The Determinants of Contraceptive Discontinuation in Northern India: A Multilevel Analysis of Calendar Data

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Abstract

Using contraceptive calendar data collected in a sample survey in a northern Indian state, we study the determinants of contraceptive discontinuation by reason and method. Reason-specific continuation rates differ significantly by method and source. With a multilevel, multinomial discrete-time hazard model, we find effects from socioeconomic wellbeing, age, parity, travel time, method access, method type and source on reason-specific risks for contraceptive discontinuation. Unobserved factors at the individual and community levels significantly affect contraceptive discontinuation by reason. Some shared unobserved risk factors across the competing alternatives are also present in the models.

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Introduction

Contraceptive use, as a proximate determinant of fertility, plays an important role in reducing fertility; and at times contraceptive prevalence has been used to evaluate the effect of family planning programs (Boulier 1985**).** Contraceptive use, however, is the consequence of contraceptive acceptance, method choice, continuation, switching and failure. As contraceptive use increases and becomes a more established behavior, prevalence is no longer a sufficient marker of program success (Jejeebhoy 1991).

Current contraceptive prevalence is the outcome of annual acceptance and the discontinuation rate. Jain (1989) has suggested both can be influenced by quality of service and demand factors and proposed that contraceptive continuation is more important than acceptance in increasing contraceptive prevalence. He identifies access to contraceptive method choice as a key element of service quality, one likely to increase contraceptive continuation and prevalence. By implication, then, it is important to assess the direct effects of contraceptive service delivery on various aspects of contraceptive practice, i.e., beyond prevalence.

Findings from recent studies indicate that contraceptive service availability, quality and community context significantly affect contraceptive behaviors. Magnani et al. (1995) find that family planning service availability and quality, integrated with maternal and child health programs, can significantly increase contraceptive use in Morocco. Service quality has been found to significantly affect current contraceptive use in Peru (Mensch, Arends-Kuenning, and Jain 1996). Adequate counseling on side effects can increase contraceptive continuation (Cotton et al 1992), and Entwisle et al. (1997) find village contexts in Thailand to affect contraceptive

method choice significantly. One study in northeast Brazil, however, finds service quality to significantly lower contraceptive use (Hotchkiss et. al 1995). Among several studies examining quality's influences on the continuity and dynamics of contraceptive use, Hossain and Phillips (1996) show household outreach in Bangladesh to have a pronounced positive net effect on contraceptive continuation. Steele, Curtis and Choe (1998) have found the extent of method choice in Morocco to raise rates of postpartum adoption of modern contraception and switching from pill to another modern method.

Most of these aspects of program service provision have been studied in terms of their effects on contraceptive use and to a much lesser extent on contraceptive continuation. Since high levels of contraceptive prevalence, outside of permanent method use, rely on extended practice of contraception, it is important to investigate the influence of socioeconomic, demographic and programmatic factors on continuation behavior. These factors' effects can reveal much not only about the personal motivations brought to bear in regulating fertility but also the adequacy of services provided. As family planning programs continue to expand and mature beyond the bounds of public provision, the dynamics of use in relation to service factors take on greater significance.

Our analysis will examine the effects of socioeconomic, demographic and service provision factors and method attributes on contraceptive discontinuation in a northern India state. It uses contraceptive continuation data collected in a three-year calendar included in a 1995 survey of married women of childbearing age conducted in Uttar Pradesh. We employ multilevel, multinomial discrete-time hazard models to estimate the effects of service quality and access on discontinuation, the latter differentiated by the reason for stopping. The multilevel approach allows us to control for unobserved heterogeneity at individual and community levels.

The present study aims to contribute on several fronts, first addressing substantive gaps in our understanding of sources of variation in contraceptive continuation behavior. Second, at a methodological level, the study treats reasons for discontinuation as separate but simultaneously competing risks, more closely approximating real life conditions. In addition, the modeling accounts for possible effects of unobserved factors at the individual and community levels. These statistical improvements together enhance the scientific validity of the findings. Last, the study setting is a populous northern Indian state, where contraceptive prevalence is comparatively much lower than in south India, such that the study's results may be informative to statewide efforts to improve contraceptive service delivery.

Uttar Pradesh, India and Contraceptive Service Delivery

Uttar Pradesh (U.P.), located in north central India, is the most populous state in India with about 150 million persons and an annual growth rate of 2.3 percent. The state is densely populated at 473 persons per square km, compared to 273 for India as a whole, but ranks fourth in area among states, covering less than ten percent of India's total land surface. Judged by socioeconomic terms, Uttar Pradesh is also one of the least developed states in India when measured by the percentage of population living in urban areas, percentage of households with electricity, literacy rate among the population aged seven and above, infant mortality rate and household income. U.P. also has a varied topography and its residents observe diverse social and cultural practices and traditions.

The fertility level in U.P. is 36 births per 1000 population, which is higher than the national rate of 28.7; the total fertility rate is about 4.5 children per woman. Current use of modern contraceptives among married couples of childbearing age is estimated at 25.1 percent in 1995 (State Innovations in Family Planning Services Project [SIFPSA] et al., 1996), compared to a

national 40.6 percent (International Institute for Population Sciences, 1995). Contraceptive use in urban areas is approximately twice that in rural areas. Among U.P. childbearing-aged couples using contraceptives, nearly 60 percent are sterilized, while another 24 percent use other modern methods, such as IUD, pills and condoms.

In U.P., public facilities are the major source of contraceptive services. According to the PERFORM Survey (SIFPSA et al.1996), 74.2 percent of current users report obtaining services from public, 14 percent from commercial and 11.8 percent from private facilities, respectively.[1] Pills, condoms and IUDs are the most widely offered methods across all public facilities. On average, 85.9 percent of public facilities provide IUDs, and more than 95 percent provide oral pills and condoms. Only 14 percent of public facilities provide sterilization. Non-governmental facilities, including both private and commercial ones, have different patterns of service provision. More than 50 percent of private facilities provide sterilization, 73.4 percent provide IUDs, and only around 40 percent provide oral pills and condoms. The 1995 survey also found that the quality of service varies across public and non-public facilities. Nearly one-third of non-governmental facilities (32.2 percent) have experienced a shortage of contraceptives in the past year, as compared to 45 percent of public facilities. Both public and private sector providers possess modest knowledge about contraceptives—39 percent of public and 34 percent of private providers are able to report contraceptive use regimens and side effects correctly.

[1] Public sources include government hospitals, clinics, community health centers, primary health centers, sub-centers and urban welfare centers. Private sources include private hospitals and clinics, including those run by voluntary organizations and industry. Commercial outlets cover medical shops, general merchant and small retail (*kirana* and *pan*) shops.

