Refining the Criteria for Stalled Fertility Declines: An Application to Rural KwaZulu-Natal, South Africa, 1990–2005

Tom A. Moultrie, Victoria Hosegood, Nuala McGrath, Caterina Hill, Kobus Herbst, and Marie-Louise Newell

Stalled fertility declines have been identified in several regions across the developing world, but the current conceptualization of a stalled fertility decline is poorly theorized and does not lend itself to objective measurement. We propose a more rigorous and statistically testable definition of stalled fertility decline that can be applied to time-series data. We then illustrate the utility of our definition through its application to data from rural South Africa for the period 1990–2005 collected from a demographic surveillance site. Application of the approach suggests that fertility decline has indeed stalled in rural KwaZulu-Natal, at about three children per woman. The stall, some 20 percent above the replacement fertility level, does not appear to be associated with a rise in wanted fertility or attenuated access to contraceptive methods. This identification of a stalled fertility decline provides the first evidence of such a stall in southern Africa, the region with the lowest fertility levels in sub-Saharan Africa. (Studies in Family Planning 2008; 39[1]: 39–48)

By the 1980s, fertility levels had started to fall across the developing world. Lower fertility was held to be positively associated with social and economic development, lower child mortality, and arrested environmental degradation. Programs, both global and national, sought to bring about fertility decline by enhancing access to modern forms of contraception and improving reproductive and sexual health services, particularly for women. In recent years, increasing attention has been paid to the possible "stalling" of fertility declines in many countries across the developing world (see, for example, Bongaarts 2006 and Westoff and Cross 2006:2).[1] No consistent definition of what constitutes a stalled fertility decline is currently in use, however. Bongaarts (2006:2) determines whether a stall has occurred by whether the total fertility rate "did not decline between two successive DHS surveys while the country was in midtransition"—that is, when the TFR was between 5 and 2.5 children per woman. In other literature (see, for example, Aghajanian 1991 and Bongaarts 2003), the concept of stalling typically is discussed without a precise definition of the term. Other researchers employ the term without defining it at all (for example, Eltigani 2003 and Westoff and Cross 2006). Semantically, the term carries with it a strong sense that fertility levels are unchanging, an impression strengthened by Bongaarts's test of "did not decline."

This article proposes a new definition for "stalled fertility decline," one that provides greater empirical precision and can take advantage of the rich data available from demographic surveillance systems. We then apply this alternative definition to retrospective and prospective data collected from a demographic surveillance system in rural KwaZulu-Natal, South Africa, to derive estimates of age-specific and total fertility and to determine whether the

Tom A. Moultrie is Senior Lecturer in Demography, Centre for Actuarial Research, University of Cape Town, South Africa. E-mail: tom.moultrie@uct.ac.za. Victoria Hosegood is Senior Lecturer and Nuala McGrath is Lecturer, London School of Hygiene & Tropical Medicine, UK, and Africa Centre for Health and Population Studies, University of KwaZulu-Natal, South Africa. At the time of preparation of this article, Caterina Hill was Demographer, Africa Centre for Health and Population Studies, University of KwaZulu-Natal, South Africa. Kobus Herbst is Senior Lecturer and Marie-Louise Newell is Professor of Health and Population Studies, Africa Centre for Health and Population Studies, University of KwaZulu-Natal, South Africa.

fertility decline has, indeed, stalled. Finally, we consider possible explanations for the phenomena observed.

Criteria for Stalled Fertility Declines

In two early works on the subject, Gendell (1985 and 1989) puts forth four criteria for determining whether a stall in fertility decline has occurred. First, a fertility decline must already have begun; that is, total fertility must have fallen by more than one-fifth from a high level (five or more children per woman of reproductive age). Thus, fertility levels must have fallen by at least twice the amount of the 10 percent decline that is conventionally regarded as heralding the beginning of a fertility transition (Caldwell et al. 1992). Second, in order to distinguish a stall from a generally slow decline, Gendell requires that the decline should have been fairly rapid—of the order of at least 0.15 (and preferably 0.25) of a child per woman per year for at least five years. Third, although a clear stall would be reflected in no change in fertility levels over some period of time (Gendell suggests five years, or four at a minimum), more realistically he assumes a stall to have occurred if a substantial deceleration is evident in the pace of fertility decline. He defines substantial deceleration as at least a halving of the rate of decline in one period compared with the rate that immediately preceded it, if the first two requirements have been met. Fourth, Gendell implicitly concedes that a stalled fertility decline may still show gradually declining fertility. He excludes cases in which fertility has "brought the TFR close to the long-run replacement level" (Gendell 1985:2), arguing that such scenarios undermine the essential concept of a stalled fertility transition. Theoretically, this final requirement is highly problematic because it carries with it the inevitable presupposition that fertility transition ends at replacement-level fertility, an assumption described by Paul Demeny (1997) as "implausible." Certainly, in Western Europe, evidence of sustained total fertility substantially below replacement levels belies this assumption (see, for example, Lesthaeghe and Willems 1999). Accordingly, we contend that the fourth criterion is not merited.

