HIV/AIDS and the Stall in Fertility Decline in Rural South Africa

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ABSTRACT

Post-apartheid South Africa has witnessed numerous societal changes over the past few decades, including significant declines in fertility levels. However, fertility decline has largely stalled among South African women in rural areas despite predictions that it would continue to fall. We use prospective data from the Agincourt Health and Socio-Demographic Surveillance System in rural South Africa to investigate changes in fertility among South African and Mozambican women from 1993-2010. We focus on the influence of two important mechanisms – AIDS-related child mortality and shifting marriage trends – on the odds of women having a second birth within 8 years of their first birth. Our results support different fertility regimes whereby Mozambican women's fertility has continued to decline while South African women's fertility, already quite low, has remained relatively stable. We find higher odds of second births among women whose first child died, who are in union, and who have at least some secondary education are likely to have contributed to the stall in fertility decline among South African women. We also find signs that Mozambican women have gained greater control over their fertility by increasing their use of contraceptives and having fewer second births, which has likely contributed to reductions in their fertility. In general, our study shows that HIV/AIDS in the absence of treatment and being in a union put upward pressure on fertility among both South African and Mozambican women but that Mozambican women's control over their fertility has ultimately resulted in fertility decline among this population.

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Countries across sub-Saharan Africa have experienced both dramatic reductions in fertility and stalls in fertility decline over the past several decades. South Africa, having undergone significant fertility decline, is now characterized by fertility levels nearing those of Western nations. These patterns are unique in the region: South Africa's fertility decline started earlier and advanced more rapidly than in neighboring countries (Camlin et al. 2004; Moultrie and Timaeus 2003; Potts and Marks 2001).

Widespread access to hormonal contraception since the mid-1970s and the postponement of higher order births contributed to the fast pace of South African fertility decline (Kaufman 1998; Timaeus and Moultrie 2008). However, in parallel to fertility decline, there was a great deal of social and economic change, much of which likely had an impact on the country's fertility transition. These changes include: the end of apartheid; globalization and economic restructuring; employment shifts; changes in marriage and cohabitation patterns; increasing labor migration among women; and soaring HIV prevalence rates. In this paper, we focus on two mechanisms that are likely to have influenced fertility change in rural South Africa: increases in child mortality caused by HIV/AIDS, and shifts in marriage patterns.

Although fertility has declined, childbearing remains an important life event for women and men in South Africa. It helps cement the bond between couples and families, and may provide a way to transition to adulthood for women with limited options due to a lack of educational opportunities and employment prospects in rural areas (Madhavan et al. 2013; Sennott 2013). Almost all women in South Africa have at least one child. The first birth is oftentimes unplanned because of unmet need for contraception among never-married adolescent women, who may encounter barriers to accessing effective contraception (Ehlers 2003; Garenne et al. 2001; Wood and Jewkes 2006). The uniquely long period between the first and second births that is common in South Africa (Timaeus and Moultrie 2008) suggests that the second birth is postponed by contraceptive use and therefore its

timing may be more likely than a first birth's to be intentional. For these reasons, our analysis focuses on the factors associated with the progression from first to second births.

Using data from the Agincourt Health and Socio-Demographic Surveillance System ("Agincourt HDSS" or "Agincourt") in rural Mpumalanga Province, we examine two mechanisms, – increasing infant and child mortality and changing marriage patterns – which are likely to have contributed to the fertility decline in rural South Africa by impacting second births. Child mortality is important in this context because of South Africa's high HIV prevalence. Overall, 16.9% of the population is HIV positive, with more women (21.3%) than men (11.6%) infected (Rehle et al. 2010). Recent research has found extraordinarily high HIV prevalence rates in rural areas, particularly among Black adults of reproductive age. A 2010–2011 study in Agincourt found that HIV prevalence for women was 27% at ages 20–24, 38% at ages 25–29, 42% at ages 30–34, and 46% at ages 35–39 (Gómez-Olivé et al. 2013). As shown in Figure 1, child mortality increased substantially starting in 1997 and by 2000 AIDS was the leading cause of child death in the Agincourt HDSS (Tollman et al. 2008). Child mortality started declining in 2006, likely due to treatment to prevent mother-to-child transmission (PMTCT), which was rolled out in South Africa beginning in 2002 (Barron et al. 2013) and available in Agincourt by 2004. Demographic transition theory suggests that couples react to high child mortality by increasing the number of children they have (Davis 1945; Notestein 1945; Preston 1978). This may be reflected in couples' having more children than they would prefer in order to ensure survival of an adequate number (insurance effects) or in replacing children that have died (replacement effects), both of which could put upward pressure on overall fertility.

Second, we examine how marital or union status may influence the progression from first to second births in Agincourt. Although few studies of marriage patterns in South Africa exist because of a lack of reliable data (Budlender et al. 2004), recent evidence suggests that marriage is

increasingly postponed to older ages (Hosegood et al. 2009; Statistics South Africa 2012): the median age at first marriage in South Africa is now estimated at 29 for women and 34 for men (Statistics South Africa, 2012). The postponement of marriage has contributed to high rates of nonmarital fertility among young women (Garenne et al. 2007; Gustafsson and Worku 2007; Kaufman et al. 2001; Moultrie and Timaeus 2003; Sennott 2013) and is likely to affect the timing of second births as well. The increasing postponement of higher order births (Timaeus and Moultrie 2008) and late age at marriage in South Africa, together, suggest that women may be waiting until they are married to have a second birth. This postponement of births could put downward pressure on fertility if women end up having fewer children than they might have had otherwise, as has been suggested by qualitative research documenting generational declines in desired family size in the midst of a virtual collapse of marriage among young people in Agincourt (Sennott 2013). Alternatively, fewer marriages might translate into more widespread nonmarital fertility at higher parities. This could increase women's dependence on the government Child Support Grant, a common source of financial assistance for single mothers in rural areas.

