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A Panel Study of Fertility Preferences and Contraceptive Dynamics in the Presence of Competing Pregnancy Risks in Uganda

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ABSTRACT Although many studies have examined the influence of women's fertility preferences on subsequent fertility behavior and the role of contraceptive use intentions on unmet need, very few have explored their concurrent effects on contraceptive use dynamics. This study examines the independent concurrent effects of women's fertility preferences and contraceptive intentions on subsequent adoption and discontinuation, treating pregnancy as a competing risk factor that may alter contraceptive need. The data are derived from a 2018 follow-up survey of a 2014 national sample of 3,800 Ugandan female respondents of childbearing age. The survey included a contraceptive calendar that recorded pregnancy, birth, and contraceptive event episodes, including reasons for discontinuation. We use competing risk regression to estimate the effect of fertility preferences and contraceptive intentions on the cumulative incidence function of contraceptive behaviors, accounting for intervening pregnancy, female background covariates, loss to follow-up, and complex survey design. We find that women's contraceptive intentions significantly increase the rate of contraceptive adoption. After having adopted, women's contraceptive intentions have been realized and do not prolong use. The risk of discontinuation among women who adopted after baseline was significantly higher than for those using at baseline, irrespective of their initial intentions. The effectiveness of the type of contraceptive method chosen significantly lowered discontinuation risk. Fertility preferences were not significantly associated with either time to adoption or discontinuation. The pace of the fertility transition in this sub-Saharan African setting is likely being shaped by reproductive regulation through the intentional use of contraception that enables spacing births.

KEYWORDS Fertility preferences • Contraceptive use dynamics • Longitudinal analysis • Competing risk regression

Introduction

The fertility preferences of women, as measured by their desired family size and intention to limit or delay childbearing, have been the subject of continuous study since the 1970s for their predictive validity of subsequent childbearing (Bankole and

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Westoff 1998; Cleland et al. 2020; Hayford and Agadjanian 2017; Morgan 1982; Vlassoff 1990; Westoff 1990; Westoff and Ryder 1977). With transitions from high to low fertility nearly complete in all regions of the world outside of sub-Saharan Africa (SSA), research is increasingly focused on understanding how fertility preferences are temporally related to the pace of fertility decline, as either a determinant or a precursor (Bongaarts and Casterline 2018). In high-income countries, researchers have used data from national longitudinal surveys of women and men (e.g., Rackin and Morgan [2018] for the United States; Iacovou and Tavares [2011] for the United Kingdom) to study fertility expectations and their achievement across birth cohorts, but elsewhere such insights are constrained by a reliance on cross-sectional survey data (e.g., Westoff and Bankole 2002). A recent review of longitudinal studies of fertility preferences and subsequent childbearing in Asia and Africa by Cleland et al. (2020) found coverage of only 28 populations since 1967, many of them subnational (23), more of them in Asia (19) than in Africa (9), and taking place over intervals ranging from 2 to 12 years. The review found that the desire for additional childbearing is consistently associated with having subsequent births and less consistently for limiting births. The authors speculated that the strength of the association is related to how well preferences are implemented by contraceptive use.

As a proximate determinant of fertility, contraceptive use is a primary means for achieving desired fertility (e.g., Feyisetan and Casterline 2000; Speizer et al. 2013). However, few studies have examined the association between contraceptive use intentions and subsequent practice, especially in SSA, and the available evidence suggests that the relationship is of modest strength (e.g., Callahan and Becker 2014; Roy et al. 2003). Exploring this relationship is important because temporal relationships between fertility preferences and subsequent childbearing at the individual level are mediated through proximal fertility-regulating behaviors, such as contraceptive use, postpartum infecundity, voluntary and involuntary abortion, sterility, and sexual abstinence. However, these intermediate factors are not autonomous and have their own contextual and individual determinants. For example, contraceptive intentions change with periods of sexual activity, over the postpartum period and birth interval (Ross and Winfrey 2001); and they are influenced by relationship dynamics, fear of contraceptive side effects, and utility to alternative choices for fertility regulation (Higgins and Smith 2016). Contraceptive awareness and preferences are influenced by peer social interactions ahead of the formation of fertility preferences, as expected of adolescents (Gage 1998). Because contraceptive practice often involves medical technologies and clinical procedures, the introduction and retention of chemical agents into the woman's body will likely affect her decision to use and choice of methods, involving factors independent of those for fertility decisions (Hoopes et al. 2018). Partner relationships will also affect contraceptive adoption and use effectiveness differently than fertility preferences (Kusunoki and Upchurch 2011).

This study, based on longitudinal data collected in 2014 from a national sample of childbearing-aged females in Uganda and a follow-up in 2018, seeks to understand how baseline fertility preferences and contraceptive use intentions concurrently but independently affect the subsequent timing of contraceptive adoption and discontinuation over a four-year period. We treat both as motivation drivers with additive effects on subsequent contraceptive adoption and discontinuation. Because planned and unplanned pregnancies will occur and can alter women's subsequent fertility preferences and contraceptive use intentions, they are treated as competing events in the study's analyses. We hypothesize first that the desire for no additional births reported by noncontracepting women at baseline, adjusting for their contraceptive intentions, will lead to more rapid contraceptive adoption than when women desire births sooner. Second, we hypothesize for this same group of nonusers that those who express intentions to use contraception in the future will adopt more rapidly than those not intending, when we adjust for fertility preferences. Third, we hypothesize that baseline fertility preferences for more childbearing will lead to more rapid contraceptive discontinuation among those using or adopting contraception after the baseline interview in 2014 than among those desiring no additional births, irrespective of their baseline contraceptive intentions. Fourth, we hypothesize that for the same user group, those intending to adopt at baseline will have a slower rate of discontinuation—that is, longer continued practice—than will those not intending, when we adjust for fertility preferences. By examining the concurrent influence of women's baseline fertility and contraceptive motivations on the timing of adoption and subsequent discontinuation, allowing for pregnancy interruption, this study will contribute new insights into the contraception decision–behavioral dynamics that enable the achievement of intended childbearing.

Fertility Preferences and Subsequent Childbearing

The Cleland et al. (2020) review assessing temporal consistency in fertility preferences and their predictive validity located eight longitudinal studies based in SSA countries, none of which involved national samples of reproductive-aged women. Among these, Machiyama et al. (2015) assessed consistency after three years with a rural north Malawi sample of couples, finding spousal concordance in fertility preferences to be highly influential. Hayford and Agadjanian (2017) followed a panel of about 1,600 married rural Mozambican women over three study waves from 2006 to 2011, finding desires to stop childbearing to be stable but also unstable and shaped by change in a woman's household economic conditions, health status, and demographic and personal factors. Similarly, Trinitapoli and Yeatman (2018) pointed to flexibility in fertility preferences of Malawian women in response to changing partner relationships, child mortality, and economic insecurity. Speizer and Lance (2015), studying ever-married urban women in Kenya, Nigeria, and Senegal, found consistency between fertility desires and pregnancy experience after two years to be highest among women not wanting more children. In all the studies reviewed by Cleland et al., the odds that a woman wanting more births would subsequently have one or more was higher than if she did not want any more. Yet most of the studies found that the proportion of women not wanting another child but ending up with one or more births was also substantial. Where data have been available, spousal concordance in desiring more children resulted in higher fertility, and lower fertility when both wanted no more, than when desires were discordant.

At least two considerations arise from what Cleland et al. (2020) called the "preference-behavior discrepancy." First, fertility preferences themselves change over time, thus affecting their relationship with later childbearing. This notion is supported in other recent studies in developed contexts. For example, Ray et al.'s (2018) study of the stability of personal fertility ideals among U.S. women using two waves of data from the National Survey of Fertility Barriers found that one-third of women adjusted their ideal number of children in either direction between waves. Such findings on both the stability of fertility desires and convergence between intended and achieved parity are also conditioned by the interval between study time points and the level of fertility at the start.

A second consideration is the measurement of birth wantedness. Studies have found that its reporting varies if measured prospectively or retrospectively. Women who report not wanting future births may at a later time have a birth and report it as wanted, especially as the child ages. Two studies based on eight waves of data over two years for young Malawian women found dynamic family size preferences at the individual level but relative stability in the aggregate (Yeatman and Sennott 2015; Yeatman et al. 2013). One of these studies (Yeatman and Sennott 2015) found that prospective classification produces a higher percentage of unwanted births among respondents than retrospective questioning. The post hoc rationalization of birth wantedness has also been examined for pregnancies reported as intended following contraceptive failure or discontinuation (Curtis et al. 2011). These findings raise questions about the strength and permanence of women's motivations to avoid pregnancy and could impact contraceptive practice.