As only a minority of contraceptors use spacing methods, the government family planning program has recently committed to increasing demand for and improving the largely poor quality of services for these methods. The government program has traditionally favored permanent contraception and done little to encourage contraceptive service delivery by the private sector. Uttar Pradesh lags behind states in the south, such as Kerala, Tamil Nadu and Maraharastra, in addressing components of service quality, such as public information, client counseling or staff training, in government family planning services. Investigating the relative importance of determinants of contraceptive continuation behaviors can be informative to recent efforts aimed at improving services.

Methodology

Data. The data used in this analysis are derived from the PERFORM Survey conducted in Uttar Pradesh's 14 divisions from May to September 1995 (SIFPSA et al., 1996). The design for the PERFORM Survey was a systematic, multi-stage cluster sample of household and facilities that allowed for district, division and state level estimates. At the first stage, two districts were selected from each division probability proportional to size (PPS). Within districts, urban blocks and villages were stratified by population size and systematically selected using PPS. In the selected 1539 villages and 738 urban blocks, households were mapped and listed. Fifteen households per village and 20 households per urban block were then systematically selected. Interviews were sought with heads of 42,006 households (achieving a 97 percent response rate with 40,633 households) to collect information on the demographic and socioeconomic characteristics of de jure and de facto residents. Interviews were next sought from 48,022 eligible women in the households, with eligibility defined as being currently married and between the ages of 13 and 49. A response rate of 94 percent was reached, with 45,262 women

interviewed.[2] De facto resident women were asked about their background, knowledge of family planning services, current and future use of family planning, and fertility and contraceptive history in the previous three years. A three-year contraceptive history (June 1992 to May 1995) was collected for each woman who, or whose husband, was not sterilized at the calendar's start. The data were recorded in a calendar matrix, consisting of rows and columns. Each row of the calendar represents a particular month. Column 1 was used to record monthly pregnancy status, column 2 marked when contraception was used, column 3 recorded the source of contraception when an episode began[3], and the last column recorded the reason for contraceptive discontinuation whenever it occurred.[4]

Goldman, Moreno and Westoff (1989), Strickler et al. (1997), and Curtis (1997) have determined that contraceptive calendar data can be of fairly good quality and are easier to obtain than with a prospective design. In particular Strickler et al., comparing reports from contraceptive calendars of a panel of Moroccan women gathered three years apart, note relatively high levels of consistency. Consistency increases where contraceptive histories are not complicated by multiple method episodes. As will be seen later, 90 percent of women in the analysis contributed only one episode and eight percent two episodes that lead to discontinuation. Given the limited use of spacing methods, errors of omission are likely to be small among this sample.

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[2] The survey also selected health facilities and private providers in relation to cluster size. Further detail on the sample design is available in Singh et al., 1997.

[3] An episode is defined as the start and end of contraceptive use during the calendar period or continued use at the time of the survey

[4] A reason was recorded also when the woman switched to another method; the observed number of switches was relatively small.

Like other event history data, contraceptive history data collected with the calendar approach have full duration, as well as right-censored, episodes. Life table and other proportional hazard models can be used to analyze these kinds of data (Steele and Choe 1997). However, left-censored durations also occur in some first episodes in the calendar. For example, an episode of contraceptive use that begins before the start of the calendar and continues through or terminates before the end of the calendar introduces left censoring that can be potentially problematic. Although such an episode ends with an event, its duration is still censored because the timing of the preceding event is unknown. This is one of the major methodological concerns for studying contraceptive continuation, since the risk of discontinuation may be different early than later in the episode.

In this analysis, we exclude the initially left-censored episodes, which according to Allison **(**1984), Curtis (1997), and Steele, Curtis and Choe (1998) do not bias the estimates. The total number of women included in this analysis is 2,307, and the number of episodes of modern method use (IUD, pill, and condom) observed during this period is 2,623.[5] About ten percent of women experience more than one spell or episode during the three-year period.

Variables. The dependent variable used in this analysis is reason-specific discontinuation of contraceptive use.[6] Women may stop using contraception due to failure (accidental pregnancy), non-method related reasons, access or availability problems, and method-related problems. The dependent variable is thus a five-category variable as defined in Table 1.

The analytic objective is to assess the net effects of service characteristics on reason-specific

[5] Recall that contraceptive prevalence overall in U.P. is low, dominated by female sterilization, such that use of IUD, pill and condoms is comparatively modest.

[6] Discontinuation is defined as beginning contraceptive use and terminating for any reason during the calendar period June 1993 to May 1995.

contraceptive discontinuation, controlling for individual social, demographic and economic factors. The explanatory variables of interest in this analysis are those related to service contexts, as best can be measured from the available data. These include the choice of methods reported by the woman to be available at the nearest facility and her reported travel time to the nearest family planning facility. Travel time to family planning services is also recognized as an important component of contraceptive availability (Rodriguez 1978; Hermalin and Entwisle 1985) and its effect on contraceptive behavior has been assessed in many studies.

Table 1 about here

In the survey, each woman is asked a series of questions about her perceived access to pill, condom, IUD, and sterilization services: "Tell me all the places you know that provide this kind of method;" "What is the nearest source for the method?" "Where is this source located?" "How far is this place from where you live?" and "How long (in minutes) does it take to reach this source?" We first identify the nearest place using travel time. We then determine the number of contraceptive methods available at this nearest location.[7] In addition to travel time and method available at the nearest facilities, we also include a third measure of service provision--source of contraception. This variable is the source used for each episode of contraception. We assume that different types of outlets provide different quality of services and that this may affect contraceptive discontinuation.

We also include the type of contraceptive method used because method and source choice may jointly determine continuation rates. Type of source may endogenously determine the

[7] The number of methods available from the nearest provider will underestimate the total supply of available methods for women in proximity to multiple sources. The bias is not likely to be large for rural women, where most have access to only one provider in their immediate area, e.g., a government subcenter that dispenses one or two methods (pills and condoms). Primary health centers additionally provide IUD insertions and, along with other private or commercial providers, are more proximate to women residing in towns or cities.

choice of method; conversely, the type of method preferred may determine the type of source used (see Akin and Rous, 1997). Because the required dynamic structural equation model with multilevel error components impose rather intractable estimation requirements, we assess the effects of these two variables with nested models. We estimate the model with source choice first and then fit the same model by adding in contraceptive method used. If the model's parameter estimates do not change appreciably with the inclusion of method used, we can feel reasonably safe inferring that both source and method choice have relatively independent effects on continuation rates.

To control for selective knowledge and use of contraceptive services, several socioeconomic and demographic variables at the individual or household level are included in the model. The woman's age and educational attainment, and household assets are chosen to measure individual socioeconomic status. Number of living children, as of June 1992, is used to control for the effects of childbearing on contraceptive continuation. Place of residence is also included both as a socioeconomic measure and to control for the differential availability of family planning services. More detailed information on the definitions of the explanatory variables is provided in Table 2.