Fertility Decline in Rural South Africa

South African fertility halved between the mid-1960s and 1990s to an overall national fertility rate of 3.2 children per woman and 3.5 for Black South Africans (Moultrie and Timaeus 2003). Fertility for Black South Africans has since dropped further, but the total fertility rate remains above replacement level, estimated at 2.9 nationally in 2007 (Statistics South Africa 2010). The fertility of rural Black South Africans dropped below 2.5 at about the same time the HIV epidemic became generalized in the rural population in the early 2000s (Camlin et al. 2004; Garenne et al. 2007). Figure 1 shows the TFR in Agincourt reaching a low of 2.4 in 2001, leveling out through 2004, and increasing from 2004 to 2008. Only in 2010 did the TFR return to 2001–2004 levels.

In other words, fertility decline in Agincourt has stalled (Williams et al. 2013). This stall is not necessarily surprising given that fertility among Black South Africans has been declining for some time and is much lower than fertility in other African countries. However, the stall is surprising because despite the extraordinarily high HIV prevalence among women of reproductive age in rural South Africa, treatment was not widely available at public facilities until 2010. Therefore, it is likely that HIV negatively affected women's reproductive spans, fecundity, and their childbearing behavior. Given this situation, one would expect fertility at the population level to decline (Moultrie and Timaeus 2003; Moultrie et al. 2008); however, this has not been the case.

[Figure 1 about here]

The Effect of Child Mortality

One fertility-related behavioral response to high levels of HIV is closely tied to child mortality. Having a child in response to another child's death is defined as a replacement effect (Preston 1978). Replacement effects have been identified in numerous individual-level studies of mortality and fertility (e.g., Cohen and Montgomery 1998; Frankenberg 1998; Grummer-Stawn, Stupp and Mei 1998; Knodel 1978; Kuate Defo 1998; Vallin and Lery 1978). A recent study reported replacement effects associated with AIDS-related infant mortality in Kenya (Magadi and Agwanda 2010). The increase in infant and child mortality in Agincourt through 2003 was due, both directly and indirectly, to AIDS (Sartorius et al. 2011; Tollman et al. 2008). Replacement effects could sustain fertility levels or possibly reverse fertility decline (e.g., Magadi and Agwanda 2010). These effects may be particularly likely in a context such as rural South Africa while AIDS-related child mortality was on the rise.

The Effect of Marriage

The relationship between marriage and fertility change is somewhat murky in South Africa. Marriage has declined significantly among all age groups (Hosegood et al. 2009), a trend that is likely

to contribute to lower fertility. And yet, nonmarital first births are common (Moultrie and Timaeus 2003; Sennott 2013) and first births often occur to adolescent women (Garenne et al. 2007; Kaufman, de Wet and Stadler 2001; Sennott 2013; Williams et al. 2013). Thus, if decreases in marriage have contributed to fertility decline, it is likely that the effect will primarily be evident at higher parities. However, the propensity for adolescent and nonmarital fertility and the decoupling of marriage and childbearing among youth in many countries around the world (National Research Council and Institute of Medicine 2005) suggest that the trend towards fewer and later marriages may actually have little effect on fertility if these other trends continue.

METHODS

Data

We use data from the Agincourt HDSS, which monitors all vital events in a population of approximately 90,000 individuals in Agincourt, a rural sub-district of Ehlanzeni District in Mpumalanga Province, South Africa. A baseline census was collected in 1992; this study draws on data from 1993-2010. The Agincourt HDSS collects information on all vital events occurring in the site each year, including births, deaths, in- and out-migrations, and unions. Complete maternity histories were collected in 1992 and thereafter from in-migrants; all maternity histories are updated annually.

The Agincourt HDSS covers an area that was previously part of the Gazankulu Bantustan (or "homeland"), a resettlement area for black South Africans as mandated by the *apartheid* policy of "separate development." A majority of residents are poor, as economic and infrastructure development since the democratic transition in 1994 has been slow, with a great deal of economic dependence on government noncontributory social grants and remittances sent by labor migrants. Every village has a primary school; however, the quality of education is poor and educational progress is often delayed. Life expectancy at birth has fallen significantly from 73 years among

women and 68 years among men in 1994 to 59 years among women and 53 years among men in 2004 (Kahn et al. 2012). Much of this decline is attributable to AIDS. The study site, mapped in Figure 2, is described in detail by Kahn and colleagues (2012).

[Figure 2 about here]

The population is primarily composed of Shangaan people, an ethnic group that resides in the area and across the border in Mozambique. One-third of the site's population is of Mozambican origin (Kahn et al. 2012). We present results for Mozambicans and South Africans separately for three reasons. First, recent evidence suggests that these groups are at different stages of the fertility transition. Williams and colleagues (2013) found from 1993-2009, South African women in Agincourt had low and fairly stable fertility rates, while the fertility of former Mozambican refugees during that same period fell from a TFR of over 5 to a TFR of under 3. Second, Sartorius and colleagues (2011) found that AIDS-related child mortality in Agincourt was primarily concentrated in poor households clustered in areas dominated by Mozambicans. Finally, Sennott (2013) found that Mozambican women who had experienced a nonmarital birth were significantly more likely to enter a first union by age 35 compared to their South African counterparts. These factors together suggest that the influence of child mortality and marriage on women's progression from a first to a second birth is likely to be substantially different for Mozambican and South African women. Indeed, Figure 3 shows that Mozambican women compared to South African native women, have much higher probabilities of progressing to a second birth within eight years in all three periods.