Fertility Preferences, Contraceptive Intentions, and Subsequent Use

Contraceptive demand is not necessarily synonymous with fertility demand. As Agadjanian (2005:639) stated, "Although contraception is linked—conceptually and practically—to reproductive aspirations, it is not a simple reflection of them." He noted that informal social interaction "functions as a major catalyst and vehicle of reproductive changes. Both reproductive aspirations and contraceptive decisions are socially produced, but the mechanisms of this social production differ" (p. 640). Based on qualitative data collected on peri-urban Mozambican females, he pointed to contradictions in the meanings and sentiments around fertility intentions and contraceptive choices that accentuate the intentions-contraception disjunction. The distinction is borne out in Babalola et al.'s study (2015) identifying relevant dimensions of contraceptive ideation and their relationship with intention to use in Kenya and Nigeria (2015). They identified four dimensions—perceived self-efficacy, myths and rumors related to contraceptives, social interactions and influence, and contraceptive awareness—all strongly related to use intentions in Nigeria but only one (perceived self-efficacy) in Kenya. These dimensions do not have parallel counterparts in the cognitive dynamics around fertility preferences. The two studies, as well as an earlier one based in Morocco (Curtis and Westoff 1996), underscore the importance of considering contraceptive intentions concurrently with fertility preferences to identify their relative influence on contraceptive practice in order to understand the mediating role of preferences in subsequent fertility.

Studies of contraception use that are based on longitudinal data and include fertility preferences, sometimes embedded in the measurement of unmet contraceptive need, are few and show mixed results. Speizer et al. (2013) and Callahan and Becker (2014) analyzed longitudinal data on noncontraceptors, observing that they may be ambivalent about future childbearing and not see a clear need for contraception.

Srivastava et al. (2019) showed for urban Indian women followed up after four years that their baseline desire for no more (or more) children is most consistently associated with their subsequent use (or nonuse) of contraception. Other studies based on a four-year follow-up of a subsample of female respondents of the 1992–1993 NFHS in India found inconsistency between fertility preferences and contraceptive intentions with subsequent fertility and contraceptive use (Koenig et al. 2006), modified by the woman's age and infant mortality experience (Roy et al. 2003, 2008). However, those who intended not to have children but to use contraception had the highest likelihood of contraceptive adoption. These are some of the few studies that examined patterns of contraceptive adoption behavior in relation to fertility preferences. Very few studies, however, have addressed the relationship between contraceptive use intentions and rate of discontinuation.

A woman's contraceptive intentions may be connected to her fertility preferences at a given time. However, in SSA settings, where the relationship between fertility preferences and subsequent childbearing behavior are observed to be moderate to weak, intentions to practice contraception are likely shaped by influences unrelated to fertility preferences. Perhaps the male partner's attitudes and preferences about contraception and childbearing exert strong proximate influences on those of his female partner's, although not necessarily in similar directions. Male partner concordance with female fertility preferences has largely been studied relative to her desire for additional births and their number (e.g., Bankole and Singh 1998; Becker 1996; Yeatman and Sennott 2015) and gender (e.g., Short and Kiros 2002; Vlassoff 1990), whereas for contraceptive decisions, the focus has been on his awareness and support for or opposition to her use (Prata et al. 2017). Male partners' objections to female contraceptive practice often center on control of her sexuality and fertility (e.g., Biddlecom and Fapohunda 1998; Kabagenyi et al. 2014). Female perceptions of partner support and couple discussion about contraceptive use enhance the likelihood of adoption, again reinforcing that her fertility preferences alone do not fully determine her contraceptive intentions.

Practices of prolonged breastfeeding and postpartum sexual abstinence also likely influence consistent and persistent contraceptive use, but with few exceptions (e.g., Winfrey and Rakesh 2014), their effects have been largely unmeasured. Ross and Winfrey (2001) noted that in the first year since their last birth, an average of 40% of women across 27 countries reported planning to adopt contraception in the coming 12 months but did not. Mumah et al.'s study (2015) documented that only about one-half of women in a Nairobi slum sample had adopted a modern contraceptive method at 6 months postpartum, with almost one-half discontinuing by 12 months.

One methodological limitation worth noting is that the measurement of future contraceptive intentions has largely been asked only of females not currently using contraception at the time of the survey. This presumes that current contraceptors are inherently predisposed to future use, an assumption that may or may not hold. The unavoidable reliance on only nonusers by which to gauge the influence of intentions on subsequent contraceptive practice introduces a potential selection bias with unmeasured consequences.

The available research overall suggests the achievement of desired fertility is more likely than undesired fertility and that the consistency between fertility preferences and contraceptive adoption is generally weak. The latter underscores the likelihood that contraceptive motivations differ from childbearing ones and that both should be examined separately, first for their influence on contraceptive adoption and next on continued use. Because concerns about contraceptives' side effects and impact on future fertility are widespread in Uganda (Kabagenyi et al. 2014) and other SSA countries (Blackstone et al. 2017), these—as well as erratic supply factors—could interfere with prolonged use despite women's motivations to use. To understand contraceptive behavior's mediating role with fertility, it is important to examine how reproductive preferences and contraceptive perceptions and intentions relate to the duration of contraceptive use. If the two relationships are weak, then short-term use or rapid discontinuation will weaken contraceptive protection from any unplanned childbearing.

Panel Study Data and Analytic Approach

Data from a prospective design or longitudinal study are needed to investigate contraceptive use dynamics and their determinants. However, panel data have special considerations for feasibility and logistics, including the costs and challenges of relocating survey respondents, particularly for studies involving large samples and mobile populations. As a result, cross-sectional surveys are more numerous compared with longitudinal ones in SSA countries, where relocation can be hampered by underdeveloped telecommunications and transportation infrastructures. It remains nonetheless important to pursue such designs to establish causal linkage and build a comprehensive understanding of the determinants of fertility and fertility-regulating behaviors.

To address such knowledge gaps in understanding and to test our hypotheses, we adopt a panel design to examine the causal relationships between reported fertility preferences and contraceptive intentions with changes in use behaviors that unfold over a four-year interval. This study is one of few conducted with data collected recently in an SSA country with an emergent fertility transition. Our analysis uses nationally representative data and aims to assess the influence of fertility preferences and contraceptive use intentions reported by Ugandan women of childbearing age in 2014 on the timing of their subsequent adoption of contraception and any contraceptive discontinuation by 2018.

Specifically, we examine two behavioral outcomes during the follow-up period: time to adoption of contraception among women who were not contracepting in 2014, and time to discontinuation among women who used contraception at any time over the four-year period. Our two main variables of interest are the woman's stated future fertility preferences and contraceptive intentions at the baseline interview in 2014.

We also incorporate a competing risk modeling approach to allow for pregnancies to influence the dynamic relationships in the observation period. Previous research has used cause-specific hazard regressions or single-decrement life tables to explore time to contraceptive uptake and discontinuation (e.g., Ali and Cleland 1999). Largely absent from these analyses is the use of competing risk methods, which model time to an event yet simultaneously account for competing events. For example, in exploring time to adoption of contraception, without including pregnancy as a competing risk, cause-specific proportional hazard models may overestimate the incidence rate for adoption outcomes. Competing risks are better suited to simulate the real-life scenario allowing women who are not using contraception to be at risk of adopting contraception but also at risk of having an intended or unintended pregnancy, which then alters perceived contraceptive need. In standard Cox proportional hazards survival analysis, pregnancy is treated as a censored event, and pregnant women's propensity to use a contraceptive method is considered similar to nonpregnant women's, which if not the case, will bias the model's estimates. Similarly, for time-to-discontinuation analyses, discontinuations for any reason are often treated equally as failure events. Recently, where data on the specific reason for discontinuation are known, researchers have incorporated these as competing risks to account for the competing causes of discontinuation (Demographic and Health Surveys [DHS] 2018). Therefore, this research contributes added methodological rigor and avoids potential bias under cause-specific hazard ratios from Cox regressions.