Table 2 about here

Analytic methods. Proportional hazard modeling is often used to analyze duration data. However, for studying contraceptive discontinuation, conventional hazard models have some limitations because of competing risks of discontinuing use. As previous studies have determined, one must take into account the reason for contraceptive discontinuation because its risk will vary from one type of reason to another, i.e., the same factor may affect the risks in different ways. The reason for discontinuation, to a considerable extent, is more important than

the duration of contraceptive use.

Duration data with repeated events during the observed period introduce additional problems to conventional hazard modeling. One can analyze the event duration separately, but this is statistically inefficient because the process is essentially the same across successive events. Another approach to dealing with repeated events involves pooling these events over all individuals. This, however, violates the assumption that multiple events must be statistically independent for each observation.[8] Flinn and Heckman (1982) propose introducing a random disturbance term as a way to relax the assumption of independence across events.

Steele, Diamond and Wang (1996) have proposed using multilevel, multinomial discrete-time hazard models as an alternative approach to analyzing contraceptive discontinuation with competing risks. By categorizing the duration of each woman's episode into intervals, one obtains a hierarchical structure of intervals at the first level and individuals at the second level. By adding a random error term at the individual woman level, one is able to allow for both correlated episodes and unobserved heterogeneity at this level. This approach permits a reasonable strong analysis of contraceptive discontinuation.

[8] For event history data on contraceptive use, this violation can be serious because a woman's past experience with contraception influences discontinuation. For example, women with less experience may discontinue use more than once during an observed period. Ignoring this pattern can overstate the significance of estimated effects of risk factors by biasing the standard errors downward.

The data used in this analysis are taken from a survey designed with multi-stage cluster sampling. Failure to consider the clustering feature may result in biased standard errors for the estimates as well. Therefore, we employ a three-level multinomial discrete-time hazard approach to study the determinants of contraceptive discontinuation. In this model, interval is regarded as level one, the individual woman as level two, and the primary sampling unit (PSU) as level three (also labeled as community level hereafter). We are thus able to consider the effects of both sample clustering and unobserved factors at the community level, such as the density of outlets in each village or urban block, on the risk of discontinuation for various reasons.

In the multinomial competing-risks model, all cases (episodes) of continued use at the time of interview, i.e. right-censored cases, are treated as the reference category. The risks of each type of discontinuation relative to the risk of continued use can be estimated simultaneously with the MLn package (Yang, Goldstein and Rashbash 1997). In the model, five components affect an individual woman's risk of contraceptive discontinuation: a baseline hazard, socioeconomic characteristics, service availability from the client's perspective, the random effects of unobserved variables at the community level, and random effects of unobserved heterogeneity at the individual level. The equation of the model we estimate in this analysis can be written as:

$$\log\left(\frac{p^{r}_{kjit}}{p^{(0)}_{kjit}}\right) = a^{r} + D^{r}_{kjit} b^{r} + X^{r}_{kji} g^{r} + m^{r}_{kj} + d^{r}_{k}$$

Where,

Subscripts k, j, i, t denote community, individual woman, episode and time interval, respectively;

r = 1,2,3,4 is the type of reason for discontinuation and 0 is continued use or the censored category;

p^{r}_{kjit} is the probability of the i-th episode of a woman j in community k discontinuing use in interval t due to reason r;

$p^{(0)}_{kjit}$ is the probability of continued use at the end of the interval t for the i-th episode of a woman j in community k;

α^r = the constant corresponding to each discontinuation reason *r*;

D^r_{kjit} = the duration effect to be modeled, these are categorical variables representing the different time intervals (1-2, 3-6, 7-12, 13-18, and 18+ months);

β^r = the vector of parameters for reason r to be estimated corresponding to each time interval;

X_{kji} = the Covariates at the episode level for woman j in community k, including reported service factors for each episode, socioeconomic status, demographic variables;[9]

γ^r = the vector of parameters for reason r to be estimated corresponding to the socioeconomic, demographic and reported service factors at the individual level;

μ^r_{kj} = the random effect for reason r at individual level within community k; and;

δ_k^r = the random effect for reason r at the community k level .

[9]For multiple episodes within individuals, each episode is assigned the same socioeconomic or demographic status as at the woman level. We assume that these factors, such as education, residence, household assets, and number of children, do not change or change very little across episodes during the calendar period (June 1992 to May 1995).

m_{kj} is a vector of random variables at individual level, while δ_k is a vector of random variables at community level. m_{kj} and δ_k are assumed to follow a multivariate normal distribution with mean **0** and variances Ω_μ, and a multivariate normal distribution with mean **0** and variance Ω_δ respectively;. Ω_μ and Ω_δ are the variance-covariance matrices corresponding to two types of random variables at the individual and community levels; **0** is the vector of means for random variables at community or individual level.

To analyze duration data with discrete-time hazard modeling, we must rearrange the data structure, resulting in a dramatic increase in sample size. Categorizing the episodes into intervals offers a tradeoff between the intervals and the sample size expected for analysis. Wider intervals may waste some information; shorter intervals will result in larger sample sizes. Steele, Curtis and Choe (1998) have suggested that a three-month interval is better for studying pill use. However, in this analysis we have grouped the episodes into five unequal intervals, 1-2, 3-6, 7-12, 13-18, and 19 months or more, and assumed a constant hazard in each interval. This is because the risk of discontinuation tends to change quickly in the early stages of use and remain stable thereafter.

Fitting a multilevel, multinomial model is computationally intensive, especially with a large sample size, and convergence problems may be encountered . To avoid this problem, Begg and Gray (1984) and Steele, Diamond and Wang (1996) suggest fitting several pair-wise binary logit models instead, as no significant difference has been found in the results of these two kinds of modeling methods. Unlike the multinomial logit model, however, fitting the pair-wise models does not allow easy estimation of the covariance matrices for random errors at the individual or community levels. These calculations are very important for studying the determinants of

contraceptive discontinuation and should not be ignored. Consequently, we present the results fitted with multilevel, multinomial model estimated with a first-order Penalized Quasi-Likelihood (PQL) procedure in the MLn package.[10]

Results

Descriptive analysis. We have a total of 2,623 eligible episodes from the calendar data contributed by 2,307 non-sterilized, contracepting women. Table 3 presents the distribution of women by the number of episodes they experienced. We see that 10.5 percent of women experienced more than one episode during the three years observed. Eight percent of women have experienced two episodes. In terms of episodes, 78.8 percent are order 1, while 14.3 percent are order 2, and 6.9 percent order 3 or higher. Successive episodes within each individual woman also mean that they are not independent, which may be the result of unobserved factors, such as previous contraceptive experience or biological factors. This requires that a random error term be considered at the woman's level, so as to identify any such unobserved effects.