[Figure 3 about here]

Variables

We analyze two dependent variables. First, we investigate the progression from a first to a second birth with a dichotomous, time-varying indicator of a whether a woman had a second birth in the study site in each year (up to year 8) since her first birth. The Agincourt HDSS collects

detailed information on all pregnancy outcomes in the study site, probing carefully for any pregnancy that occurred after the last recorded birth in order to limit the undercounting of pregnancies between annual census rounds that do not result in live births or are followed by a neonatal death. The second dependent variable examines the planning status of the second birth. At the census following a birth, women are asked a series of questions about their pregnancy, including: "Was this pregnancy planned?" We construct a three-category variable indicating that the birth was planned, unplanned, or no second birth occurred (reference). In these analysis, a woman contributes a person-year for each calendar year since the first birth up to and including the year in which the second birth occurs or the year in which censoring occurs through death, migration, or completing 8 years without a second birth.

We investigate two main time-varying independent variables: an indicator of the first child's death and an indicator of women's union status (in union or single) in each person-year. Unions include both informal cohabiting unions and formal marriages. We also include several independent variables that have been shown to be associated with fertility patterns. Exposure time is measured in calendar years since the first birth (1-8). We include a categorical indicator of the time period during which the first birth occurred (1993–1995, 1996–1999, and 2000–2002). The periods are defined based on stages of South Africa's fertility transition (see Williams et al. 2013) and progression of the AIDS epidemic in Agincourt (see Figure 2), and notably only include years prior to the nationwide rollout of PMTCT and other antiretroviral treatment. The first period (1993–1995) exhibits fertility decline before a generalized AIDS epidemic; the second period (1995–1999) is defined by a stall in fertility decline and an emerging AIDS epidemic; and the third period (2000–2002) is characterized by a generalized AIDS epidemic and continued stall in fertility decline. Age at first birth is grouped into four categories: 15-19; 20-24; 25-29; and 30-34. We include a dichotomous indicator of whether a woman intended to use contraception after her first birth. Because this information was collected

at the first census after the birth, this measure is prospective for women whose birth had recently occurred and had not yet started using contraception. A woman is coded "yes" if she said she was planning to use any of the following: condom, injection (DepoProvera), loop (IUD), pill, or sterilization. A woman is coded "no" if she intended to use traditional methods or did not intend to use contraception. Education data were collected in 1992, 1997, 2002, and 2006. Education is time-varying and dichotomized as completed primary or less (8 or fewer years) or some secondary or more (9 or more years). If education is missing in a given year, we impute the highest level previously reported. Women were asked at the round during which a birth was reported whether it had been planned or unplanned. In the models predicting the planning status of the second birth, we include an indicator of the planning status of the first birth. Because 5-10% of observations have missing data on planning status of the first birth (6%), contraceptive use (10%). and education (7%), we include missing categories for these variables.

Sample Selection

All women aged 15-34 who had a first birth observed in the site between 1993-2002 were eligible for inclusion in the sample. Models predicting the planning status of the second birth included only those women with non-missing information on planning status of the first and second births.[1] The median interval between first and second births in South Africa is long at 60 months (Timaeus and Moultrie 2008); limiting first births to those that occurred prior to 2003 allows us to follow women for up to eight years or 96 months (through 2010). The data were transformed into person-years starting with the year of a woman's first birth and right-censoring at the time of a woman's second birth, out-migration, or death. The sample for models predicting second births comprises 5,274 women (29% are Mozambican, n=1,540) and 22,484 person-years. The sample for

[1] 262 women (1,382 person-years) are excluded from the models predicting the planning status of second birth because they are missing information on the dependent variable.

models predicting the planning status of second births comprises 5,012 women (29% are Mozambican, n=1462) and 21,102 person-years.[2]

Analytic Strategy

We use discrete-time event history analyses and present two sets of models. First, we examine the likelihood of having a second birth within eight years using logistic regression. Results are presented as odds ratios. We present: a baseline model including the number of calendar years of exposure to a second birth and time period; a second model adding our two main predictor variables; and a final model including all control variables. The second set of models employs multinomial logistic regression to investigate the likelihood of having a planned, unplanned, or no second birth (reference). Results for these models are presented as relative risk ratios. For this outcome, we present a full model including all predictor and control variables. All models are run separately for Mozambican and South African women.

RESULTS

Table 1 provides individual-level descriptive statistics for our sample of women by the period of their first birth and nationality (native South African versus Mozambican). Turning to South Africans first, around one-third of women in the sample have a second birth within 8 years of their first, a figure that changes little over time. The proportion of women whose first child dies slightly increases across periods. Just under one-third of women are married or cohabiting at some point during the study. The proportion of first births that were to teenagers declines over time. The proportion of South African women with at least some secondary education increases between 1993 and 2002. The percentage of women intending to use contraception after their first birth hovers around half in all three periods; between 26% and 30% of women planned their first birth, and 11-19% planned their second birth.

[2] Five women were excluded from both sets of models because they were missing information about nationality.