A more rigorous approach to defining and measuring stalled fertility is possible. Building on Gendell's ideas, we propose an alternative definition of stalled fertility decline that would require a statistically significant difference in the rate of fertility decline over two time periods—with each period greater than or equal to five years' duration but not necessarily of the same length. Preferably, too, the slope of the line relating to the second period should not differ significantly from zero. This second criterion is not statistically robust; a small number of points, for example, may not allow us to reject the null hypothesis (slope equal to zero) in favor of the alternative. Nonetheless, a clear downward trend, even for a small sample size, would show a statistically significant departure from zero. This definition encompasses—but more rigorously operationalizes—Gendell's criteria.

Fertility Decline in South Africa, 1990–2005

Fertility among African South Africans has been falling for the better part of 40 years (Moultrie and Timæus 2003), a decline noteworthy both for its steady but slow pace and for its having been driven by a lengthening of birth intervals since contraceptives became widely available in the early 1970s (Brown 1987; Moultrie and Timæus 2002; Moultrie 2005). Analyses of recent data suggest that the trend in fertility in South Africa might continue inexorably downward: between the 1996 and 2001 censuses, fertility among African South Africans continued to fall, from 3.5 to 3.0 children per woman of reproductive age (Moultrie and Dorrington 2004). In KwaZulu-Natal Province (the focus of this study), fertility levels among African South African women fell at almost the same rate between the two censuses, from 3.7 to 3.2 children per woman. The earlier figure is strongly congruent with the three-year total fertility rate (TFR) of 3.7 children for African women in this province indicated by the 1998 South Africa Demographic and Health Survey (DHS), a rate centered almost exactly on the census date.[2]

Camlin and her colleagues (2004) analyzed the retrospective fertility data from the Africa Centre Demographic Information System (ACDIS) using a virtual census conducted on 1 January 2001 and exponential trend extrapolation to estimate trends in fertility in earlier years. By contrast, this study seeks to elucidate historical trends directly from the data, although the results derived are essentially similar. Also, the Camlin study did not examine the prospective data collected after 2001, and the ambiguities of women's residency were neither dealt with nor acknowledged explicitly. Children born to mothers who are resident outside of the demographic surveillance area (DSA) but who are still reported as a member of a household in the DSA may or may not be faithfully recorded depending on the recall of the respondent in each round of the household survey, and the direction of any distortion that may result cannot be determined with certainty. Error in recall may apply also to the children of (absent) resident women in the household born since the previous visit. It would seem reasonable, however, to anticipate that errors of recall would be greater for children born to nonresident women. The magnitude of any such error is likely to be relatively small, however, in light of the design of the survey instrument. Consequently, in any prospective analysis, restricting the analysis to women resident in the DSA, and to births to mothers known to be resident at the time of the birth, is preferable.

Methods

The Africa Centre for Health and Population Studies (referred to here as Africa Centre) demographic surveillance site has been well described in the medical and demographic literature (Hosegood and Timæus 2005; Hosegood et al. 2005). It covers a population of approximately 86,000 individuals, both resident and nonresident,[3] who are members of households in a 435-square-kilometer area approximately 250 kilometers (153 miles) northeast of Durban, the principal city in the province. The site is almost entirely rural, although part of a township is included within the area. Unemployment is high: in 2001, 25 percent of people aged 15–65 years reported that they were unemployed and actively seeking work (Case and Ardington 2004). Health-care and family planning services are provided almost exclusively through a network of state hospitals and clinics. HIV prevalence in the region is exceedingly high: 27 percent of female residents aged 15–49 and 14 percent of male residents aged 15–54 were found to be infected with HIV in 2003–04 (Welz et al. 2007). Overall, 22 percent of residents aged 15–49 years were infected with the virus, with a correspondingly devastating implication for the level of adult mortality. Mortality of children younger than five also is high, estimated at 97 deaths per 1,000 births between 2000 and 2002 (Garrib et al. 2006).

These characteristics indicate that the site is not atypical of a southern African population. An important differentiating exception, however, is that contraceptive use—both nationally and in the study area—is high by African standards, a legacy of the early roll-out of family planning and contraceptive services in South Africa, commencing in the early 1970s when the government was worried about the implications of differential growth rates of the African and white populations of the country (Moultrie 2005).

Data and Analyses

The fertility data from the Africa Centre are analyzed separately and prospectively—a strategy necessitated by the start of data collection in ACDIS on 1 January 2000. The retrospective analysis covers the period from 1990 to 1999 and uses the birth histories collected as part of the baseline round conducted in 2000. In this round, women were asked to provide detailed maternity histories from which the calendar year of each child's birth and the exact age of the mother at each birth could be computed.[4]

The first round of data collection asked only about the histories of women aged 15–49 years. Retrospective estimates of fertility for all years are censored to some extent, therefore, and increasingly so as one looks further back in time. The calculation of the estimates of both numerator and denominator (exposure to risk) is relatively straightforward from such data. The results, however, are not directly comparable with those derived from the prospective analysis because although whether the mother was resident on 1 January 2000 is known, the data collected do not indicate whether she was resident at the time of the birth of her children (because no detailed migration or residency histories were collected in the baseline round of the study). As a result, the retrospective data almost certainly—and unavoidably—include a number of births to women who were not resident at the time. Also, children born within the DSA prior to 1 January 2000 but whose mothers had emigrated before that date would likely not be included in the fertility measurement. Given the high levels of out-migration from the DSA (Hill and Hosegood 2005; Camlin et al. 2007), the latter births likely would have been excluded, whereas mothers would be underrepresented in the estimation of the proportion exposed to risk. The direction of the net effect of migration on the calculated age-specific fertility rates cannot be ascertained without a clearer understanding of these two distortions.