Table 3 about here

[10] Goldstein and Rasbash (1996) show that PQL procedures can largely eliminate the bias for binary response models in the situation described by Rodriguez and Goldman (1995) and that second-order PQL procedures may produce the most accurate estimates within the MLn package. For multinomial response models, Yang (1997) shows that both the first- and second-order PQL procedures can improve estimates almost equally well, yielding reasonably unbiased estimates for fixed effects and slightly (downwardly) biased estimates for random effects at level 2. Unfortunately, we encounter convergence problems in estimating the model with second-order PQL procedures. Rodriguez and Goldman (1997) identify alternative estimation techniques, but these are computationally intensive, require customized software and may not be usable for three-level multinomial models. Therefore, despite the slight bias in estimated random effects, we have opted for the first-order PQL approximation available in MLn.

The condom is the most often used method, accounting for 50 percent of the episodes, while IUDs and pills account for 17.9 percent and 32.8 percent, respectively (see Table 2). Of the 2,623 episodes, 900 (34 percent) terminate for a range of reasons. Among the discontinued episodes, half end for non–method related reasons (452/900) and 29 percent for method related reasons (262/900) with the remainder ending for failure or access related reasons

Table 4 reveals whether women discontinue contraception for the same reason more than once. We see that overall some 15 percent of women (115/742) experienced multiple discontinuation episodes, and 18 percent of women (64/362), who discontinued use for non-method related reason, experienced multiple discontinuation. Among women with multiple discontinuations, more than half (64/115) discontinue for non-method related reasons (desiring a pregnancy or changing marital status), suggesting that a high proportion of U.P. women using temporary contraceptive methods do so to space their births. Method-related reasons, including side effects and health concerns, are the next most frequently cited type; 26.1 percent of women (30/115) who experienced multiple discontinuation terminate for this reason.

Table 4 about here

Contraceptive discontinuation may vary by method and source of services. The IUD requires little user intervention and usually has a higher continuation rate than the pill and condom. In Figure 1 we see that continuation rates among IUD, pill and condom users in U.P. vary, and the Log-rank test for the continuation function is significantly different ($\chi^2(2)=183.05$, $p<0.01$). Four-fifths of IUD users continue use for up to 20 months; only 50 percent of pill users continue for up to 10 months.

Figure 1 about here

Continuation rates also vary significantly by the source of contraceptives ($\chi^2(2)=24.97$, $p<0.01$). Figure 2 shows the continuation rate at 24 months for women served by private facilities is 66 percent as compared to 50 percent for public facilities and 43 percent for commercial outlets (which primarily provide condoms and pills).[11]

Figure 2 about here

Multiple decrement life table analysis. Since the risk of discontinuation varies for several reasons, couples who discontinue contraception due to one reason simultaneously avoid the risk of discontinuing for other reasons. Using multiple decrement life table analysis, we calculate the continuation rates by eliminating specific causes of discontinuation, as shown in Figure 3. We see that eliminating two reasons for discontinuation (non-method related or method-related) can increase the overall continuation rate considerably.[12] Thus, among the four types of reasons, non-method related and method-related reasons appear to be the main causes of contraceptive discontinuation.

Figure 3 about here

Based on life table analysis, the median duration of contraceptive use in U.P. is 22.6 months during the observed period. This means that 50 percent of couples, who begin using contraception in the observed three-year period, can be expected to continue use for up to 22.6 months until discontinuing for one of four types of reasons. The overall median duration can be expected to be longer by eliminating the specific reasons of discontinuation. Eliminating the

[11] A slightly higher proportion (44.3 percent) of women served by the private sector use IUDs as compared to the public sector (32.6 percent). Couples served by the commercial sector tend to be disproportionately condom users (66.8 percent).

[12] The lx is the observed overall continuation rate of contraceptive use; and lx(-1), lx(-2), lx(-3) and lx(-4) are the continuation rates after eliminating specific causes--failure, non-method related reason, access problems and method-related reasons, respectively.

causes of failure and access problems for discontinuation can increase the median duration from 22.6 months to 25.1 and 25.8, respectively. Eliminating non-method related and method related reasons for discontinuation increases the median duration even more. We see from Figure 3 that 61 percent and 52 percent of couples can be expected to continue use for up to 36 months, after eliminating non-method related and method related reasons respectively. This suggests that contraceptive access and availability may be less important than side effects or health concerns as priorities for service quality improvements.

The effects of use duration

Table 5a presents the parameter estimates for the multilevel multinomial logit model with socioeconomic, demographic and reported service variables. It shows that the effects of use duration on discontinuation vary with the type of reason for terminating. Compared to the reference group with use duration of more than 18 months, contraceptors within the first half year of use are significantly less likely to discontinue for reasons of failure and, if within the first year of use, for non-method related reasons. The risk of failure increases dramatically after the first two months of use. This may be due to a delay in detecting the pregnancy in the initial months (Steele, Diamond and Wang, 1996). The risk of discontinuation for non-method related reason increases significantly after one year of use. This is to be expected since the termination is intended, either because the woman sought pregnancy or was no longer exposed to the regular risk of pregnancy (spousal separation or marriage dissolution). However, use duration does not appear to be a significant determinant of the risk of discontinuation for either reasons of access or those related to the method she was using (e.g., experience with side effects, health concerns, or inconvenience).

Table 5a about here

The effects of socioeconomic and demographic factors

The socioeconomic variables, place of residence and household assets, both have significant effects on discontinuation for non-method related reasons, but have no significant effects relative to the other reasons. We find that the risk of discontinuation for non-method related reasons is greater if a couple lives in a rural, rather than urban area and is lower if they own a motor vehicle and a television. The wife's level of education is not a significant determinant of discontinuation for any type of reason, except marginally where women with 6-10 years of education, relative to those with no education, are less likely to terminate their use for reasons of access. The lack of educational differentials in contraceptive discontinuation is consistent with those seen in other studies (Ali and Cleland 1996; Curtis and Blanc 1997).

Demographic factors also play a significant role that varies by the reason for discontinuation. The woman's age significantly lowers the probability of discontinuing at ages 21-31 and 32+ years, relative to those aged 20 and under, for non-method related reasons only. This is understandable since younger women will terminate contraceptive use to have planned pregnancies. Increasing parity tends to motivate women to continue contraception. Parameter estimates are increasingly negative and statistically significant for number of living children 2-4 and 5+, relative to 0-1, for discontinuing due to failure and at the 5+ level for non-method related and access reasons.

The effects of travel time, method choice and source type

The service variables examined for their effects on reason-specific discontinuation are reported travel time to the nearest facility, methods available at the nearest facility and source type. All show significant effects on discontinuation for one or more reason.[13] The risk of discontinuation for non-method related reasons (e.g., a planned pregnancy) is lowest at 31-60 minutes, and then five or fewer minutes. Given the uniformly negative effect that reported travel times under one hour have on discontinuation and given that eliminating the non-method related reasons for discontinuation can mostly increase the overall duration of use, it is possible that these effects are being observed for a fairly select group of women. It seems likely that U.P. women who are able to plan pregnancies with contraceptive use also perceive services to be within reasonable travel times. Increased travel times to the nearest facility, particularly between 31 to 60 minutes, slightly increases the risk of discontinuation among women who cite access as the reason.