[Table 1 about here]

Reflecting their different stages of the fertility transition, we see some different patterns among Mozambican women in our sample. A higher proportion (46%-52%) has a second birth within 8 years of their first, a figure that declines slightly over time. The percentage of women whose first child dies increases from around 4% to almost 7% and the percentage of women who were married or cohabiting during the study declines from 62% to 46% among Mozambicans. The proportion of first births that were to teenagers increases over time, the opposite to the pattern for South African women. Similar education patterns exist with secondary schooling becoming more common. The intention to use contraception after the first birth becomes more common over time; however, during the same period we see increases in the proportions of first and second births that are reported as unplanned among Mozambican women.

Table 2 provides the life table probabilities of having a second birth within eight years, by nationality and time period, across the main predictor variables and controls. In general, the probability of having a second birth within eight years declines remains relatively stable for South Africans and declines for Mozambicans. This supports the overall fertility decline among Mozambican women and the stall in decline among South Africans during the same period. This trend is relatively consistent across the control variables; however, there are some notable differences by nationality in the main predictor variables. For South Africans, the probability of having a second birth after a first child's death declines over time from 64%-62% (with a drop to 55% in period 2), whereas it increases for Mozambican women from 70%-82%. The probability of having a second birth for women in unions declines for South African women by 10% over time from whereas Mozambican women's probability of having a second birth while in a union remains relatively stable.

[Table 2 about here]

Table 3, Model 1 shows the odds of progressing to a second birth within 8 years significantly declined among Mozambican women (by 38%) between the first (1993-1995) and third (2003-2005) periods. Model 2 adds child mortality and union status. South African women have significantly higher odds of having a second birth within eight years following a first child's death. Being in a union is also significantly associated with a higher likelihood of progressing to a second birth within 8 years for both Mozambicans and South Africans. Model 3 includes control variables. The trend of declining odds of a second birth across time reaches statistical significance for South Africans in this model. We see similar relationships for South African and Mozambican women in control variables: a linear relationship of lower odds of a second birth the older a woman was at her first birth; a positive association between some secondary education and having a second birth within eight years (only significant for South African women, $p < 0.001$); and a strong negative significant association between intending to use contraceptives after the first birth and having a second birth within eight years.

[Table 3 about here]

Table 4 provides the results of multinomial logistic regression models examining the planning status of a second birth occurring within 8 years of the first birth. Turning to planned second births, we see similar relationships by nationality. The odds of having a planned second birth decline significantly over time for both South African and Mozambican women. Despite this trend, our two main independent variables – having a first child that died and being in a union – both have strong significant positive associations with planned second births among South Africans and Mozambicans.

Turning to the control variables, we see some important differences by nationality. Planned second births among both groups are negatively associated with higher ages of first birth (marginally significant among Mozambicans, $p<0.10$) and significantly negatively associated with the intention

to use contraception after the first birth. Both groups have significant positive associations between having planned the first birth and planning the second birth, suggesting that some women, likely those with consistent access to contraception, may be more effective overall at planning their fertility. For South African women, having some secondary education ($p<0.01$) is positively associated with planned second births whereas the association is negative (but not significant) for Mozambicans.

[Table 4 about here]

Table 4 shows some clear differences between Mozambican and South African women in the likelihood of having an unplanned second birth. Although both groups show a decline in the odds of having an unplanned second birth over time, the trend is only significant for Mozambican women ($p<0.05$ in 1996-1999 and $p<0.10$ in 2000-2002). Additionally, while South African women have a higher likelihood of having an unplanned second birth after a first child's death ($p<0.01$), the relationship is negative and not significant for Mozambican women. The influence of the control variables on having an unplanned second birth within 8 years is similar for Mozambican and South African women. We see a negative linear relationship between having an unplanned second birth and the age of a woman at her first birth; a positive association with some secondary education (significant for South Africans, $p<0.001$); a negative and significant association with intended contraceptive use after the first birth; and a negative and significant association with having planned the first birth.

DISCUSSION

Understanding fertility change in rural South Africa necessitates attention to myriad factors given the important societal changes that have occurred since the end of apartheid. Our analysis focuses on two important aspects of South African life – AIDS-related infant and child mortality

and marriage trends – to understand how they influence the progression from a first to a second birth among Black women in the rural Agincourt HDSS.

Our findings indicate that the effect of HIV/AIDS, as evinced through child mortality levels, is likely to have contributed to higher fertility and thus a stall in overall fertility decline. We find strong evidence that child mortality prompts South African couples to "replace" a child that has died: the death of the first child increased the likelihood that a South African woman would have a second birth within 8 years. After disaggregating second births by whether they were planned or unplanned, we also found that Mozambican women were significantly more likely to follow a child death with a planned second birth. The literature on replacement fertility effects generally assumes that having a child to replace one that died is an intentional event. This assumption holds true for Mozambican and South African women. Yet, our results also show that the death of the first child is associated with a greater likelihood of having an unplanned second birth for South African women. South African women's fertility decline stalled in the mid-2000s whereas Mozambican women's fertility levels continued to decline (Williams et al. 2013). Our results provide some evidence that replacing children lost to the AIDS epidemic may be one mechanism that has contributed to the stall in fertility decline among South Africans. Replacement fertility effects among Mozambican women were only important for planned second births. This suggests that Mozambican women who have lost a child due to AIDS may be particularly careful about whether and when they have another child.

Despite the virtual collapse in marriage that has been documented in Agincourt and other areas of rural South Africa (Hosegood et al. 2009; Sennott 2013), we find strong associations between being in a union and having a second birth within 8 years. Being in a union is, in fact, the strongest predictor of having a second birth for both Mozambican and South African women. Women who are currently in a union are significantly more likely to have both planned and

unplanned second births, although the effect is stronger for planned births. These results provide some evidence that women in South Africa who have had a child may prefer to wait until their conditions support having another child, in this case, because they are married. The combination of low union rates and low fertility creates conditions that are likely to increase unplanned births because of increased periods of time during which women may want to postpone or avoid childbearing. We see some evidence of this in the increases in unplanned first and second births among both South African and Mozambican women over time (Table 1). Although Mozambican women were significantly less likely to have both planned and unplanned second births over time, the effect was much stronger for planned fertility. This is also likely to have contributed to stability in the likelihood of having unplanned births among South African women across the periods (Table 4).