Data, Measures, and Methods

The data for this study come from two waves of the Uganda Performance Monitoring and Accountability (PMA) surveys: Round 1 (R1, or baseline) survey, conducted between April and June of 2014; and the Round 1 Follow-up (R1F) survey, fielded from June to August of 2018. As a multistage cluster survey, PMA Uganda R1 had a sample of 110 clusters or enumeration areas (EA)[1] drawn from urban and rural strata, with approximately 200 households in each EA.

Uganda

Uganda has a population of about 44 million in 2018[2] with nearly one-half under age 15. The total fertility rate (TFR) declined from 7.4 in 1988–1989 to 5.4 births in 2016 (Kaijuka 1989; Uganda Bureau of Statistics and ICF 2018). The wanted TFR in 2016 (4.3) was 1.1 births below the actual TFR. Compared with the 1988–1989 Uganda DHS, the median age at marriage among 25- to 49-year-old females rose from 17.0 years to 18.7 years. Between 2000–2001 and 2018, infant mortality has declined by almost one-half from 88 to 43 deaths per 1,000 births, and under-5 child mortality declined from 151 to 64 deaths per 1,000 births. The present annual rate of natural population increase is 3.2%, signifying rapid population growth. Three-quarters of the population reside in rural areas. The proportion of the female population with no schooling declined from 37.8% in 1988–1989 to 9.6% in 2016. Rutaremwa et al. (2015) noted the consistent association of female education with increased contraceptive use and reduced fertility levels between 2011 and 2016; and for the same period, Ariho et al. (2018) pointed to increased education and delayed marriage as key drivers of lower fertility.

[1] In Round 1, one EA was not included because of an outbreak of foot and mouth disease. For the purposes of the follow-up study fieldwork, we include Round 2 household and female respondent data for that one EA, which were collected 6 months after Round 1. These additions bring the total households targeted for relocation and reinterview to 4,295 and the total women to 3,800.

[2] See www.prb.org/international/geography/uganda.

Per the latest DHS of 2016, modern contraceptive prevalence rate (MCPR) among married women ages 15–49 is 35%, up from 14% in 2000–2001. Despite little change in use of most modern or traditional methods between 2000–2001 and 2011, the prevalence of hormonal injections among married women rose from 6% to 14% during the period, and increased further still to 19% by 2016. Unmet contraceptive need among married women was 28% in 2016 (18% for spacing), an increase from 24.4% in 2000–2001 (14.7% for spacing). Thus, the fertility transition is underway in Uganda, and contraceptive demand has been rising.

Data

In baseline R1, following mapping and listing of households in each EA, a sample of 44 households was systematically selected, and all occupants were enumerated. All eligible women ages 15–49 were identified and contacted for interview. Both surveys were conducted using Open Data Kit software-programmed forms and administered by trained resident enumerators using smartphones. Collected data were subsequently transmitted to a cloud server for data cleaning, processing, and file management. Further information on the design of PMA2020 surveys is available online (https://www.pmadata.org) and in Zimmerman et al. (2017).

The R1F survey was fielded with a primary objective of assessing the predictive utility of reproductive and contraceptive intentions reported in R1 and other measures used frequently by reproductive health practitioners. The target sample was all original R1 households and female respondents. Methods of data collection were approved by institutional review boards at the Makerere University School of Public Health in Kampala, Uganda; at the Bloomberg School of Public Health at Johns Hopkins University in Baltimore, Maryland; and at the Uganda National Council for Science and Technology.

All household dwellings from the R1 sample were revisited. After the households were located, interviewers confirmed the identity of the original R1 household. If the R1 dwelling was destroyed, vacant, or not found, the interviewer recorded this result. If all members of the original R1 household had moved and been replaced by new occupants, the interview effort ended. Because of resource constraints, no attempt was made to locate and follow up households or occupants who had moved.

If at least one original adult member of the PMA R1 household was present in the dwelling, the interviewers contacted that individual for the household survey and updated the demographic information for all original R1 household members, as well as enumerating any new household members. After completing the household survey, the interviewers conducted the female survey with consenting eligible females. For the follow-up, female respondent eligibility was defined as being between ages 18 and 55 years (allowing for aging over the four years since R1) and a resident of an R1 household.

In the R1 sample, 4,802 households were selected, and 4,257 heads were interviewed (88.7% response rate). Of household occupants, 3,987 females were of eligible age, and 3,762 were successfully interviewed (94.4% response rate). Although one EA was missed in R1, its households were included in R1F, resulting in a total baseline sample of 4,295 households and 3,800 women with completed interviews (see Table A1 in the online appendix).

A total of 2,814 R1 households and 1,716 women were successfully reinterviewed (65.5% and 45.2%, respectively). Of the 1,716 women, 1,655 (96.4%) had completed R1 data that could be linked to their R1F data to create a panel data set.

Our analytic sample is the 1,655 female respondents successfully recontacted and reinterviewed after four years. Women who were pregnant at any time are included. Because of potential bias from loss-to-follow-up (LFU), we constructed a weight based on inverse probabilities of LFU from a propensity score model estimated with multivariate logistic regression with female age, parity, marital status, school, wealth quintile, and residence as covariates. The predicted LFU probability weight was then multiplied by the R1 individual female survey weight to reweight the R1F responses. When applied to the R1F sample, the LFU weight closely restored the composition to that of the baseline R1 sample, indicating that the weighted findings in this analysis can be interpreted to reflect the national characteristics of childbearing-aged women for the reference baseline year. Except where noted, the R1F results in this analysis have been weighted to adjust for LFU.

Measures

The R1F questionnaire measured many of the same items in the R1 questionnaire. One addition was a five-year reproductive and contraceptive calendar, modeled after the DHS (2018), covering the period June 2013 to June 2018. The interviewer recorded the woman's pregnancies, pregnancy outcomes, and episodes of contraceptive use and type of method in this period. For contraceptive discontinuation, the reason for termination was recorded.

The calendar instrument relies on self-reported information, which has been shown to introduce respondent recall bias (Bradley 2016) and social desirability bias (MacQuarrie et al. 2018; Polis et al. 2016). In our assessment of the R1F calendar data, we find similar rates of decay in recall of contraceptive use as with the 2016 Uganda Demographic and Health Survey and close alignment in both level and trend of MCPRs with the cross-sectional PMA surveys.

We use the contraceptive and pregnancy calendar data to construct episodes of use for our two outcomes of interest: time to adoption of contraception, and time to discontinuation. *Time to adoption of contraception* is defined as months to uptake of contraception after R1 interview among noncontracepting women. *Time to discontinuation* outcome is defined as months to discontinuation of any contraceptive episode at or since baseline or thereafter in the calendar period. For the discontinuation analysis, a woman could contribute one or more use episodes from the calendar period.

Our two explanatory variables of interest are fertility preferences and contraceptive intentions measured at R1. The relevant questions for fertility preferences are, "Would you like to have a/another child, or would you prefer not to have any more children?," and "How long would you like to wait before the birth of a/another child?" In case of pregnant women, the questions were prepended with, "After the child you are expecting now." Fertility preferences are classified as (1) want another child in less than two years, (2) want another child after two or more years or undecided, or (3) want no more children. For contraceptive intentions, women not contracepting were asked, "Do you think you will use a contraceptive method to delay or avoid getting pregnant any time in the future?" Contraceptive intentions at R1 are classified as (1) intend to use in future and (2) do not intend to use in future. A third category of women currently using any contraception in R1 is included to serve as a reference category and retain the original sample size.

Background control covariates are measured at the time of R1: woman's age (<30 [reference group], 30–39, and 40 or more years); her highest level of schooling (never attended [reference group], primary, or secondary/university or vocational/technical); parity (0–2 children [reference group], 3–4 children, or 5 or more children); marital status (currently married [reference group], widowed/divorced/separated, or never married); and residence (urban [reference group] or rural). Household wealth was measured using a set of household assets, main material of floor, roof, external walls, and the main source of drinking water and of sanitation common to both R1 and R1F to construct a score with principal components factor analysis, modeled after the DHS wealth index. The first principal factor scores of R1 are applied to the woman's R1F household assets, and the distribution of wealth scores are divided into quintiles.