The choice of methods has been argued to be a key element in defining service quality; and it has been hypothesized that expanding the choice of methods is not only important for meeting individual needs but also for achieving better results in demographic terms (Jain 1989). We only observe statistically significant effects from the number of methods available at the nearest facility on the risk of discontinuation for method-related reasons, and here the direction of effects is positive. The risk of discontinuation is greater at two (est γ=0.479, $p < 0.10$) and three or more methods (est $\gamma = 0.763$, $p < 0.01$), relative to one method. Because these are levels of available

[13] These results should be interpreted cautiously since we do not use objective, but rather reported, measures of service delivery. The perception of service delivery can be endogenously determined by individual characteristics. However, since our motivation here is to understand these perceptions of service factors in relation to immediate decisions about continued use, rather than testing their effects at the stage of initial adoption, these results can be informative.

methods reported by a select group of U.P. women who use modern contraception, it is conceivable that their awareness of method access influences their willingness to terminate following a dissatisfying experience. Those with access to two or more methods also have access to other providers in the area. Jain (1989) has suggested that increased method availability across sources can increase method switching, enabling more contraceptive discontinuation. Our results would be consistent with this interpretation.

The type of source for contraceptive services also has a significant effect on the risk of discontinuation. Couples who obtain contraceptives from commercial sources are more likely to discontinue for all except method related reasons. The risk is greatest for non-method reasons, that is, when the woman seeks to become pregnant (est $\gamma = 0.608$, $p < 0.01$). On the one hand, this suggests again that users with adequate contraceptive experience to terminate for a planned pregnancy are also self-sufficient enough to acquire their supplies commercially. On the other, because commercial outlets dispense only the pill and condom, these methods are also more easily discontinued than the IUD. By comparison, contracepting women who discontinue for method-related reasons, that is, those who experience side effects or have health concerns, are less likely to discontinue when they obtain their services from private sources (est $\gamma = -0.517$, $p < 0.05$) or commercial ones (est $\gamma = -0.252$, n.s.). Private sources may provide better services through the amount of information and counseling they give. More likely, though, is the fact that contraceptors using private and commercial services probably paid for their services, suggesting stronger motivation and a disincentive to arbitrary discontinuation.

The effects of source type on discontinuation may be conditioned by the type of method adopted. The type of method used during the episode may also influence the effects of other variables in the model. The estimation of their separate simultaneous effects on discontinuation

risk is computationally intensive, especially in a multilevel, multinomial discrete-time structure. Our approach is to re-estimate the model and include the variable, method used (pill, condom, with IUD as the reference category). Table 5b shows that relative to IUD users, pill contraceptors are the most likely to discontinue for any type of reason but particularly for access-related ones (est $\gamma = 2.726$, $p < 0.01$). Condom users are also more likely than IUD users to discontinue for access-related reasons (est $\gamma = 2.136$, $p < 0.01$).

With the inclusion of the type of method used, the estimated parameters for other factors in the model neither change appreciably nor in terms of statistical significance. However, the effect of commercial source on discontinuation across all reasons declines. Once the type of method is taken into account, the risk of a woman discontinuing contraception due to side effects or health concerns, when served by either private or commercial sources, is even lower. The risk of discontinuation for all reasons, except access ones, tends to decrease if the contraceptor obtains her services from a private provider, although the magnitude of the effect is not always statistically significant. It seems then that the constrained distribution of certain methods (pill and condom) through commercial and private providers does introduce joint effects from method and source used on reason-specific risk of discontinuation. The findings suggest also, though, that commercial and private providers offer important opportunities to augment statewide services for contraception by addressing preferences and needs of experienced contraceptors.

The type of contraceptive method used appears, therefore, to be an important determinant of the likelihood of discontinuation, and its effects vary by reason. At an earlier stage of this analysis, we attempted to fit method-specific models of discontinuation but were unable to complete this due to inadequate sample size. These models incurred greater unreliability of parameter estimates due to higher standard errors. We also estimated, a single-level multinomial

logit procedure using the STATA 5.0 package with the same model specification to determine if any interaction existed between method and any of the identified determinants. However, no significant evidence of interaction was found, suggesting it was not necessary for us to fit the model by method. Largely consistent and stable results in Tables 5a and 5b also confirm this.

Table 5b about here

Unobserved heterogeneity

We observe significant random effects at both community and individual levels for some, if not all, types of discontinuation. Moreover, correlation exists between some of the random error terms. At the individual level, significant random effects are found for all types of discontinuation reasons (see Table 5b). This indicates that each type of discontinuation reason may have its own unobserved factors affecting the risk of termination. These unobserved factors may or may not be the same across all competing alternatives. Steele, Diamond and Wang (1996:15) point out that the "full multinomial approach in the single-level situation has a potential disadvantage in that most multinomial logit programs require the same set of covariates with the same functional form to appear in the linear prediction for each contrast with the reference group." Thus, it may result in an under-specification of the model, at least for some if not for all response categories to relative to the baseline. This kind of under-specification can be more easily detected if fitted by a multilevel modeling approach.

Statistically significant individual level correlation is found between the random disturbance terms for non-method related and access reasons and between the random-disturbance terms for failure and method related reasons. This strongly suggests the presence of the same unobserved factors affecting discontinuation for non-method related and access reasons, as well as for failure and method related reasons. Hill, Axinn and Thornton (1993) discuss the possibility of shared

unobserved risk factors across competing alternatives in a discrete-time competing risk model. Our findings in this analysis empirically support their contention.

The significant correlation between unobserved factors for failure and method related discontinuation at the individual level suggests considering factors such as previous contraceptive experience and biological or fecundity factors as potential sources for the shared unobserved heterogeneity (Steele, Diamond and Wang 1996)**.** Women with less contraceptive experience or higher fecundity may encounter more problems (accidental pregnancy or side effects) after starting an episode of use observed in the calendar period. They may also contribute more than one short spell. In contrast, women with more contraceptive experience may contribute only one long episode of use due to lower risk of discontinuation. The correlation of random effects is negative for non-method related and access reasons, while positive for failure and method related reasons. They clearly suggest a need to better understand the determinants of contraceptive continuation in order to better model their dynamics.

At the community level, we find significant random effects for discontinuation due to non-method related and method related reasons. These random error terms are also significantly correlated. There may be unobserved factors of service availability and quality, as well as social development, at the community level jointly affecting these two reasons for discontinuation. For example, a woman who lives in the community where there is poor availability or quality of contraceptive services may have a higher likelihood of discontinuation for reasons of wanting to become pregnant since she may have a high desired number of children. Correspondingly, a woman who lives in the same community and has previously used contraceptives may have higher likelihood of discontinuation from side effects due to exposure to poor quality services.