We also find increases in secondary schooling among both Mozambicans and South Africans over time, but a strong association between secondary education and having a second birth (planned or unplanned) within 8 years among South African women. This suggests that women with more education may be in a better financial position to support another child, and may be less likely to postpone childbearing, a factor that has contributed to fertility decline in South Africa (Timaeus and Moultrie 2008). Thus, increasing education among South Africans is also likely to have contributed to their stall in fertility decline.

Despite its contributions, our study has some limitations. First, our analyses are somewhat limited by the lack of direct measures of the socioeconomic status of women and their households. Direct measures were not available in the Agincourt HDSS until 2001 and therefore could not be uniformly applied to the sample. However, we gain some purchase on this relationship by including

proxy measures, such as educational attainment, which we found had some influence on our outcome variables[3].

Second, our examination of the relationship between the AIDS epidemic and fertility decline in South Africa would be strengthened by information about women's own HIV status and its possible effect on second births in Agincourt. Furthermore, our study examined the influence of HIV/AIDS via infant and child mortality among women whose first birth occurred prior to the national rollout of PMTCT and other antiretroviral treatment for HIV. Given that these treatment options are now more widely available, future research investigating the impact of treatment on second births (planned and unplanned) by women's HIV status would be illuminating. There is some evidence that the rollout of PMTCT contributed to an increase in fertility in Agincourt (Williams et al. 2013). Free antiretroviral treatment for those infected with HIV became available in Agincourt in 2010; therefore, we may see increases in fertility in later years given that treatment may relieve the suppressive effects that HIV is likely to have had on fertility. Recent research has shown that pregnancy is more common among HIV positive women on antiretroviral treatment than among HIV positive women not on treatment (Homsy et al. 2009; Myer et al. 2010) and that antiretroviral treatment has contributed to increases in unplanned fertility (Schwartz et al. 2012; Wanyenze et al. 2011). Thus, research examining parity progression by HIV positive women across the life course before and after expansions in treatment is much needed and likely to demonstrate further complexities in the extent and direction of fertility change in rural South Africa.

Third, Agincourt is characterized by high seasonal and permanent migration. We have attempted to mitigate the potential effect of migration on women's parity progression by limiting our analyses to births observed in the site. Nonetheless, a notable proportion (45%) of women in

[3] We also included a time-varying measure of whether the household head was female, which is associated with higher rates of poverty in rural South Africa (Woolard 2002). Because this variable was not significantly associated with the outcomes and model post-tests indicated it could be dropped, we did not include it in the final models.

our sample leave the study site within 8 years and are not observed having a second birth. Thus, our estimates may underestimate second births. Despite this, we are reassured by the similarity in Agincourt fertility levels and fertility among women nationwide.

Our results emphasize that family planning programs need to be strengthened, especially for young and unmarried women who often have unplanned first births in Agincourt. Our results show that women who planned their first birth were significantly more likely to plan their second birth as well. Yet, we also found that South African women who had a first child that died had a higher likelihood of having an unplanned second birth, suggesting an unmet need for contraception. These women may themselves be HIV positive and many studies have shown reduced fertility desires after a positive HIV test (e.g., Cooper et al. 2007; Hoffman et al. 2008; Taulo et al. 2009; Yeatman 2009), emphasizing that after an HIV diagnosis women's fertility preferences and contraceptive needs may be likely to change. Integrating family planning with HIV/AIDS health services is vital to reducing HIV prevalence and limiting unwanted fertility among HIV positive women and couples. If HIV treatment programs do not incorporate contraceptive services, it is likely that unplanned pregnancies among HIV positive individuals will increase as antiretroviral treatment expands, especially if marriage continues to decline.

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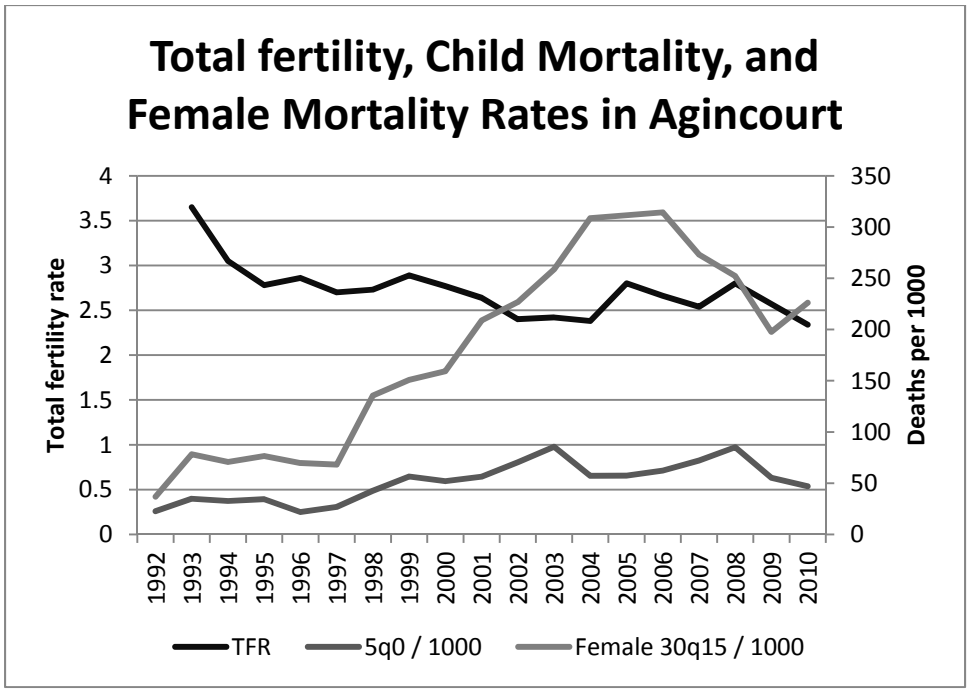
Figure 1: Total Fertility Rate, Child Mortality Rate, and Female Reproductive Age (15-45) Mortality Rate in the Agincourt HDSS, 1992–2010