Methods

We first conduct exploratory and descriptive data analyses. Our descriptive analysis provides the composition of the R1 sample and follow-up sample, both with R1 weights only and then also adjusted for LFU (Table 1). The outcomes of interest are similarly presented in Table 2. Second, we examine the association between fertility preferences and contraceptive use intentions within R1 and R1F separately to test for internal consistency within respondent (Table 3). The associations of two covariates of interest with subsequent contraceptive adoption or pregnancy events are presented in Table 4.

Finally, to test the four hypotheses that fertility preferences and contraceptive use intentions separately influence the rates of contraceptive adoption and discontinuation, we estimate their effects first through multivariable Cox's proportional hazard regression model, and then through competing risk hazard regression model (Kalbfleisch and Prentice 2002; Lau et al. 2009) of time to adoption and time to discontinuation. We conduct competing risk analysis to estimate the marginal probability of contraceptive adoption and discontinuation in the presence of other competing risks (pregnancy in the case of time to contraceptive adoption, and stopping to become pregnant in the case of time to discontinuation) that may simultaneously affect the outcomes.

For the multivariate Cox proportional hazard regression, we use the following model:

$$h_i(t\,|\,\mathbf{X}) = h_0(t)\exp(\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_\mathrm{p} X_p),$$

where h_i is the hazard rate at time t expressed as a function of the baseline hazard $h_0(t)$ and the covariate vector $\mathbf{X}$ and regression coefficients β that include the woman's fertility preferences, contraceptive intentions, and background covariates. For the competing risk hazard regression models, we use Fine and Gray's (1999) semiparametric proportional hazards model for the subdistribution hazard of cause r for a subject with covariate vector $\mathbf{X}$:

$$\lambda_\mathrm{r}(t\,|\,X) = \lambda_{r0}(t)\exp(\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_\mathrm{p} X_p),$$

where $\lambda_{r0}(t)$ is the baseline subdistribution hazard of cause r, and βs are the coefficients for the covariates, including woman's age, her highest level of schooling, parity, marital status, residence, wealth quintile, and type of method.

The results of the cause-specific and competing risk regression models are shown in Tables 5 and 6, respectively. All regression model estimates of the hazard ratios and standard errors are adjusted for multistage complex survey design, weighted for sample selection probability and any loss to follow-up, and woman-level clustering of multiple episodes of use.

Results

The R1 and R1F sample compositions according to age, education, parity, marital status, wealth quintile, and residence are shown in Table 1. The R1 weighted composition of the baseline sample of 3,800 female respondents is shown in the first column, and that for those followed up (1,655) is shown in column 2. The follow-up sample composition's 2014 values further weighted for LFU are shown in column 3. A comparison of column 3 with column 1 shows that the LFU weights restore the original sample composition well enough to allow interpretation of the results as reflective of the reproductive and contraceptive experiences of a 2014 national sample of childbearing-aged women. Differential loss to follow-up rates are provided in Table A2 in the online appendix. The 2018 composition of the sample of reinterviewed females is shown in column 4 with original R1 weights and after adjustment for LFU. We discuss change in the panel over time by comparing columns 3 and 4. The differences reflect changes in demographic characteristics of the study respondents after four years.

The number of respondents under age 25 dropped noticeably by 2018—from 41.4% to 25.7%—likely because of marriage and rural-urban migration for schooling and work. The panel composition in terms of education and residence remains stable, as expected, whereas its marital composition changes, with a smaller proportion never married by 2018 (22.6% to 15.7%) and a larger share of married or widowed, divorced, or separated. The proportion having five or more children rises from 28.6% to 39.8%. Panel females increasingly reside in households with more wealth, at rates of 20.1% to 26.8% for the highest quintile. Table 1 shows that by adjusting for attrition, we can study the motivation and behaviors of the cohort of 1,655 females over time with confidence.

Along with the sociodemographic compositional shifts in the two samples after four years, their fertility preferences and contraceptive behaviors change accordingly, as shown in Table 2. Again, column 3 shows that the composition of the follow-up sample weighted for LFU remains similar to that of the original sample (column 1). Panel change (i.e., change over the four years, displayed in columns 3 and 4) shows a gain in MCPRs from 22.2% to 31.1%, with the injectable method accounting for approximately one-half of users at baseline or follow-up. The share of use with the subdermal contraceptive implant method rises from 11.7% to 18.1%. Panel women have a higher percentage wanting no more children by 2018, rising from 32.5% to 37.8%. Nonusers intending to use contraception rises from 55.3% to 59.2%.

In Table 3, we examine the association of the panel's fertility preferences with contraceptive use intentions within each survey round to assess the temporal con-

Table 1 Distribution of female respondent characteristics for Uganda 2014 baseline and 2018 follow-up samples

	2014 Values[a]			
Covariate	Baseline Sample	Follow-up Sample	Follow-up Sample Weighted for LFU	Follow-up Sample in 2018, Weighted for LFU
Number of Females	3,800	1,655	1,655	1,655
Age				
15–19 years	20.9	10.1	21.0	4.6
20–24 years	21.5	15.9	20.4	21.1
25–29 years	18.9	20.6	19.3	18.1
30–34 years	13.6	15.9	13.8	17.8
35–39 years	10.9	15.6	10.9	13.5
40–44 years	8.7	13.5	8.8	11.7
45+ years	5.7	8.6	5.8	13.3
Education				
Never attended	13.6	16.4	13.3	11.9
Primary	58.0	62.5	58.9	60.1
Secondary/university	25.4	18.2	24.9	23.7
Other/vocational/technical	3.0	2.9	2.9	4.2
Parity				
0–2 children	52.1	34.2	51.7	33.5
3–4 children	19.8	23.5	19.7	26.6
5+ children	28.0	42.3	28.6	39.8
Marital Status				
Never married	23.0	11.3	22.6	15.7
Currently married/cohabiting	65.0	76.5	65.7	68.0
Widowed/divorced/separated	12.0	12.2	11.7	16.3
Wealth Quintile[b]				
Lowest quintile	18.8	21.3	19.7	16.0
Lower quintile	20.7	22.0	20.4	16.8
Middle quintile	18.7	20.2	19.1	18.4
Higher quintile	21.0	21.1	20.7	22.1
Highest quintile	20.8	15.5	20.1	26.8
Urban/Rural Residence				
Urban	20.4	12.6	21.4	21.4
Rural	79.6	87.4	78.6	78.6

[a] Baseline (2014) and follow-up (2018) values are weighted with original sample selection probabilities; loss to follow-up weight is based on inverse propensity score.

[b] Wealth quintile is constructed using set of assets, water sources, and sanitation facilities common to baseline and follow-up surveys.

sistency of the relationship. In 2014, contraceptive use is highest among those wanting no more children (30.0%) and is high among the small number of women reporting themselves to be infertile in 2014 (27.7%). In 2018, contraceptive use remains highest among those wanting no more children (34.9%) but is also high among women wanting to space births (33.7%). In 2014, panel females wanting to have a child soon or after two or more years are both more likely to report an intention to use (43.2% and 47.4%, respectively). Those wanting no more births have

Table 2 Baseline and follow-up measures of contraceptive use, fertility preferences, and future contraceptive use intentions for the Uganda 2014 baseline and 2018 follow-up samples

	2014 Values[a]			
Covariate	Baseline Sample	Follow-up Sample	Follow-up Sample Weighted for LFU	Follow-up Sample in 2018, Weighted for LFU
Number of Females	3,800	1,655	1,655	1,655
Contraceptive Prevalence	21.9	25.6	23.3	33.0
Modern Contraceptive Prevalence[b]	20.9	24.1	22.2	31.1
Type of Method[c] Among Users	(827)	(413)	(413)	(527)
Long-acting method	18.5	22.8	22.1	28.0
Implant	12.1	12.3	11.7	18.1
Other long-acting	6.4	10.5	10.4	9.9
Short-acting method	81.5	77.2	77.9	72.0
Injectable	54.2	52.7	53.1	47.8
Other short-acting	27.3	24.5	24.8	24.3
Fertility Preferences	(3,763)	(1,637)	(1,637)	(1,654)
Wants more children in <24 months	11.4	9.7	10.2	11.0
Wants more children, 24+ months; or undecided	53.6	44.6	54.6	46.9
Wants no more children	32.2	42.3	32.5	37.8
Infertile	2.9	3.4	2.7	4.3
Future Contraceptive Intentions Among Non-Users	(2,886)	(1,210)	(1,210)	(1,125)
Intention to use	54.6	51.5	55.3	59.2
No intention to use	45.4	48.5	44.7	40.8

Note: Values in parentheses are sample *n*s.