Summary and discussion

This analysis has shown that the effects of determinants of discontinuation among married, non-sterilized contracepting women in Uttar Pradesh, India vary by the type of reasons. Overall contraceptive prevalence in this large populous state is low, estimated to be only 25% with three-fifths of contraceptors using permanent sterilization, a method favored by public sector providers. Contraceptors of modern temporary methods (pill, condom and IUD) tend to be somewhat better educated, of lower parity, and more urban than the average U.P. contraceptor. One half of the observed discontinuations occurred due to non-method related reasons (seeking pregnancy or experiencing a change in marital exposure to pregnancy risk). These contraceptors tend to use for more than a year and primarily for the purpose of birth spacing. The next most frequently reported discontinuation reason was method related (side effects, health concerns, and inconvenience) and then access related. Method-specific continuation rates show, not unexpectedly, the highest continuation levels for IUD and the lowest for condom users. Contraceptors obtaining services from private providers (clinics and hospitals) had the highest continuation rates, while those served by the public sector and commercial outlets (which dispense only condoms and pills) had similarly low levels. Multiple-decrement life table analysis revealed that the overall continuation rate could be raised substantially by eliminating discontinuation due to non-method and method related reasons.

Applying a multilevel, multinomial discrete-time hazard model allows us to analyze the effects of selected socioeconomic, demographic and service delivery factors, as well as use duration and method type, on the risk of discontinuation by reason. This modeling approach permits us to adjust for correlations between repeated episodes contributed by single individuals and for random effects from unobserved variables at the individual and community levels on the

competing risks for discontinuation. The socioeconomic determinants of residence area and household assets yielded largely expected results of urban residence and higher economic wellbeing (judged by ownership of a motor vehicle and television) decreasing the risk of contraceptive discontinuation. These were statistically significant only for non-method related reasons, implying that couples in urban areas or with higher economic wellbeing may prolong their birth intervals, as well as have smaller families, thereby reducing the probability of discontinuing for a planned pregnancy. Woman's education did not show any statistically significant effects for any type of reason, a finding consistent with those from other studies (Ali and Cleland 1996; Curtis and Blanc 1997).

The analysis estimated the effects of travel time, number of contraceptive methods at the nearest facility, source and method type on discontinuation risk. The first two measures are based on women's reports and subject to bias from prior contraceptive experience or service exposure. Travel times shorter than one hour significantly lowered discontinuation risks, primarily for those stopping for non-method related reasons. The number of methods available significantly raised discontinuation risk but only for method related reasons. The reported availability of more methods lowered the probability of discontinuation due to failure, but the effect was not statistically significant. These latter findings suggest that the contraceptive use episodes analyzed are contributed by a select group of U.P. couples who, if terminating for side effects or health concerns, do so with awareness that they can access other types of contraceptives at the proximate facility. In this sense, they appear to be behaving according to their perceived quality of services.

More interesting, although perhaps not surprising, are the protective effects of private providers of contraception on discontinuation for all types of reasons except access-related ones.

Use of a commercial source for contraceptives lowers the risk of discontinuation due to side effects or health concerns but raises it for those seeking to become pregnant. These two sets of results indicate that the role of non-government providers can be expanded to increase statewide capacity for service delivery, as well as supply the contraceptive needs of an important and presumably growing segment of the contracepting population. Including the type of contraceptive method used in our model confirms that pill and condom use lead to higher discontinuation than IUD use for all reasons but considerably more so for access-related ones. The inability to access supply-type contraceptives, a reason cited for about 12 percent of all terminated episodes, identifies a continuing need to improve service coverage.

Other studies of contraceptive discontinuation (e.g., Steele, Curtis and Choe, 1998; Curtis, 1997) obtain similar evidence supporting the influence of service variables on contraceptive continuation. Steele et al. (1998), who use linked health facility and individual data, find that the presence of a nearby public health center lowers method-failure rates and the presence of a pharmacy lowers discontinuation due to side effects or health concerns. Curtis and Blanc (1997) find in their comparative analysis of discontinuation patterns in six developing countries that IUD method users tend to abandon less for reduced need than users of either pill or condom. Our findings, as those of related studies, suggest that duration, method type and service source can have enduring influences on the effectiveness of contraceptive practice. Assessing the influences of service and individual background factors across a range of contraceptive prevalence levels, including low ones as in Uttar Pradesh, will improve the understanding of contraceptive use dynamics.

In addition to its substantive results, this study confirms the importance of studying discontinuation reasons with a competing-risk approach. Contraceptors can abandon practice for

multiple reasons and the determinants of these decisions should be analyzed accordingly. Moreover, unobserved factors are found to be relevant at different levels of the hierarchical causal structure, such as the individual and community. Their differential significance for discontinuation behavior warrants continued consideration, identification and estimation in future analyses.

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Table 1. Definition of the dependent variable categories and percent distribution of 2,623 episodes

Code	Categories	Proportion	Description
0	Continuing use	.66	Woman is using contraception at time of interview
1	Failure	.03	Woman accidentally became pregnant while using contraception
2	Non-method related reasons	.17	Woman stopped using contraception because she wanted to become pregnant, husband was away, or marital dissolution or separation occurred
3	Access or availability problems	.04	Woman stopped using contraception because of reasons of access or availability, husband or relative disapproval, cost or poor quality of contraceptive
4	Method related reasons	.10	Woman stopped using contraception because of method side effects, health concerns, inconvenient use, or desire for more effective method

Table 2. Definitions of independent variables and descriptive statistics for 2623 episodes

Variable	Description	Category	Mean	SD
	Individual variables			
Age	Woman's age (in years) as of June 1992	<21	.096	.295
		21-31	.665	.472
		>31	.239	.426
Education	Woman's years of schooling	0	.433	.496
		1-5	.119	.324
		6-10	.224	.417
		11+	.223	.416
Residence	If resides in rural village (0 otherwise)	1	.680	.494
Assets	If household owns both motor vehicle and TV set (0 otherwise)	1	.228	.420
Number of children	Number of children alive as of June 1992	0-1	.457	.498
		2-4	.448	.497
		5+	.095	.293
	Service variables			
Reported travel time	Time reported by woman to reach nearest source for family planning services (in minutes)	≤5	.313	.464
		6-30	.477	.500
		31-60	.128	.334
		>60	.082	.274
Methods available	Number of modern methods (restricted to IUD, pills, condom,MTP[a],and sterilization) available at the nearest reported source of family planning services	1	.114	.318
		2	.436	.497
		3+	.451	.499
Source of supply	Source of contraception for each episode in the calendar period	Public	.425	.494
		Private	.109	.312
		Commercial	.466	.495
Methods used	Type of methods used across episodes	IUD	.179	.383
		Pill	.328	.470
		Condom	.493	.500