Data come from the Agincourt Health and Socio-demographic Surveillance System 1992–2010

Figure 2: Agincourt Health and Socio-Demographic Surveillance System Site

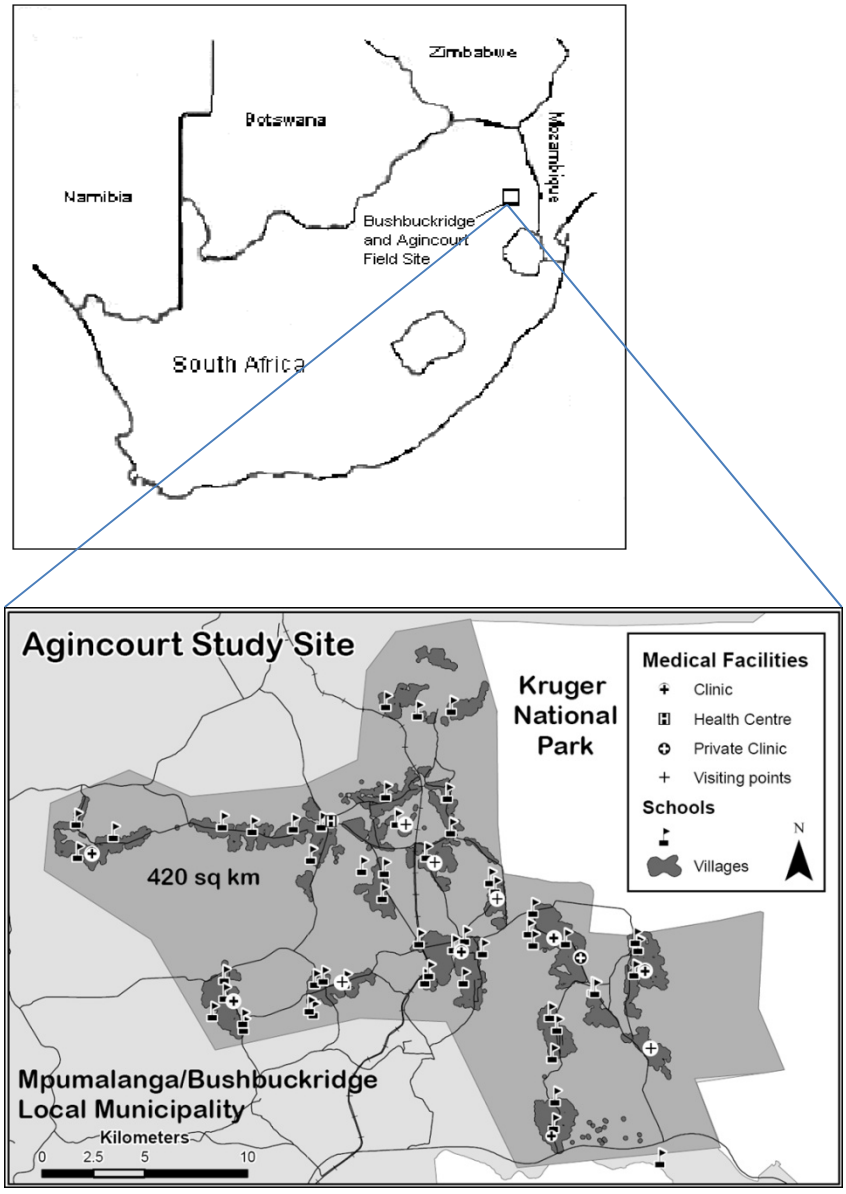


Figure 3: Cumulative Probability of 2nd Birth within 8 Years, By Period and Nationality