[a] Baseline (2014) and follow-up (2018) values are weighted with original sample selection probabilities; loss to follow-up weight is based on inverse propensity score.

[b] Modern contraceptives include female sterilization, male sterilization, implant, IUD, injectables, pill, emergency contraception, male condom, female condom, diaphragm, foam/jelly, standard days/cycle beads, and lactational amenorrhea method.

[c] Long-acting contraceptives include female sterilization, male sterilization, implant, and IUD. All others are coded as short-acting.

a level of intended use (29.8%) lower than those planning to space but nearly the same as those who are using (30.0%). The paradoxical pattern of women wanting no more children but no future intention to use contraception is observed in 2014 (40.3%) and 2018 (37.2%). The inconsistency in both 2014 and 2018 between fertility preferences and contraceptive use and intentions is greater for women not wanting additional births, and those wanting more appear to use contraception to space.

Table 4 closely examines the subsample of women not contracepting at R1 and presents the associations between their R1 fertility preferences and contraceptive use intentions with the first of one of three mutually exclusive experiences: adopting contraception, becoming pregnant, or not adopting contraception. Among women who

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Table 3 Association of fertility preferences with contraceptive use intentions for panel sample of Ugandan females from 2014 Round 1 followed up in 2018[a]

Fertility Preferences[b]	Current Contraceptive Use	Intention to Use Contraception in the Future		Total
		Yes	No	
Panel Sample in 2014 (N = 1,611)				
Wants more children <24 months (167)	19.7	43.2	37.1	100.0
Wants more children, 24+ months; or undecided (720)	24.2	47.4	28.4	100.0
Wants no more children (671)	30.0	29.8	40.3	100.0
Infertile (53)	27.7	11.4	60.9	100.0
Panel Sample in 2018 (N = 1,651)				
Wants more children <24 months (145)	31.1	47.3	21.6	100.0
Wants more children, 24+ months; or undecided (608)	33.7	50.7	15.5	100.0
Wants no more children (803)	34.9	27.9	37.2	100.0
Infertile (95)	14.7	3.9	81.4	100.0

[a] Round 1 follow-up values are weighted for loss to follow-up using inverse propensity score.

[b] About 40 respondents have missing baseline information on fertility preferences.

desire a pregnancy soon or after two years, more than one-half (56.8% and 50.3%, respectively) become pregnant. The highest percentage adopting contraception came from women wanting to space at 26.0%, compared with 17.2% for those wanting to become pregnant soon and 19.4% for those wanting no more. The latter group was most likely to not contracept at all (52.1%) but also less likely to become pregnant (28.5%). The association of baseline contraceptive use intentions with subsequent behaviors is nuanced. Although those intending to use are more likely to adopt contraception than those not intending (32.0% vs. 11.7%), they are also more likely to become pregnant (49.9% vs. 37.0%). Consistency in contraceptive intentions and subsequent behavior is highest for those not intending to adopt contraception, at 51.3% compared with 32.0% for those intending.

We next estimate cause-specific and competing risk hazard regression models for fertility preferences and contraceptive use intention effects on time to adoption among women not using contraceptives at R1, adjusting for possible confounding effects from background covariates: age, parity, education, marital status, place of residence, and household wealth quintiles. The first column of Table 5 presents the conventional cause-specific hazard ratios (CsHRs), 95% confidence intervals (CIs), and p values for the R1 main covariates' effects on the hazards of contraceptive adoption. The second column presents the subdistribution hazard (or subhazard) ratios (SHRs), confidence intervals, and p values from the Fine-Gray models (1999) for the same set of covariates' influences on the cumulative incidence of contraception adoption but incorporating pregnancy as a competing risk. The model results are adjusted for loss to follow-up and the standard errors for the complex multistage cluster sur-

Table 4 Association of baseline fertility preferences and contraceptive use intentions among panel sample of noncontracepting Ugandan females with subsequent adoption of contraception or pregnancy[a]

	Subsequent Event			
Baseline Fertility Preferences/ Contraceptive Intentions	Adopted Contraception	Became Pregnant	Never Adopted Contraception	Total
Panel Sample (N = 1,128)[b]				
Wants more children <24 months (128)	17.2	56.8	26.0	100.0
Wants more children, 24+ months; or undecided (521)	26.0	50.3	23.7	100.0
Wants no more children (443)	19.4	28.5	52.1	100.0
Infertile (36)	5.5	23.4	71.1	100.0
Panel Sample (N = 1,112)[b]				
Intention to use contraception (535)	32.0	49.9	18.1	100.0
No intention to use contraception (577)	11.7	37.0	51.3	100.0

[a] Round 1 follow-up values are weighted for loss to follow-up using inverse propensity score.

[b] The sample includes only women not contracepting at baseline.

vey design. The SHRs are not interpretable in the same manner as the CsHRs (Austin and Fine 2017). The latter estimates the ratio of the risk of adoption occurring at a given interval of time between fertility preference or contraceptive intention groups, whereas the SHRs estimate the relative effects of the covariates over time on the cumulative incidence function of the particular cause. The positive-negative signs of the SHRs indicate whether the cumulative incidence function shifts up or down, and the relative magnitudes of the ratios can be discussed in those terms but do not represent the actual magnitude of the covariates' effects on the outcome of interest.

From Table 5, we observe that CsHRs for R1 fertility preference categories of wanting to space or wanting no more children, relative to wanting children soon, are positive (>1.0), suggesting that the probability of contraceptive adoption is higher but not at a statistically significant level. The same pattern of association holds in the competing risk model, and although the subhazard ratios are large, they are not statistically significant. However, for those intending to contracept, the CsHR is 2.34 (95% CI = 1.48–3.69, $p < .01$); and after adjusting for pregnancy as a competing risk, we find a SHR of 2.11 (95% CI = 1.40–3.18, $p < .01$).

Among the background characteristics, adjusted CsHRs for older age (40 years or older) and being unmarried or widowed or divorced/separated, relative to being younger than 30 and being married (respectively), significantly delay the time to contraception adoption. Having secondary or higher schooling levels hastens adoption relative to never attending school. Increasing household wealth is associated with earlier adoption but not at a statistically significant level. Although most of the patterns are similar in the competing risk model, the never-married category is no longer statistically significant. The strongest predictors of adoption in both models are education and intention to use in the future.

In Table 6, the same modeling approaches are used for time to discontinuation, with discontinuation due to a desired pregnancy considered as the competing risk.

Table 5 Results of cause-specific and competing risk hazard regression models of time to contraceptive adoption among Round 1 nonusers[a]

Round 1 Covariate	Adjusted Cause-Specific Hazard Ratio ($n = 1{,}085$) Hazard Ratio	Confidence Interval	p Value	Adjusted Competing Risk Hazard Ratio ($n = 1{,}085$) Hazard Ratio	Confidence Interval	p Value
Fertility Preferences (ref. = wants in <2 years)						
Wants more children, in more than 2 years; or undecided	1.12	(0.61, 2.03)	.72	1.34	(0.80, 2.27)	.27
Wants no more children	1.29	(0.63, 2.65)	.48	1.67	(0.88, 3.15)	.12
Contraception Intentions (ref. = no intention to use)						
Intention to use	**2.34**	**(1.48, 3.69)**	**<.01**	**2.11**	**(1.40, 3.18)**	**<.01**
Age (ref. = <30 years)						
30–39 years	0.64	(0.41, 1.01)	.06	0.79	(0.55, 1.13)	.19
40+ years	**0.20**	**(0.10, 0.41)**	**<.01**	**0.29**	**(0.15, 0.54)**	**<.01**
Parity (ref. = 0–2 children)						
3–4 children	1.15	(0.72, 1.84)	.56	1.24	(0.83, 1.87)	.30
5+ children	1.36	(0.71, 2.60)	.36	1.26	(0.70, 2.27)	.45
Education (ref. = never attended)						
Primary	**2.30**	**(1.30, 4.09)**	**<.01**	**2.30**	**(1.32, 4.00)**	**<.01**
Secondary/university/technical/other/vocational	**3.21**	**(1.65, 6.26)**	**<.01**	**3.21**	**(1.67, 6.16)**	**<.01**
Marital Status (ref. = currently married)						
Widowed/divorced/separated	**0.43**	**(0.23, 0.82)**	**.01**	**0.56**	**(0.33, 0.95)**	**.03**
Never married	**0.44**	**(0.26, 0.75)**	**<.01**	0.68	(0.42, 1.08)	.10
Residence (ref. = urban)						
Rural	0.79	(0.50, 1.27)	.33	0.84	(0.53, 1.34)	.48
Wealth Quintile (ref. = lowest quintile)						
Lower quintile	1.02	(0.62, 1.66)	.95	1.06	(0.68, 1.65)	.80
Middle quintile	0.97	(0.65, 1.46)	.90	0.95	(0.65, 1.40)	.80
Higher quintile	1.10	(0.69, 1.74)	.69	1.13	(0.74, 1.73)	.56
Highest quintile	1.63	(0.71, 3.71)	.24	1.62	(0.82, 3.19)	.16

Note: Ratios in bold reflect statistical significance at $p < .05$.