The estimation of fertility from the prospective data covers the six calendar years from 1 January 2000 through 31 December 2005. This estimation requires a greater degree of care and attention to detail, and presents a different set of challenges. Central to the estimation of fertility using such data is the need to ensure a definitional and logical consistency between the elements of the numerator and denominator in the derivation of estimated age-specific fertility rates. This imperative is rendered stronger by virtue of the complex and broad rules for determining individual membership of households and by the desire to estimate fertility among the residents (as opposed to absentee household members) of the DSA.

A linear regression model is fitted to the natural logarithm of the TFR so that the resulting rates reflect a continuous exponential decline in total fertility. The independent variables included in the model are (a) a measure of calendar time, and (b) a dummy variable distinguishing whether each time period in the measure of calendar time is before [coded 1] or after [coded 0] the presumed point of inflection in the fertility rates.[5] If an interaction term between the dummy variable and the measure of calendar time in the model is statistically significant, the implied rates of decline are statistically significant before and after the point of inflection.

Results and Discussion

The number of births and the aggregate person-years of exposure from the retrospective (1990–99) and prospective (2000–05) data are shown in Figure 1. A spike is seen in the number of reported births in 1997 from the retrospective fertility histories of women present at the baseline round. No obvious explanation for this spike can be offered. The apparent falloff in births prior to 1992 is likely attributable in part to the increasing censoring of the data.[6] In the prospective data, births were deemed eligible for inclusion only if the mothers were resident at the time of the birth—that is, a residency episode of the mother included the date of birth of the child. The annual number of births to eligible women in the prospective analysis shows a strongly declining trend, from 1,650 in 2001 to 1,416 in 2005.

The exposure-to-risk line clearly indicates the increased censoring of data the further back one goes from the baseline study of January 2000, whereas a gradual attrition has occurred in the aggregate exposure of resident women covered in the demographic surveillance site during the six calendar years covered by the prospective analysis (2000–05).

The fertility rates estimated from the retrospective and prospective data are shown in Table 1. The impact of the spike in births in 1997 is evident in the estimates of fertility for that year, but few other obvious distortions can be observed. The estimates of total fertility are generally consistent with those for Africans in KwaZulu-Natal from the 1996 and 2001 censuses and the 1998 Demographic and Health Survey. Furthermore, as can be seen in Figure 2, fertility rates fell in most age groups until the year 2000, as Caldwell and his colleagues (1992) suggested would be characteristic of the African fertility decline. The exceptions are teenagers,[7] whose fertility has remained almost constant since the mid-1990s, and 45–49-year-olds, whose fertility was fairly constant until declining after 2000.

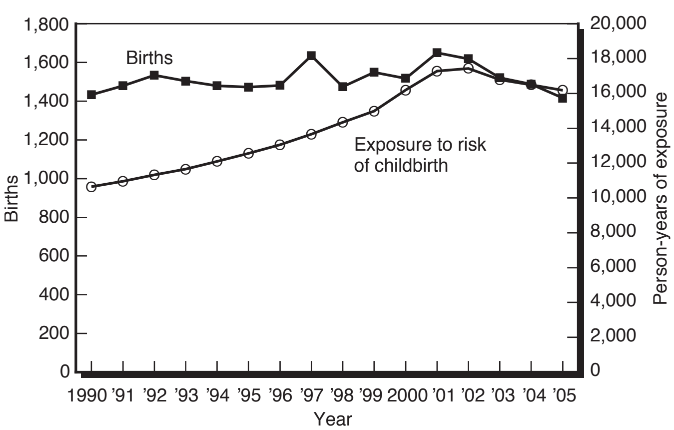
The pace of fertility decline shown by the prospective analysis is much slower than that indicated by the retrospective analysis. Whereas fertility had fallen by 3.3

Table 1 Age-specific and total fertility rates by year, KwaZulu-Natal, South Africa, 1990–2005