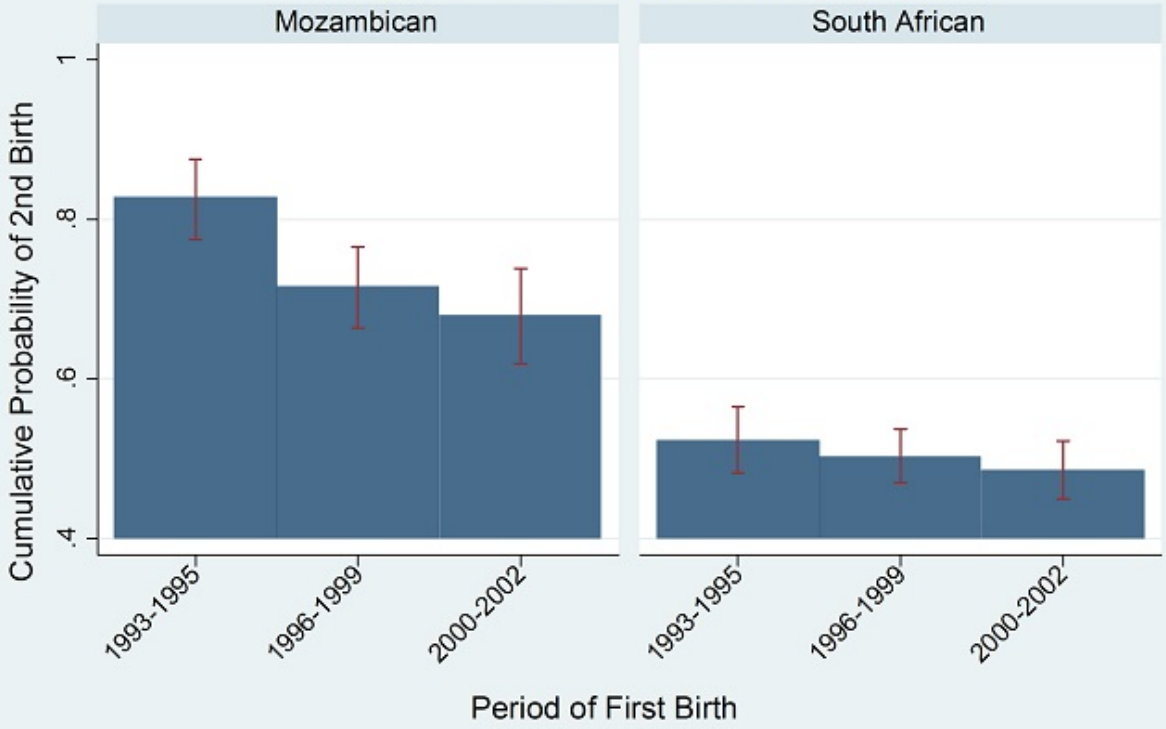


Table 1: Individual-Level Descriptive Statistics for Women by Period and Nationality, (%)

		South African			Mozambican		
		1993-1995	1996-1999	2000-2002	1993-1995	1996-1999	2000-2002
Had second birth		33.3	32.9	34.0	52.4	45.6	45.5
First child died		3.5	4.3	5.7	4.3	6.3	6.9
In union		30.6	32.6	30.9	62.0	56.0	45.5
Age at first birth							
	15-19	61.3	56.4	55.7	56.1	62.0	64.5
	20-24	29.6	31.3	30.1	31.0	29.5	29.0
	25-29	7.1	10.3	11.6	10.2	5.8	4.9
	30-34	2.1	2.1	2.6	2.8	2.7	1.6
Education							
	<=Completed primary	24.2	18.5	15.4	56.7	50.2	48.2
	>=Some secondary	54.6	68.7	82.9	12.1	33.7	50.0
	Missing	21.2	12.9	1.8	31.2	16.1	1.8
Intended contraceptive use after first birth							
	No	39.9	34.0	46.8	73.9	50.6	56.7
	Yes	46.6	55.7	45.3	18.9	38.8	37.5
	Missing	13.6	10.3	7.9	7.2	10.6	5.8
Planned first birth							
	No	64.3	63.0	68.9	35.7	51.1	66.7
	Yes	28.8	30.1	26.1	58.8	43.5	29.5
	Missing	7.0	6.9	5.0	5.5	5.5	3.8
Planned second birth							
	No	75.5	79.8	82.9	63.1	69.6	74.1
	Yes	19.4	16.1	11.4	31.4	26.7	19.4
	Missing	5.1	4.2	5.7	5.5	3.7	6.5
N		1,061	1,501	1,172	471	621	448

Data come from women aged 15-34 who had a first birth from 1993-2002 in the Agincourt Health and Socio-Demographic Surveillance Site

Notes: The estimate for in union includes women who were ever in a union during their exposure years to a second birth.
The estimate for education is based on the maximum level reported.

Table 2: Life Table Estimate of % having 2nd Birth within 8 Years and Sample Size by Period, Nationality, and Covariates

		South African			Mozambican		
		1993-1995	1996-1999	2000-2002	1993-1995	1996-1999	2000-2002
By first child died							
	No	51%	50%	48%	77%	74%	70%
		1024	1436	1105	451	582	417
	Yes	64%	55%	62%	70%	72%	82%
		37	65	67	20	39	31
By in union							
	No	41%	41%	42%	53%	55%	59%
		736	1011	810	179	273	244
	Yes	78%	74%	68%	89%	87%	88%
		325	490	362	292	348	204
By age at first birth							
	15-19	48%	48%	48%	73%	69%	72%
		650	846	653	264	385	289
	20-24	58%	52%	50%	85%	81%	70%
		314	469	353	146	183	130
	25-29	47%	63%	46%	65%	84%	70%
		75	155	136	48	36	22
	30-34	100%	46%	60%	69%	73%	33%
		22	31	30	13	17	7
By education							
	<=Completed primary	40%	58%	47%	79%	74%	81%
		257	277	180	267	312	216
	>=Some secondary	53%	49%	48%	75%	71%	66%
		579	1031	971	57	209	224
	Missing	59%	51%	57%	72%	83%	40%
		224	193	21	147	100	8
By intended contraceptive use after first birth							
	No	52%	53%	49%	80%	75%	74%
		423	510	549	348	314	254
	Yes	49%	50%	50%	63%	74%	68%
		494	836	531	80	241	168
	Missing	57%	48%	40%	72%	62%	68%
		144	155	92	34	66	26
By planned first birth							
	No	45%	46%	46%	70%	64%	68%
		682	946	808	168	317	299
	Yes	66%	62%	58%	80%	87%	82%
		305	452	306	277	270	132
	Missing	57%	54%	41%	70%	53%	61%
		74	103	57	26	34	17
Total		51%	51%	49%	76%	73%	71%
		1061	1501	1172	471	621	448

Data come from women aged 15-34 who had a first birth from 1993-2002 in the Agincourt Health and Socio-Demographic Surveillance Site

Notes: The estimate for in union includes women who were ever in a union during their years of exposure to a second birth. The estimate for education is based on the maximum level reported.