[a] Round 1 follow-up values are weighted for loss to follow-up using inverse propensity scores. The analysis excludes women who were using contraception at Round 1, women self-reporting to be infertile ($n = 37$), and women with discordant calendar and Round 1 reported use status ($n = 68$). The analysis uses Fine and Gray (1999) competing risk regressions where possible outcomes include censoring (never adopt), adoption of contraception (outcome of interest), or pregnancy (competing risk).

Table 6 presents results from the cause-specific and competing risk regression models for time to discontinuation. Again, we do not observe statistically significant associations between R1 fertility preferences for spacing or limiting childbearing, relative to desires for immediate childbearing, and discontinuation risk. However, the associations are statistically significant ($p<.05$) for contraceptive use intentions. Episodes from women reporting intentions to contracept in R1 and subsequently adopting contraception have a discontinuation risk significantly higher than

Table 6 Results of cause-specific and competing risk hazard regression models of time to contraceptive discontinuation among contraceptive users, 2014–2018[a]

	Adjusted Cause-Specific Hazard Ratio ($n = 937$)			Adjusted Subdistribution Hazard Ratio ($n = 935$)		
Round 1 Covariate	Hazard Ratio	Confidence Interval	p Value	Hazard Ratio	Confidence Interval	p Value
Fertility Preferences (ref. = wants in <2 years)						
Wants more children, in more than 2 years; or undecided	1.07	(0.66, 1.73)	.58	1.12	(0.75, 1.68)	.58
Wants no more children	0.89	(0.49, 1.61)	.89	0.96	(0.58, 1.59)	.89
Contraception Intentions (ref. = contraceptive user in Round 1)						
No intention to use	**2.13**	**(1.30, 3.56)**	**.01**	**2.26**	**(1.61,3.74)**	**<.01**
Intention to use	**2.15**	**(1.19, 3.81)**	**<.01**	**2.45**	**(1.32, 3.86)**	**<.01**
Method[b] (ref. = long acting)						
Short-acting	**2.09**	**(1.31, 3.35)**	**<.01**	**2.00**	**(1.34, 2.98)**	**<.01**
Age (ref. = <30 years)						
30–39 years	**0.61**	**(0.40, 0.93)**	**.02**	**0.68**	**(0.47, 0.98)**	**.04**
40 + years	0.65	(0.32, 1.30)	.22	0.74	(0.41, 1.35)	.33
Parity (ref. = 0–2 children)						
3–4 children	0.89	(0.58, 1.37)	.60	0.96	(0.69, 1.34)	.80
5 + children	1.25	(0.82, 1.92)	.29	1.40	(0.94, 2.07)	.09
Education (ref. = never attended)						
Primary	0.76	(0.47, 1.23)	.26	0.76	(0.47, 1.21)	.25
Secondary/university/ technical/ other/vocational	0.93	(0.52,1.64)	.79	0.95	(0.54, 1.67)	.86
Marital Status (ref. = currently married)						
Widowed/divorced/separated	0.56	(0.27, 1.17)	.12	0.62	(0.31, 1.24)	.18
Never married	1.26	(0.74, 2.16)	.39	1.52	(0.92, 2.49)	.10
Residence (ref. = urban)						
Rural	1.39	(0.93, 2.08)	.11	1.11	(0.68, 1.81)	.69
Wealth Quintile (ref. = lowest quintile)						
Lower quintile	0.89	(0.60, 1.34)	.59	0.91	(0.61, 1.36)	.64
Middle quintile	0.67	(0.40, 1.11)	.12	0.66	(0.41, 1.05)	.08
Higher quintile	**0.53**	**(0.30, 0.94)**	**.03**	**0.49**	**(0.30, 0.81)**	**.01**
Highest quintile	0.55	(0.28, 1.05)	.07	**0.58**	**(0.35, 0.96)**	**.03**

Note: Ratios in bold reflect statistical significance at $p<.05$.

[a] The analysis is restricted to episodes from women using at or after Round 1, excludes women self-reporting to be infertile, and adjusts for clustering by woman. Round 1 follow-up values are weighted for loss to follow-up using inverse propensity scores. The analysis uses Fine and Gray (1999) competing risk regressions where possible outcomes include censoring (never discontinue), discontinuation of contraception for any reasons except the desire to get pregnant (outcome of interest), or discontinuation due to desire to get pregnant (competing risk).

[b] Long-acting methods include female sterilization, male sterilization, IUD, and implant. Short-acting methods include injectables, pills, emergency contraception, male condoms, female condoms, standard days/cycle, lactational amenorrhea method, and other traditional methods. This grouping was made because of the small sample size.

users at baseline adjusted hazard ratio (AHR = 2.15, 95% CI = 1.29–3.56, $p < .01$), possibly because their intentions have been realized and now carry less influence. Episodes from women not intending to contracept but subsequently adopting a method also are more likely to end sooner than baseline users' episodes (AHR = 2.13, 95% CI = 1.19–3.81, $p = .01$). Note that baseline users, as the reference group, are experienced with contraception and are likely selected on unmeasured factors that can affect their proclivity to discontinue. The discontinuation rate models also include contraceptive method type used—long- versus short-acting—and discontinuation risk is significantly greater if a short-acting method is used (AHR = 2.09, 95% CI = 1.31–3.35, $p < .01$). Among the background covariates, women of older (30–39 years) relative to younger age (< 30 years) discontinue at a significantly slower rate, as do women in higher household wealth quintiles relative to the lowest quintile.

When taking the competing risk of a discontinuation due to a desired pregnancy into account, we find that SHRs are generally more pronounced than the CsHRs, but the differential patterns observed in the first panel remain. The associations with fertility preferences do not change; the association for intending users substantially shifts the hazard upward (SHRs of 2.45, 95% CI = 1.32–3.86, $p < .01$, and 2.26, 95% CI = 1.61–3.74, $p < .01$, for those not intending use). The elevated hazard among those with and without baseline intentions to use suggest that their subsequent adoption behaviors, including the type of method selected, alter the salience of the earlier motivations. As seen in the cause-specific hazard regression, the lower effectiveness of short- versus long-acting methods significantly shorten the duration of use (SHR = 2.00, 95% CI = 1.34–2.98, $p < .01$).

The relationships between fertility preferences and contraception intentions and adoption and discontinuation are graphically presented in Figures 1 and 2, which show the differences among the adjusted cumulative incidence curves (the competing risk regressions) and their relative patterns over time. Women's baseline fertility preferences do not significantly differentiate time to adoption, and those wanting no more children are slowest to adopt (Figure 1, panel a). However, women intending future contraceptive use at baseline adopt contraception significantly more rapidly (Figure 1, panel b).

Among all users, women's baseline fertility preferences do not differentiate time to discontinuation (Figure 2, panel a), and contraceptive use intentions among nonusers at baseline do not seem to influence time to discontinuation after they become users (Figure 2, panel b). Those who use contraception at R1 are the slowest to discontinue.