	Age-specific fertility rate							
Year	15–19	20–24	25–29	30–34	35–39	40–44	45–49	TFR
1990	0.083	0.191	0.197	0.219	0.134	0.054	0.010	4.4
1991	0.088	0.190	0.205	0.192	0.132	0.054	0.010	4.4
1992	0.101	0.186	0.201	0.175	0.137	0.054	0.010	4.3
1993	0.091	0.176	0.185	0.181	0.127	0.054	0.010	4.1
1994	0.091	0.158	0.184	0.172	0.114	0.053	0.010	3.9
1995	0.102	0.143	0.179	0.164	0.100	0.050	0.010	3.7
1996	0.085	0.147	0.161	0.161	0.112	0.059	0.007	3.7
1997	0.092	0.166	0.172	0.159	0.115	0.057	0.010	3.9
1998	0.090	0.142	0.133	0.139	0.105	0.041	0.011	3.3
1999	0.084	0.154	0.144	0.145	0.090	0.041	0.009	3.3
2000	0.082	0.137	0.133	0.120	0.079	0.033	0.012	3.0
2001	0.088	0.134	0.130	0.120	0.090	0.035	0.004	3.0
2002	0.083	0.145	0.135	0.105	0.081	0.028	0.005	2.9
2003	0.076	0.148	0.131	0.125	0.067	0.026	0.002	2.9
2004	0.075	0.147	0.126	0.108	0.092	0.031	0.003	2.9
2005	0.073	0.152	0.117	0.102	0.077	0.034	0.002	2.8

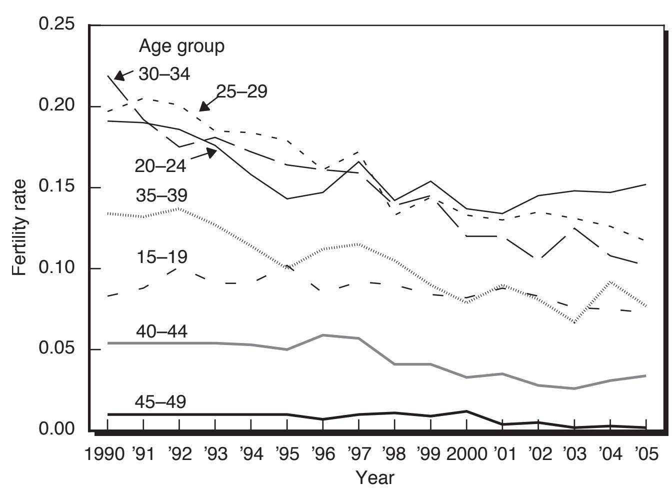
Source: Africa Centre Demographic Information System.

Figure 1 Number of births and person-years of exposure, KwaZulu-Natal, South Africa, 1990–2005



Source: Africa Centre Demographic Information System.

Figure 2 Age-specific fertility rates by age group, KwaZulu-Natal, South Africa, 1990–2005



Source: Africa Centre Demographic Information System.

percent per annum in the period from 1990 to 1999, the equivalent pace of decline from 2000 through 2005 was 1.1 percent per annum. As can be seen from the data for 2000–05 in Figure 2, the pace of decline in fertility has slowed in five of the seven age groups. The slowing was moderate among women aged 25–34, but was so dramatic among those aged 20–24 and 40–44 that fertility actually increased over this period in these two age groups.

Of course, the fertility rates derived from the prospective data are not entirely comparable with those from the retrospective investigation: the latter reflects the fertility of women present at the baseline round, irrespective of earlier residency; the former is the fertility of residents of the DSA. The estimation of the proportion of women exposed to risk that takes into account residency episodes cannot be precise with biannual data collection. Might this definitional difference account for the apparent stall? We argue that it does not. Evidence to this effect can be marshaled from a comparison of the results presented here with those pertaining to the fertility of women who had unbroken residency within the DSA during the period of investigation—that is, women who had never migrated out of the DSA during the period of investigation. The comparison (not shown) reveals that the fertility of women who leave and return is not materially different from that of women who never leave, even though the exposure of those who have never left accounts for less than half of the total exposure for all women.

The data, therefore, suggest a significant and substantial reduction in the pace of fertility decline in the Africa Centre DSA population during the past 15 years, with the leveling off of the decline occurring sometime around 2000. Indeed, fertility in the area might have stalled. The slowing of the pace of fertility decline has occurred in the period since abortion was legalized in 1996,[8] but if any effect were associated with legalized termination of pregnancy, it would have increased rather than decreased the pace of fertility decline.

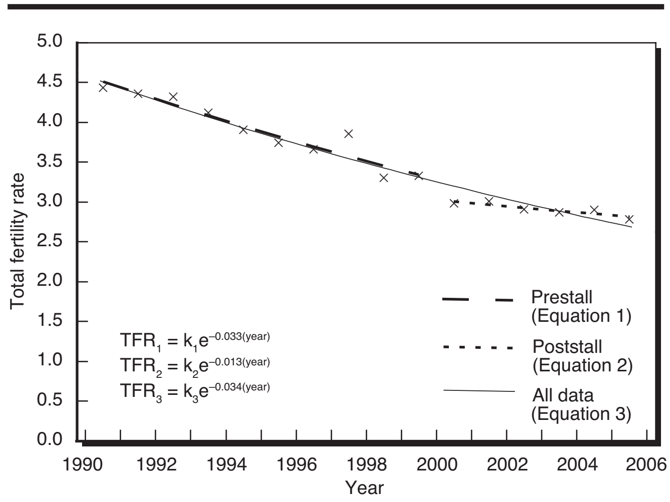
Revisiting the Definition of Stalled Fertility Decline