[a] MTP = medical termination of pregnancy

Table 3. Distribution of women and episodes by the order of episodes

Episode order	Number of women	Percentage of women	Number of episodes	Percentage of episodes
1	2066	89.5	2066	78.8
2	188	8.2	376	14.3
3	37	1.6	74	2.8
4 and above	16	0.7	107	4.1
Total	2307	100.0	2623	100.0

Table 4. Percent distribution of women by the number of episodes and reason for discontinuation

No. of episode	Failure		Non-method related		Access or availability		Method related		Total	
	%	No.	%	No.	%	No.	%	No.	%	No.
1	90.1	63	82.3	298	84.1	74	86.5	192	84.5	627
2	7.1	5	12.7	46	14.8	13	9.9	22	11.6	86
3	1.4	1	3.6	13	0	0	2.7	6	2.7	20
4+	1.4	1	1.4	5	1.1	1	0.9	2	1.2	9
Total	100.0	70	100.0	362	100.0	88	100.0	222	100.0	742

Figure 1. Contraceptive continuation rate by method

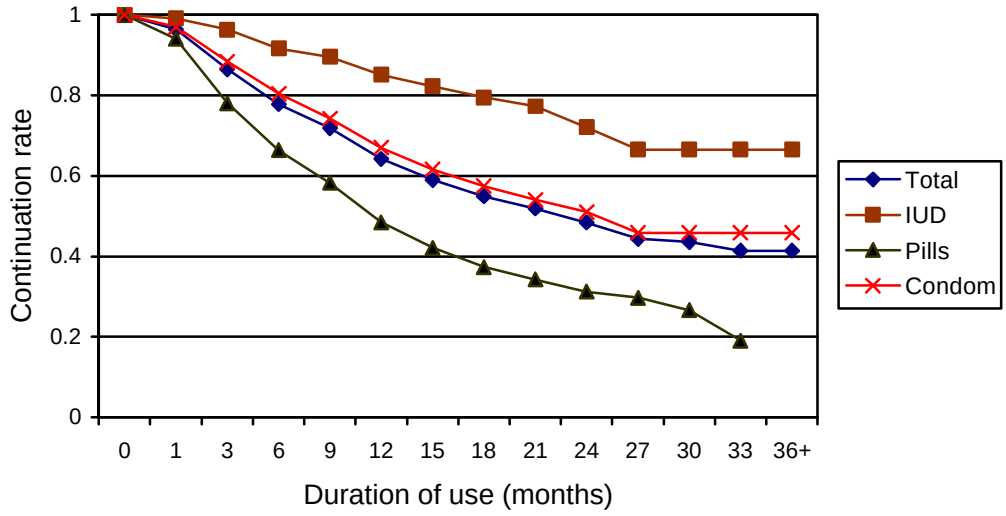

Figure 2. The continuation rate for all episode by type of surce of contraceptive supply

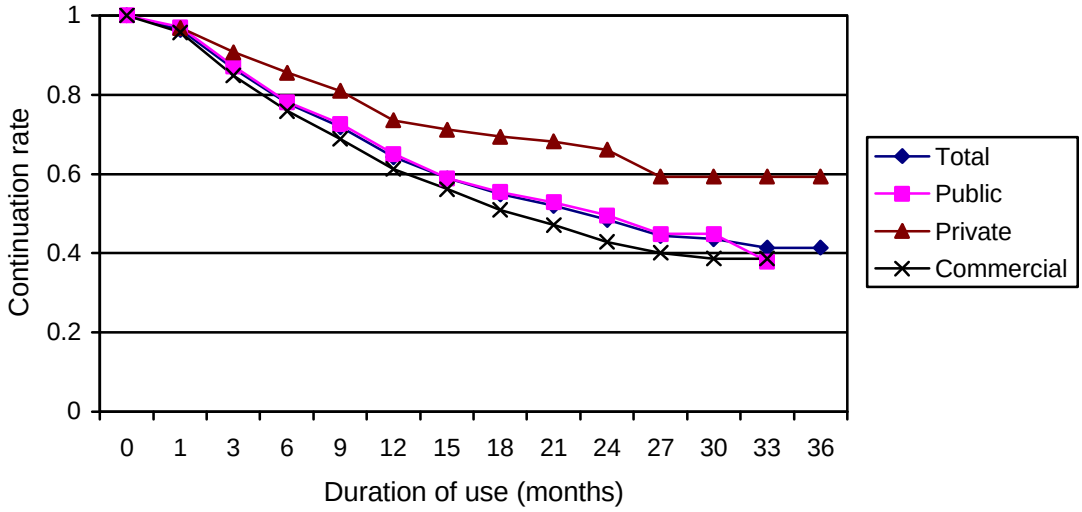

Figure 3. Contraceptive continuation rate with specific causes eliminated

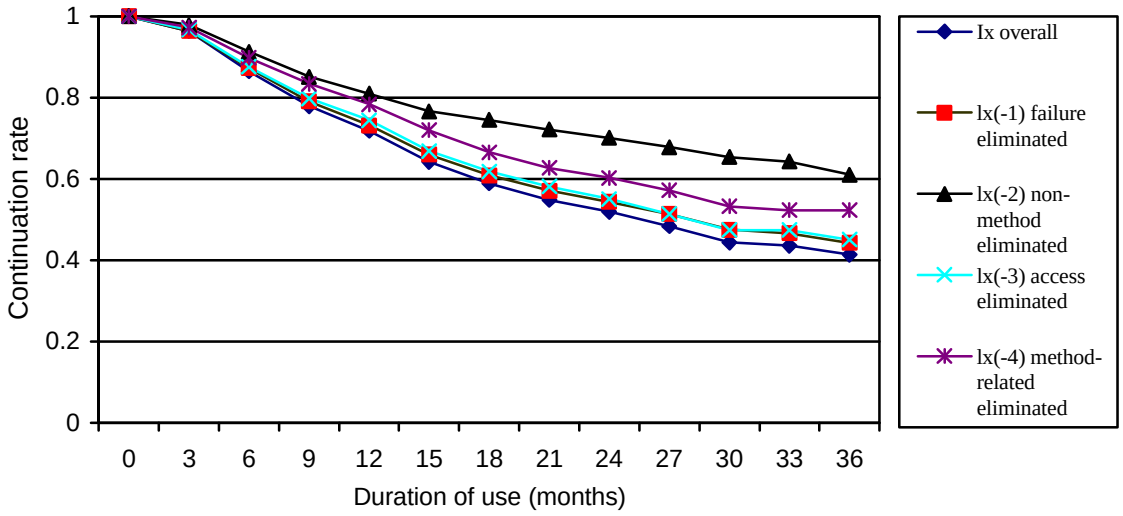

Table 5a.Multilevel multinomial logit estimates with random-effects, comparing risks of discontinuation to continuing use