Discussion

This study aimed to assess the individual influence of fertility preferences and contraceptive use intentions reported in 2014 on subsequent contraceptive adoption and discontinuation, net of intervening pregnancies, by mid-2018 among a nationally representative sample of reproductive-aged women in Uganda. We sought to provide a better understanding of the consistency of women's fertility preferences and contraceptive use intentions with contraceptive behaviors over time, allowing for desired or accidental pregnancies to occur. These relationships are fundamental components in

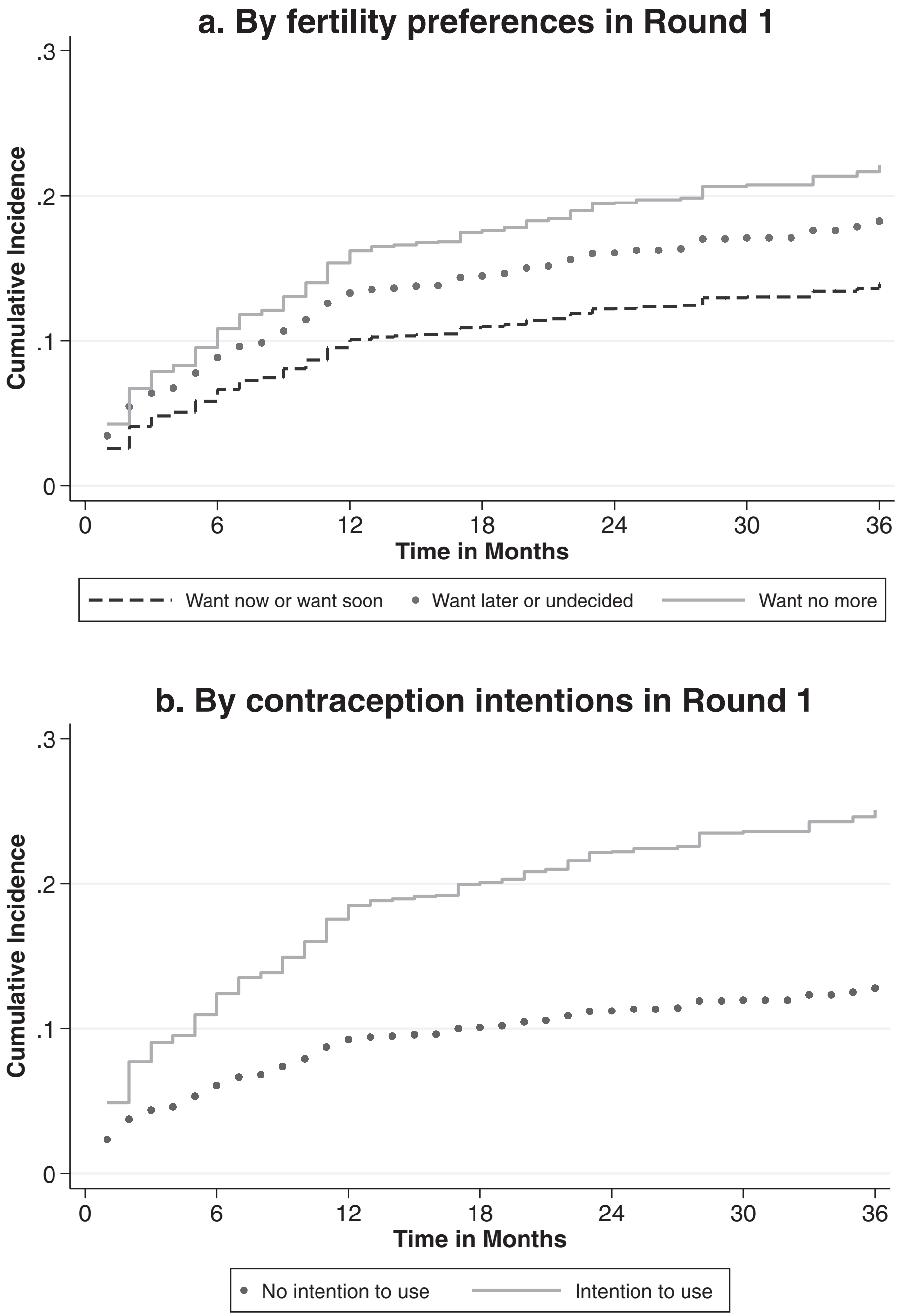

Fig. 1 Cumulative incidence of time to contraceptive adoption by Round 1 fertility preferences and contraceptive use intention, adjusted for competing pregnancy risk

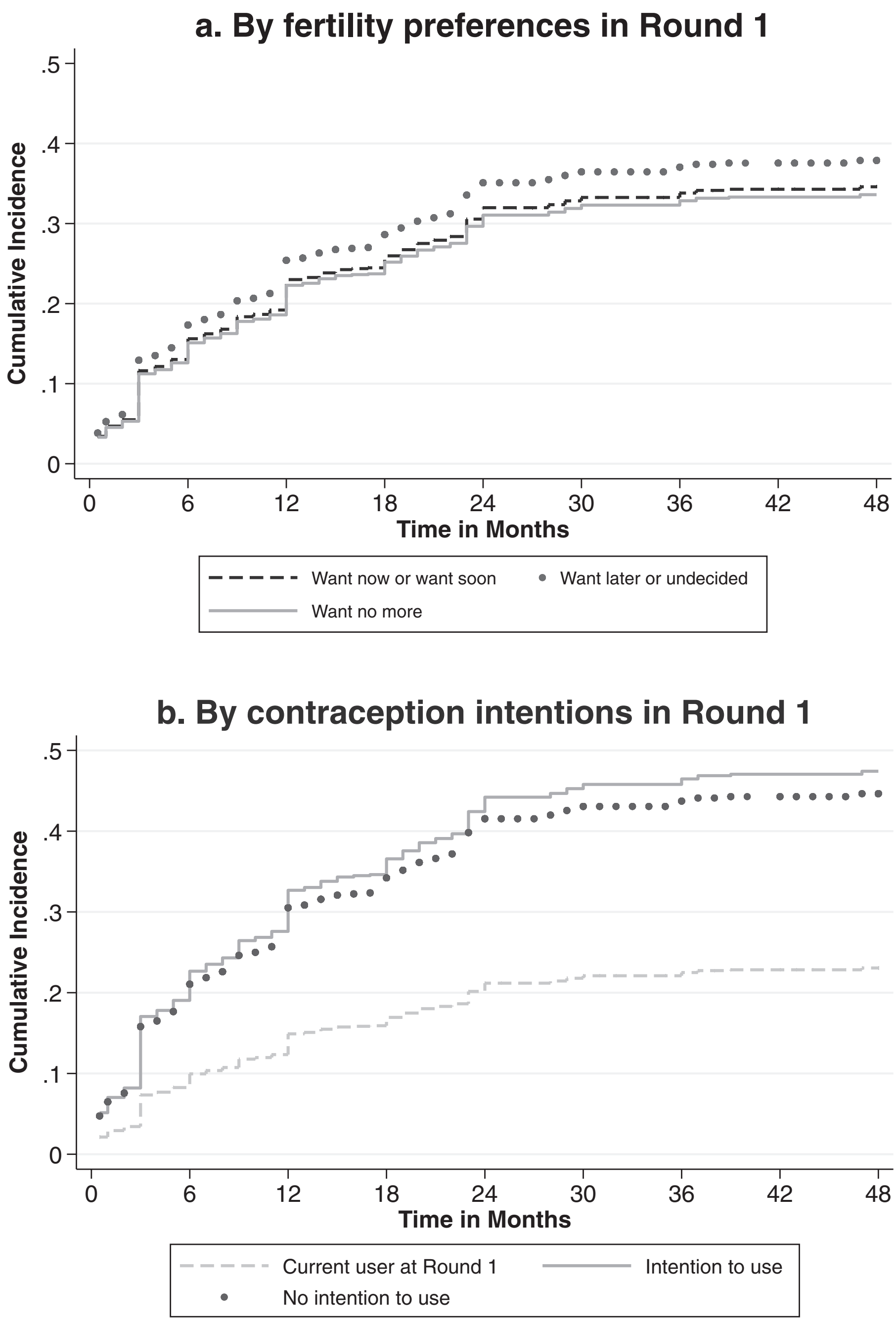

Fig. 2 Cumulative incidence of time to contraceptive discontinuation by Round 1 fertility preferences and contraceptive use intention, adjusted for competing pregnancy risk

the programmatic measure of unmet contraceptive need. We tested four hypotheses, finding empirical support, after adjusting for background covariates, for three in the expected directions: among nonusers, baseline fertility preferences for no more children are associated with earlier contraceptive adoption, although this association was not statistically significant but more robust when we allowed for competing pregnancies. Baseline intentions to use contraception are significantly associated with earlier contraceptive adoption but were mitigated when we controlled for pregnancy incidence. Third, among contraceptors, baseline preferences for no more children were associated with lower discontinuation than when children were desired soon, but this difference was not statistically significant; the associations were largely unchanged when we allowed for competing pregnancies. Our results did not support the fourth hypothesis of baseline contraceptive intentions and time of discontinuation. Compared with baseline contraceptors, women adopting after 2014 and especially those using short-acting methods, irrespective of intention status, discontinued more quickly. This finding suggests underlying short intervals of use and higher cumulative incidence after we adjust for termination to have desired pregnancies.