The fertility trends for the population under investigation meet all of Gendell's conditions. Even without the ancillary evidence from the two most recent censuses, fertility in the district has been falling for some time and is certainly more than a fifth lower than it was before the South African fertility decline began in the 1960s. The decline has not been as rapid as Gendell specifies, but the point that the South African fertility decline is remarkable for its slow pace has been established in the literature. Gendell's third criterion is met: a clear and abrupt change in the pace of fertility decline occurred around the year 2000 (the rate in the period 2000–05 is less than half the rate of the preceding five-year period). With regard to his fourth requirement, fertility levels of about three children per woman are substantially higher than the currently estimated replacement fertility rate of between 2.4 and 2.5 children per woman suggested for South Africa (Garenne et al. 2007).

Our revised criteria for a stall, by contrast, allow for more rigorous operationalization. In effect, what is tested is whether two exponential curves (fitted to the portions of the data where the dummy variable is 1 and 0) fit the data better than a single exponential curve fitted to all the data. Applying this test to the 16 data points derived earlier results in the estimation of the underlying rate of decline (dummy variable = 0) of –0.013 percent per annum (as derived earlier), with a 95 percent confidence interval of –0.028 to 0.019. That the confidence interval includes zero and that the coefficient has a p-value of 0.080 suggest that it is not possible to conclude that the underlying rate of fertility decline for the most recent period (where the dummy variable is equal to zero) is not statistically different from zero. The coefficient of the interaction term is estimated to be –0.021 and is statistically significant ($p = 0.022$). Together, these coefficients show that the annual rate of decline estimated from the retrospective data was 3.2 percent, a pace of decline that is statistically different from the estimated pace of decline in the post-2000 years of 1.3 percent per year. Therefore, the rate of change in the second period not only differs significantly from the rate of change in fertility but also may not be different from zero.

The model is represented graphically in Figure 3. The model shows that the two curves fit the data better than

Figure 3 Models of fertility decline, KwaZulu-Natal, South Africa, 1990–2005



Source: Africa Centre Demographic Information System.

does a single curve. This point is also apparent from the autocorrelation of the residuals that arise from fitting the single curve. In the second period, the residuals from a single curve evidently indicate a clear trend from negative to positive, implying that the residuals are not randomly distributed. This analysis shows, therefore, that a clear difference can be observed in the pace of the fertility decline in the Africa Centre DSA for the period 2000–05 relative to the previous decade.

Possible Explanations for the Stall

As with the lack of agreement on the criteria for stalls in fertility decline in the developing world, no consensus exists about the causes of such stalls. In his study of countries that stalled in midtransition, Bongaarts (2006) finds that these countries differ in their socioeconomic characteristics and the stalls are not attributable to reduced access to contraception, but that an overriding commonality is found in a leveling of demand for contraception and a rise in the wanted fertility rate. In a detailed study of Kenya, Westoff and Cross (2006) reach similar conclusions. Both of these studies stand in contrast to Eltigani's (2003) study of stalled fertility in Egypt, in which the author concluded that the failure to lower the fertility desires of comparatively well-off women in Egypt eliminated the potentially substantial influence of this group in diffusing a preference for lower fertility.

Several explanations for the observed stall in fertility decline in rural KwaZulu-Natal may be considered. First, it may be simply an artifice of the data. This explanation is unlikely, however, in light of the strong consistency between the levels in the fertility estimates from the retrospective and prospective analyses. Moreover, a strong consistency is seen between the fertility schedules within each analysis, and most of the divergence in the data can be explained by the differing definitions of residency used in the two investigations. The consistency of the fertility schedules also suggests that the trend in fertility seen in the prospective analysis is unlikely to reflect random error.

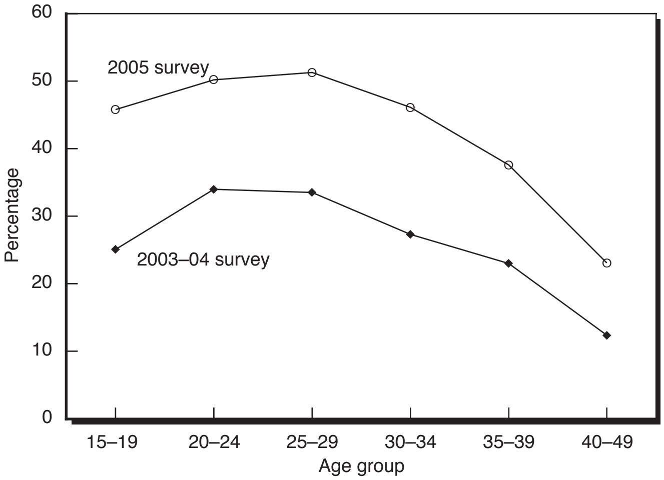
A second explanation, following the approach of Bongaarts (2006) and Westoff and Cross (2006), may be sought in the trends in contraceptive use in the DSA over the entire duration of the study. Unfortunately, data were collected on ever use of contraceptives only at baseline; therefore, long-term trends in current contraceptive use cannot be examined for the period before 2000. Furthermore, changes in the patterns and trends in contraceptive use can be determined only for the period from 2003–04 to 2005. Should clear leveling off in rates of contraceptive adoption or—more importantly in this context—a shift in method mix from more to less effective means of contraception occur in the wake of a generalized HIV/AIDS pandemic, this shift might offer a compelling explanation for the slowing decline in fertility in the area. The shift in method mix may be highly significant. Great effort has been expended to convince women to use condoms as protection against HIV/AIDS transmission and—in the absence of a significant proportion of dual-method use—to protect against both HIV and the risk of becoming pregnant. An increase in condom use at the expense of the use of more effective methods may result in a greater level of contraceptive failure, unintended pregnancy, and commensurately higher fertility, thereby creating the impression of a stall in fertility decline.