	Failure		Non-method related		Access problems		Method related	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Constant	-3.274	0.697 ***	-1.543	0.440 ***	-4.621	0.791 ***	-3.497	0.485 ***
Duration (months)								
1-2	-2.944	0.585 ***	-2.610	0.225 ***	-1.826	0.485 ***	-1.691	0.284 ***
3-6	-0.827	0.350 **	-1.295	0.175 ***	-0.184	0.378	-0.274	0.229
7-12	-0.624	0.361 *	-0.642	0.168 ***	0.374	0.371	0.095	0.229
13-18	-0.107	0.361	-0.055	0.165	0.245	0.398	-0.320	0.264
18+								
Age (years)								
<21								
21-31	0.313	0.313	-0.492	0.187 ***	0.056	0.318	0.093	0.200
>31	0.545	0.480	-0.739	0.309 ***	-0.083	0.493	-0.008	0.294
Education (years)								
None								
1-5	-0.065	0.386	0.084	0.240	0.230	0.355	0.050	0.234
6-10	-0.368	0.325	0.050	0.202	-0.638	0.351 *	-0.248	0.208
11+	-0.421	0.400	-0.130	0.258	-0.576	0.424	-0.112	0.248
Residence								
Urban								
Rural	0.157	0.284	0.703	0.202 ***	0.220	0.304	0.117	0.188
Household assets								
None								
Own vehicle & TV	-0.668	0.369 *	-0.439	0.223 **	-0.300	0.368	-0.116	0.213
No. of children								
0-1								
2-4	-0.639	0.289 **	-0.126	0.181	0.316	0.290	0.156	0.179
5+	-1.091	0.528 **	-0.601	0.342 *	-1.560	0.716 **	0.048	0.308
Travel time (minutes)								
<5	-0.026	0.497	-0.706	0.309 ***	0.462	0.558	0.069	0.309
6-30	0.225	0.450	-0.564	0.278 **	0.199	0.531	0.009	0.284
31-60	-0.914	0.607	-0.837	0.316 ***	1.022	0.551 *	-0.097	0.318
60+								
Methods available								
Only one								
2	-0.554	0.360	0.133	0.247	0.181	0.383	0.479	0.283 *
3 and above	-0.129	0.355	0.182	0.252	-0.299	0.405	0.763	0.283 ***
Sources of contraception								
Public								
Private	-0.436	0.506	-0.262	0.284	0.606	0.394	-0.517	0.268 **
Commercial	0.494	0.263 **	0.608	0.166 ***	0.453	0.274 *	-0.252	0.165
Random effects								
Covariance at community level								
Failure	0.435	0.676						
Non-method related	0.277	0.347	1.964	0.347 ***				
Access	-0.284	0.505	0.402	0.360	1.038	0.731		
Method related	0.053	0.317	1.008	0.228 **	-0.161	0.331	0.953	0.293 ***
Covariance at individual level								
Failure	1.535	0.954						
Non-method related	-0.381	0.455	1.589	0.270 ***				
Access	-0.544	0.783	-1.254	0.471 **	5.844	0.990 ***		
Method related	0.935	0.462 **	-0.516	0.281	0.852	0.474	0.824	0.355 **

*** p<0.01, ** p<0.05, *p<0.1.

Table 5b. Multilevel multinomial logit estimates with random-effects, comparing risks of discontinuation to continuing use after controlling for method used

	Failure		Non-method related		Access problems		Method related	
	Coeff.	S. E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Constant	-4.401	0.833 ***	-2.373	0.418 ***	-6.419	0.964 ***	-3.870	0.494 ***
Duration (months)								
1-2	-3.100	0.574 ***	-2.606	0.221 ***	-1.804	0.509 ***	-1.689	0.292 ***
3-6	-0.973	0.346 ***	-1.268	0.174 ***	-0.122	0.406	-0.232	0.239
7-12	-0.731	0.356 **	-0.615	0.168 ***	0.435	0.401	0.165	0.240
13-18	-0.169	0.356	0.036	0.167	0.273	0.433	-0.296	0.278
18+								
Age (years)								
<21								
21-31	0.316	0.318	-0.560	0.159 ***	0.043	0.310	0.104	0.195
>31	0.588	0.490	-0.862	0.273 ***	-0.029	0.473	0.028	0.285
Education (years)								
None								
1-5	0.036	0.389	0.129	0.203	0.234	0.340	0.143	0.226
6-10	-0.177	0.332	0.134	0.173	-0.510	0.344	-0.147	0.204
11+	-0.340	0.409	-0.095	0.226	-0.405	0.412	0.110	0.241
Residence								
Urban								
Rural	-0.011	0.293	0.586	0.178 ***	0.072	0.298	-0.027	0.182
Household assets								
None								
Own vehicle & TV	-0.620	0.374 *	-0.424	0.197 **	-0.247	0.362	-0.096	0.209
No. of children								
0-1								
2-4	-0.641	0.296 **	-0.137	0.156	0.309	0.283	0.126	0.175
5+	-1.156	0.543 **	-0.544	0.299 *	-1.588	0.710 **	-0.013	0.297
Travel time (minutes)								
<5	-0.035	0.510	-0.844	0.262 ***	0.296	0.532	0.112	0.300
6-30	0.237	0.462	-0.623	0.233 ***	0.067	0.506	0.058	0.275
31-60	-0.947	0.615	-0.937	0.266 ***	0.780	0.525	-0.057	0.307
60+								
Methods available								
Only one								
2	-0.604	0.370	0.048	0.213	0.084	0.369	0.474	0.278 *
3 and above	-0.165	0.366	0.090	0.218	-0.419	0.395	0.746	0.278 ***
Sources of contraception								
Public								
Private	-0.450	0.525	-0.238	0.259	0.745	0.391	-0.543	0.267 **
Commercial	0.113	0.283	0.323	0.153 **	0.084	0.278	-0.315	0.174 *
Method used								
IUD								
Pill	1.992	0.545 ***	1.598	0.249 ***	2.726	0.638 ***	1.070	0.213 ***
Condom	1.500	0.542 ***	1.345	0.247 ***	2.136	0.638 ***	-0.146	0.228
Random effects								
Covariance at community level								
Failure	0.523	0.694						
Non-method related	0.275	0.370	2.186	0.384 ***				
Access	-0.251	0.503	0.509	0.373	1.047	0.706		
Method related	0.016	0.319	0.907	0.238 ***	-0.144	0.324	0.762	0.288 ***
Covariance at individual level								
Failure	3.822	1.014 ***						
Non-method related	-0.738	0.481	4.704	0.429 ***				
Access	-0.553	0.755	-1.401	0.480 ***	6.061	0.989 ***		
Method related	0.933	0.465 **	-0.556	0.300	0.695	0.464	1.801	0.391 **

***p<0.01, **p<0.05, *p<0.1.