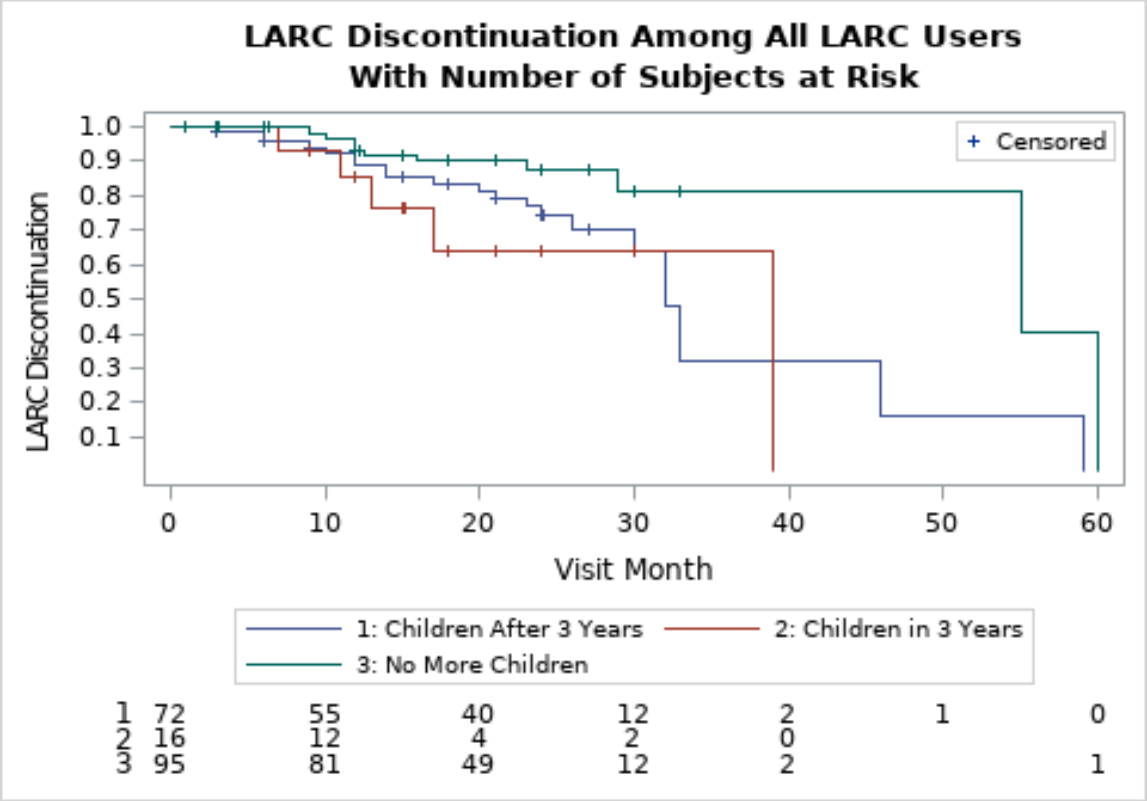


Figure 3. **KM Curve of LARC Uptake Stratified by Fertility Intent at Baseline**



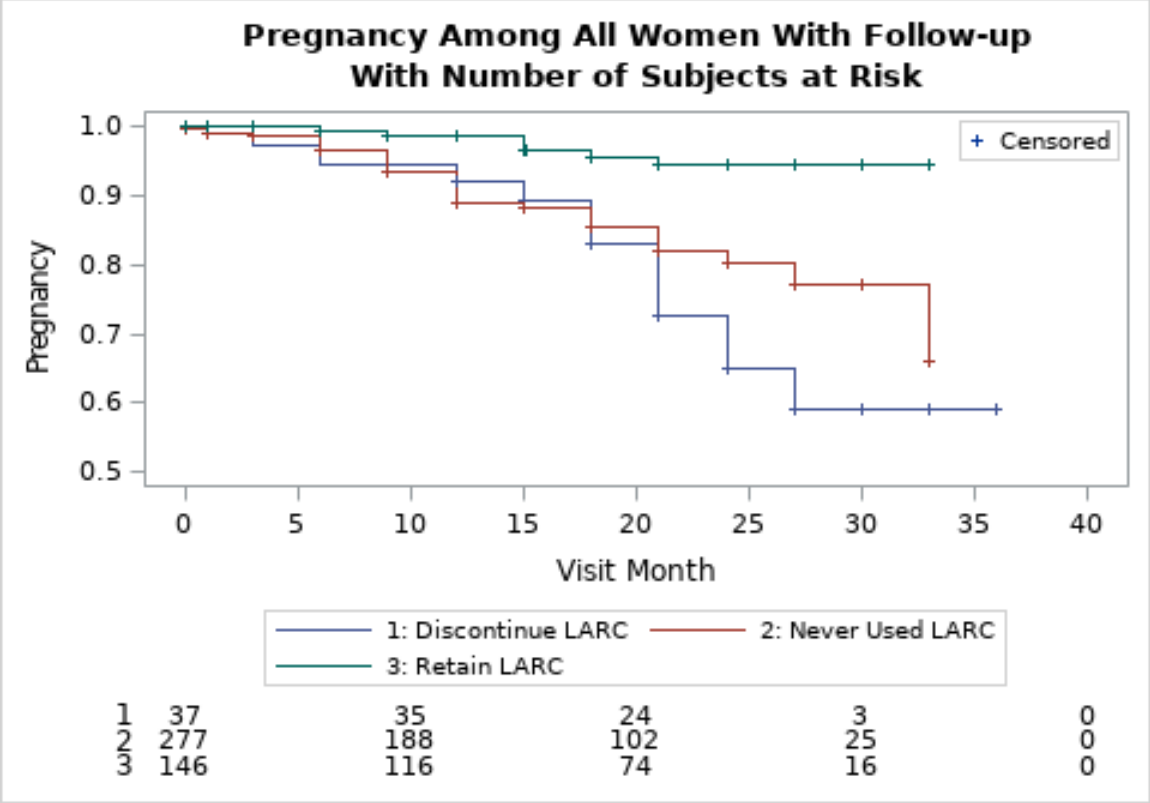
Log-rank p-value: 0.0850

Figure 4. KM Curve of LARC Discontinuation Stratified by Fertility Intent at Baseline



Log Rank p-value: **0.0164**

Figure 5. KM Curve of Incident Pregnancy Stratified by LARC Retention



Log Rank p-value: **0.0002**

FIGURE 6. INCIDENT PREGNANCY BY CONTRACEPTIVE USE