Although the results from the 2003 South Africa Demographic and Health Survey cannot be used to evaluate continued trends in current contraceptive use over time relative to earlier studies,[9] the 1998 DHS reported that in KwaZulu-Natal, 58 percent of sexually active women were currently using any method of contraception (Department of Health 2002) and 57 percent were using modern methods. At the time the survey was conducted, condom use was very low, at less than 3 percent of sexually active women. The most commonly used methods were hormonal (injectables [26 percent] and the pill [14 percent]). If the data in that survey are restricted to African women living in rural KwaZulu-Natal (n = 546), the figure for current contraceptive use is 35 percent; the vast majority (23 percent, or two-thirds of all women currently using a method) reported using injectables. Only three women reported current use of (male) condoms for contraception.

The detailed data collected by the Africa Centre tells a more nuanced story. Between 2003–04 and 2005, current use of contraceptives increased from 25 percent to 41 percent, and the increase was roughly equally spread over all age groups (see Figure 4). This increase suggests that a slowdown in contraceptive adoption is not responsible for the apparent stall in fertility, nor is the extent of the increase mirrored in the small observed decline in fertility between 2004 and 2005.

When the trends in contraceptive use by method are analyzed, however, an interesting pattern emerges, as shown in Figure 5. Data relating to current use of the pill and injectables (Depo Provera and Nuristerate) are overwhelmingly consistent (albeit showing an outlier in the 30–34 age group for Nuristerate in the 2003–04 survey resulting from the small number of women using the method). Current use of all three methods has changed marginally between the two dates. Of greater significance is the shift in the pattern of condom use, particularly among younger women. A detailed investigation into the

Figure 4 Percentage of women surveyed who reported that they were currently using modern contraceptives, by age group, KwaZulu-Natal, South Africa, 2003–04 and 2005



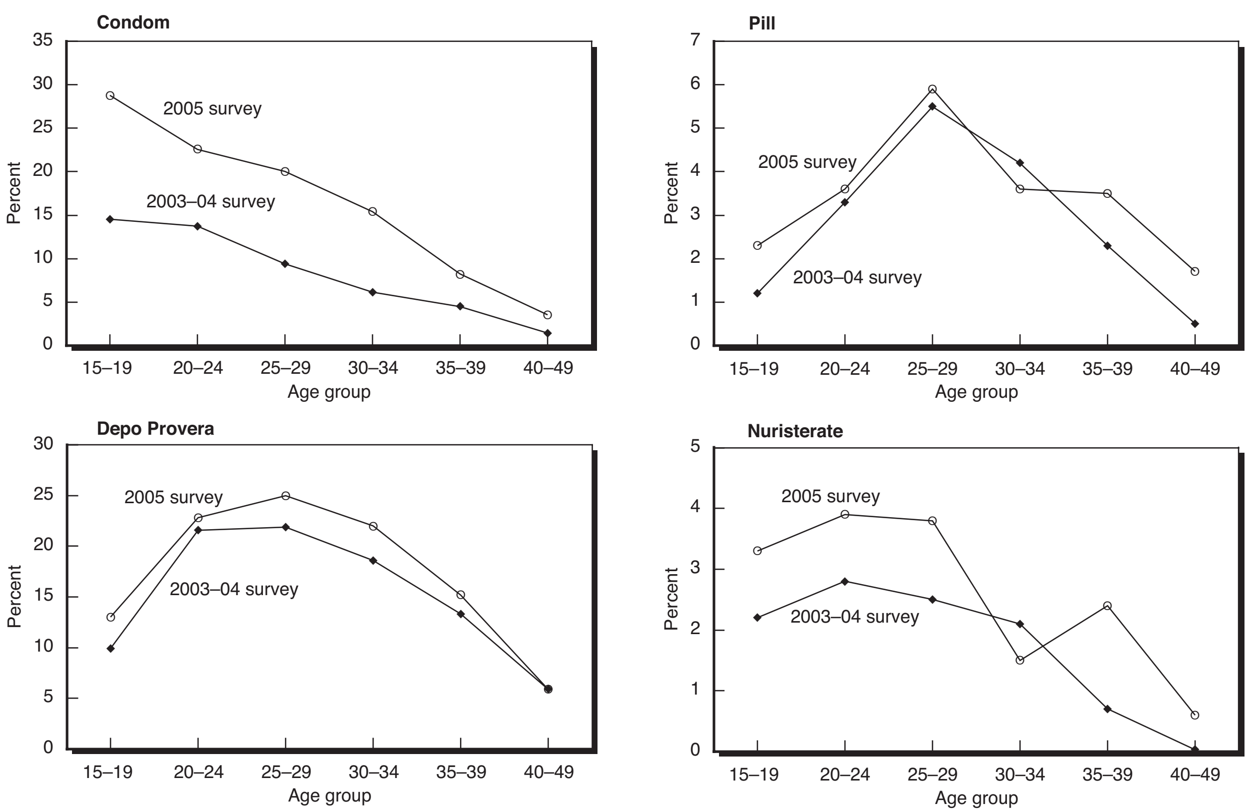
Source: Africa Centre Demographic Information System.