Although this last finding seems counterintuitive, it likely reflects the achieved contraceptive experience of those who adopted contraception at least once in the four-year period: their earlier contraceptive intentions were no longer salient after they became users, particularly of short-acting methods. The accelerated discontinuation risk may reflect short episodes of use given that in the study period, many women became pregnant, delivered, and then adopted contraception before being at risk of discontinuation. We conducted two types of sensitivity analyses to estimate the same models, first restricted to nonusers at baseline and next adjusting for contraceptive use following a preceding pregnancy (data not shown). In the first, we found no change in the strength of fertility preference associations with discontinuation risk. Relative to women not intending contraceptive use, those intending still showed greater discontinuation risk, but this difference was not statistically significant. In the second, those intending had a lower discontinuation risk compared with those not intending, among women who had a pregnancy before the first contraception adoption episode. This suggests that nonusers at baseline who intended to adopt may have done so postpartum for birth spacing. It further indicates that once contraceptive adoption has occurred, earlier intentions in either direction no longer predict duration of use. The type of contraceptive method selected also strongly and significantly influenced the discontinuation rate, with short-acting methods leading to faster termination than long-acting methods. We hypothesized that fertility preferences and contraceptive intentions would be concurrent factors; we captured only their partial additive effects on adoption and discontinuation behaviors. Our modeling results suggest that the consistency between contraceptive intentions with subsequent adoption is stronger than that for fertility preferences. Once achieved, those early contraceptive intentions do not prolong use more than in the absence of intentions to contracept.

These results inform the observed weak relationship between fertility preferences and subsequent contraceptive use and fertility found in SSA countries. In high-fertility settings, fertility desires are likely characterized by ambivalence and flexibility, as other studies have found. The absence of a strong and significant influence of reproductive preferences on contraceptive adoption and discontinuation risk is consistent with the temporal variation in women's childbearing desires observed in other longitudinal studies (e.g., Hayford and Agadjanaian 2017; Roy et al. 2003, 2008; Yeatman et al. 2013). Because fertility preferences do not remain static across individual women's lives, intervening life events, partner relationships, economic needs, and other contextual circumstances will shape ensuing motivations to time, space, or limit subsequent births. The relative instrumentality of contraceptive use for the woman will not necessarily parallel her fertility preferences (Curtis et al. 2011). Nascent contraceptive motivations, decisions, and behaviors may reflect inexperience and may not operate at the full level of use effectiveness, as might be found in low-fertility high-income countries. These motivations likely will vary with time as well, but studies with longitudinal measures of contraceptive intentions for low-income country populations are almost nonexistent. Our study suggests that women's ideation around contraceptive intentions, beyond fertility preferences, exercises a stronger influence on adoption and discontinuation compared with their reported fertility desires. This may reflect the disjunction between intentions and contraceptive use that Agadjanian (2005) and Speizer et al. (2013) referenced for predicting future wanted pregnancy. It is also possible that the consistency in the relationship between fertility desires and contraceptive prevalence levels is empirically stronger at the population level than at the individual woman level (see Bongaarts and Casterline 2018).

This study's design offers several strengths, including the scale of follow-up of a national sample of Ugandan females, the recent conducting of the survey in the mid-2018, the ability to examine reproductive motivations in the context of an ongoing fertility transition in an SSA country with nontrivial HIV acquisition risk, and the focus on contraceptive dynamics as opposed to use status. The inclusion of a pregnancy and contraceptive calendar enabled us to relate baseline reported fertility preferences and contraceptive use motivations to subsequent contraceptive adoption and discontinuation behaviors. Contraceptive use status reconstructed for the panel sample with the calendar data aligned closely with the panel's use profile over the four years. Likewise, 12-month discontinuation rates calculated with life table methods by method and reason (see Table A3 in the online appendix) were high and similar to those reported in the 2016 Uganda DHS for almost the same period. The dynamic modeling approach adjusted for pregnancy as a competing risk to contraceptive adoption and discontinuation to minimize biased estimation of outcome rates. Pregnancy as an accidental occurrence in the decision sequence leading to adoption is a well-known risk. Discontinuation of contraceptive use to achieve a desired pregnancy or after contraceptive failure has also been well established. For these reasons, pursuing a competing risk hazard regression for both outcomes is an appropriate modeling approach.

There are limitations to the study, the foremost of which is the loss of sample when the sample is followed up after four years and restricted to those original respondents who remained in place. Migration to urban areas is apparent, with cohort members being drawn largely from younger and rural respondents in 2014. Nonetheless, we calculated the individual-level correlation statistic for the panel observations ($\rho = .44$) and the required sample power ($n = 1{,}174$) to detect a 3% margin of error in the contraceptive prevalence estimate and also the effective sample size required for a hazard rate ratio comparison of two groups (0.75; $n = 1200$). In both cases, our sample size was adequate. Furthermore, the weighting adjustment for loss to follow-up restored the panel composition to approximate that for the original sample. The four-year interval, moreover, offers the needed temporal window during which to observe contraceptive adoption and discontinuation episodes as well as pregnancies. The low MCPR—at 20.9% among women ages 15–49 in 2014—inevitably constrained the number of observed adoption and discontinuation episodes for analysis despite the recent rise in use. A large proportion of the sample never adopted and thus did not contribute episodes for analyzing contraceptive dynamics.

Another limitation relates to our reliance on a five-year reproductive calendar instrument, which can be subject to recall bias (see Bradley 2016). Following DHS protocol, we used pregnancies to anchor contraceptive events during the calendar period, which assists in mitigating recall issues. However, we could not capture elective abortions accurately through the survey (see MacQuarrie et al. 2018). The induced abortion rate in Uganda in 2013 is estimated at 39 abortions per 1,000 women ages 15–49 (Prada et al. 2016), which suggests that this study should have detected 60 or so terminations rather than just the single one reported. The underreporting of abortion will bias the findings depending on how pregnancy outcomes are reported (94% of pregnancies in the calendar had live birth outcomes). Most likely, voluntarily terminated pregnancies were unreported, which would bias adoption rates downward and discontinuation rates upward. Despite the study's limitations, the panel's weighted results were robust and comparable with levels observed in later repeat surveys in the same areas, indicating that the gains in information outweigh the losses. These limitations also recommend improvements in longitudinal study design and measures that can enhance future research efforts to deconstruct the dynamic relationship of fertility preferences with subsequent childbearing and the mediating contributions from changes in contraceptive intentions and use dynamics.

This study offers new insights from a SSA country setting into the parallel movement of a cohort's fertility preferences and contraceptive use intentions over time, with both offering separate additive effects. At a time when social ideation around contraceptive use is still nascent in Uganda, women have a strong individual interest in spacing births. Recent studies on women's covert contraceptive use—that is, use without the partner's knowledge—in Uganda (Heck et al. 2018) and SSA (Choiriyyah and Becker 2018; Gasca and Becker 2018) suggest that discordant fertility desires between partners, negative community stereotypes, and financial insecurity are contributing factors. Individual demand for contraception nonetheless appears well established in Uganda as of 2014 and is increasingly realized through the adoption of short-acting contraceptive methods. Contraceptive discontinuation rates for short-acting methods exceed those of long-acting ones, irrespective of the woman's earlier fertility preferences or contraceptive intentions. Although women have been able to meet their individual demand for birth spacing through contraceptive adoption, our study findings suggest that the fertility transition in Uganda will progress slowly until women's reproductive preferences and contraceptive intentions are more closely aligned and fertility limitation becomes a more salient proposition for women and their partners. ■

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