Table 3: Odds Ratios from Logistic Regression Models Predicting 2nd Birth within 8 Years, by Nationality

	South Africans						Mozambicans					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
Variables	**OR**	**Sig.**	**OR**	**Sig.**	**OR**	**Sig.**	**OR**	**Sig.**	**OR**	**Sig.**	**OR**	**Sig.**
Exposure time to 2nd birth												
1 year	1.00		1.00		1.00		1.00		1.00		1.00	
2 years	3.71	***	3.90	***	3.82	***	4.19	***	4.31	***	4.24	***
3 years	5.13	***	5.66	***	5.44	***	7.98	***	8.77	***	8.50	***
4 years	5.88	***	6.81	***	6.32	***	7.24	***	8.63	***	8.16	***
5 years	5.95	***	7.23	***	6.48	***	9.03	***	11.99	***	11.13	***
6 years	5.69	***	7.16	***	6.20	***	5.53	***	8.10	***	7.46	***
7 years	6.29	***	8.36	***	7.09	***	3.01	***	4.43	***	4.06	***
8 years	5.96	***	8.22	***	6.87	***	3.50	***	5.32	***	4.85	***
Period of first birth												
1993-1995	1.00		1.00		1.00		1.00		1.00		1.00	
1996-1999	0.94		0.92		0.85	*	0.69	***	0.74	**	0.68	**
2000-2002	0.89		0.88		0.72	***	0.62	***	0.78	*	0.66	***
First child died												
No			1.00		1.00				1.00		1.00	
Yes			2.02	***	2.11	***			1.37		1.30	
In union (time-varying)												
No			1.00		1.00				1.00		1.00	
Yes			3.22	***	3.87	***			3.39	***	3.52	***
Age at first birth												
15-19					1.00						1.00	
20-24					0.83	*					1.05	
25-29					0.72	**					0.69	+
30-34					0.69	+					0.52	*
Education (time-varying)												
Completed primary or less					1.00						1.00	
Some secondary or more					1.48	***					1.12	
Missing					0.37	***					0.36	***
Intended contraceptive use												
No					1.00						1.00	
Yes					0.71	***					0.65	***
Missing					0.89						0.75	+
Pseudo R2	0.035		0.072		0.085		0.073		0.120		0.136	
N	3,734		3,734		3,734		1,540		1,540		1,540	

Data come from women aged 15-34 who had a first birth from 1993-2002 in the Agincourt Health and Socio-Demographic Surveillance Site

*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Table 4: Relative Risk Ratios from Multinomial Logistic Regression Models Predicting Planning Status of 2nd Birth Occurring within 8 Years, by Nationality

		South Africans		Mozambicans	
Variables		**Planned Sig.**	**Unplanned Sig.**	**Planned Sig.**	**Unplanned Sig.**
Exposure time to 2nd birth					
	1 year	1.00	1.00	1.00	1.00
	2 years	4.39 ***	3.35 ***	4.68 ***	3.65 ***
	3 years	6.85 ***	4.66 ***	9.96 ***	6.72 ***
	4 years	7.44 ***	5.59 ***	10.28 ***	5.66 ***
	5 years	7.60 ***	5.15 ***	16.35 ***	5.40 ***
	6 years	9.76 ***	4.11 ***	9.87 ***	5.20 ***
	7 years	13.34 ***	3.45 ***	4.51 **	2.47 *
	8 years	8.53 ***	3.94 ***	4.37 **	2.76 *
Period of first birth					
	1993-1995	1.00	1.00	1.00	1.00
	1996-1999	0.64 ***	1.02	0.69 *	0.71 *
	2000-2002	0.41 ***	0.92	0.58 **	0.70 +
First child died					
	No	1.00	1.00	1.00	1.00
	Yes	3.34 ***	1.79 **	1.81 *	0.76
In union (time-varying)					
	No	1.00	1.00	1.00	1.00
	Yes	8.69 ***	2.07 ***	7.37 ***	1.78 ***
Age at first birth					
	15-19	1.00	1.00	1.00	1.00
	20-24	0.97	0.72 **	0.95	1.06
	25-29	0.82	0.64 *	0.59 +	0.64
	30-34	0.74	0.51 +	0.50 +	0.29 +
Education (time-varying)					
	Completed primary or less	1.00	1.00	1.00	1.00
	Some secondary or more	1.50 **	1.52 ***	0.97	1.22
	Missing	0.35 ***	0.31 ***	0.30 ***	0.32 ***
Intended contraceptive use					
	No	1.00	1.00	1.00	1.00
	Yes	0.64 ***	0.78 **	0.72 *	0.58 ***
	Missing	0.68 +	0.91	0.74	0.68
Planned first birth					
	No	1.00	1.00	1.00	1.00
	Yes	1.36 *	0.77 *	1.55 **	0.65 *
	Missing	1.47	0.91	1.22	0.72
Pseudo R2			0.100		0.145
N			3,550		1,462

Data come from women aged 15-34 who had a first birth from 1993-2002 in the Agincourt Health and Socio-Demographic Surveillance Site
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$