fieldwork operations in the two rounds of the study that collected contraceptive-use data suggests, too, that socially desired response bias is an unlikely explanation. The trends suggest, however, that method shift from more to less effective methods of contraception cannot explain the trajectory of the fertility decline after 2000.[10]

Finally, the rollout of interventions to prevent mother-to-child transmission of HIV may have allowed HIV-positive women to consider the possibility of bearing (more) children when such a notion was not possible previously. This change may account for the most recent stall in fertility decline, but it is unlikely to explain the stall in the early years of the data collection. Furthermore, the testing that allows people to obtain knowledge of their HIV serostatus has been developed more recently than the period of time for which we observe a change in fertility decline, and has been available to those in an age group for which the fertility impact of HIV would still play a role (via subfecundability).

During the early years of the pandemic, HIV-infected women were discouraged from childbearing. The advent of drugs that substantially reduce the risk of mother-to-child transmission of the virus around the time of delivery, however, has eased concerns that HIV-positive women will bear infected children who will die young. This change of view has been further strengthened by the wider availability of antiretroviral therapy used to

Figure 5 Percentage of women surveyed who reported that they were currently using modern contraceptives, by method type and age group, KwaZulu-Natal, South Africa, 2003–04 and 2005



Source: Africa Centre Demographic Information System.

delay progression of the disease among infected people, reducing concerns that parents may not live long enough to see their children grow up. The stalling of fertility decline seen in KwaZulu-Natal, where programs to prevent mother-to-child transmission and to provide HIV treatment were introduced in 2001 and 2004, respectively, may be an early indication that the fertility of HIV-positive women is currently less affected by their infection than it was previously. As more data become available from the annual HIV surveillance in the Africa Centre setting, this aspect of stalling can be explored in greater detail.

Conclusion

This article offers a new, more robust way of conceptualizing a stalled fertility decline and suggests a novel approach to quantifying such an event. The application of this approach to one poor, rural part of South Africa strongly indicates that fertility decline may have stalled. The stall may be widespread elsewhere in South Africa, but current survey and census data are inadequate to determine whether this is the case. Until now, given the slow, sustained pace of fertility decline in South Africa, a stall in fertility had seemed highly improbable. In their 1993 study, Caldwell and Caldwell could not decide whether the fertility decline in South Africa had been fast (given the institutional forces ranged against Africans) or slow (considering the comparatively developed nature of the South African economy and the strength of the family planning programs instituted by the apartheid government).

Our documenting of this stall is noteworthy for several reasons. First, it expands our knowledge of the locations of stalls in fertility decline in the developing world, revealing that a stall has occurred in a southern African country that started off with a relatively low level of fertility. Second, the stall does not appear to be associated with obviously changed patterns of contraceptive use (for example, substitution of methods). Third, the stall in fertility decline is not likely to be associated with a rise in wanted fertility, in light of the historical evolution of long birth intervals in South Africa (Moultrie and Timæus 2002). This reasoning is buttressed by the argument by Timæus and Moultrie (2003) that simple typologies of birth spacing and limiting are inappropriate in a South African context; the pattern of childbearing in the country is consistent neither with limitation (cessation of childbearing when the desired parity has been reached) nor with spacing as conventionally defined (bearing a subsequent child when the last-born child has reached a specified age). Instead, the pattern of childbearing is reminiscent of the "permanent postponers" discussed by Lightbourne (1985). Likewise, the disrupted and fractured nature of sexual relationships in South Africa, both during and after apartheid, with their attendant consequences for gender and power relations, are unlikely to provide an explanation of why the fertility decline has stalled now rather than in the past.

This study adds to the growing literature that calls into question the presumption of a causal association between HIV and fertility. If the expected effect of HIV is only to reduce fertility, the stall in fertility decline in a population as severely affected by HIV, according to the findings reported by Terceira and her colleagues (2003), is remarkable. Certainly, the stall calls into question the generalizability of the study by Lewis and his colleagues (2004), which suggested that total fertility would decline by 0.37 percent for every percentage point of HIV prevalence among women aged 15–44 in sub-Saharan Africa. In terms of the Africa Centre data, such an effect would suggest that the fertility decline attributable to HIV infection would be of the order of 10 percent, or approximately 0.3 of a child per woman during the past decade. The observations set forth here may be interpreted, rather, as offering empirical support to the arguments advanced by Ezeh (2003), who finds no association between HIV prevalence and fertility intentions. The findings from our study suggest further that—at least in terms of aggregate measures of fertility—HIV prevalence is subsidiary in impact to the main determinants of fertility (socioeconomic, social, and demographic).

Although this study documents and demonstrates a new approach to conceptualizing the identification and measurement of stalled fertility transitions, much more effort must be focused on developing our understanding of their causes. We suspect that the search for universal explanations, capable of explaining stalls in a multiplicity of situations, is unlikely to be successful; however, the more nuanced understanding of local conditions and socioeconomic dynamics provided by longitudinal data captured by demographic surveillance sites may prove invaluable in helping researchers understand why, and under what conditions, fertility stalls.

Notes

1 Bongaarts (2006:1) observes that "stalling is a neglected issue" in the literature on fertility transitions, but an examination of papers presented and session topics discussed at the annual meeting of the Population Association of America in the past two years indicates that the topic is attracting increased interest.

2 Estimates of fertility from the 2003 DHS are neither presented nor compared because they have been shown to be unreliable. Results from this survey suggest an impossibly low three-year TFR in

KwaZulu-Natal of around 0.6 children per woman (Department of Health 2004).

3 Residency is self-defined by household members. Typically, it is the place where they keep their daily belongings and spend most nights. An individual can be recorded as resident at only one homestead at any point in time. At each field-worker visit, all changes in residency (internal or external in- and out-migration) are recorded.

4 Retrospective birth histories were also collected from new entrants to the DSA in the first round in which they were identified as new household members. Because these women are known to have moved into the area, they are clearly different from those identified at the time of the baseline study, so they have been excluded from the retrospective analysis.

5 The reason for coding in this order is that the main effect relating to the slope refers to the more recent (that is, stalling) period. The coefficient of this main effect, therefore, can readily be tested for whether it is significantly different from zero. One obvious limitation of the model is that the estimates of total fertility are themselves random variables. For the kinds of sample sizes required to estimate fertility with any degree of reliability, however, the formula for the variance of the total fertility rate given by Smith (1992) results in a relatively small variance for the total fertility rate, thereby making the point-estimate of the rate of decline in fertility influenced less by random error. The point of inflection should be determined by the data, rather than by supposition. The approach adopted here was to use the Akaike Information Criterion (AIC) goodness-of-fit statistic to determine which division of points (into pre- and post-stall) best fit the data.

6 As mentioned above, retrospective data on fertility were collected only for women aged 15–49 at the inception of the study. Therefore, estimates of fertility are increasingly censored with each year preceding the baseline study. In order to estimate the fertility of women aged 45–49 five years before the baseline (that is, in 1995), retrospective reporting of fertility data for women aged 50–54 at the baseline would have been required. Evidently, the estimates of older-age fertility are censored first. The coincidence is fortunate that fertility within the older age groups is both much less significant than fertility within younger age groups and that absolute changes in fertility within these age groups are less dramatic than those within younger age groups. Hence, in order to derive a longer series of fertility estimates from the baseline study, the fertility rate in the 45–49 age group for years before 1996 was constrained to be the average fertility rate in that age group in the years 1997–99 (ten children per 1,000 women), whereas fertility estimates in the 40–44 age group before 1993 were similarly constrained to be the average fertility rate of women aged 40–44 in the years 1994–96 (54 children per 1,000 women). If fertility has been falling in this population, a result of both adjustments would be that the estimated total fertility rates certainly will be slightly underestimated for those earliest years and will likely reflect a slightly slower pace of fertility decline than that which was experienced. Some indication of the lack of sensitivity of the most distant observations to the assumptions made about the fertility of women older than 40 can be seen by observing that if both the 40–44 and 45–49 age-specific fertility rates were 25 percent higher, the estimated total fertility rate would increase by less than 2 percent.

7 See Moultrie and McGrath (2007) for further discussion of the contentious subject of fertility rates among teenagers.

8 The legislation became effective in February 1997. The legal framework notwithstanding, availability of abortion services is contingent on the willingness of nurses to perform the procedure. This contingency has curtailed women's access in rural areas such as the study site.

9 The data cannot be used for the same reason that the fertility data are unreliable: the women in the 2003 survey are disproportionately nulliparous and, therefore, have a materially different pattern of contraceptive use.

10 Changes in the way data on contraception are collected in ACDIS limit the usefulness of these investigations for shedding light on the link between changing patterns of contraceptive use and the apparent stall in fertility decline. Nevertheless, we note that the current contraceptive-use data are broadly consistent with those observed in the 1998 DHS and that the proportion of women in ACDIS reporting ever using contraceptives also increased between 2000 and 2003–04. Most of this increase occurred among younger women reporting ever having used condoms.

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