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Towards below replacement fertility in Southern Africa

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Abstract

Aims: To analyse trends in fertility rates and net reproduction rates in Agincourt, a rural area of South Africa located in the former homeland of Gazankulu near the Mozambican border. Trends are analysed in the context of widely available modern contraceptive methods and of increasing HIV/AIDS.

Methods: A health and demographic surveillance system is in place since 1992 in Agincourt, on a population of approximately 70 000 persons, with annual census and comprehensive recording of births and deaths. It was complemented with a retrospective study of fertility at baseline. Retrospective and prospective data were used to calculate trends in fertility, survival and net reproduction. When possible, they were compared with data from other censuses and surveys in the same ethnic group.

Results: The fertility transition has almost ended over a period of 25 years in Agincourt. The Total Fertility Rate (TFR) averaged 6.0 in 1979, and 2.3 in 2004. Fertility declined in a proportionate fashion in all age groups, including adolescents in the recent period. The Net Reproduction Rate (NRR) declined from 1.8 to 1.0 during the prospective period (1992-2004). At the current rates of changes in fertility and mortality, the NRR could be expected to reach 0.63 by year 2010.

Conclusions: The situation of a below replacement fertility level is new for rural Africa, and is likely to have many demographic, economic and social implications in the future. The population might even decline for the country as a whole, and is already stagnating in Agincourt because of negative migration flows balancing the small excess of natural increase.

Key word: Fertility rate, Fertility trends, Net reproduction rate, Replacement fertility, Demographic transition, HIV/AIDS, Agincourt, South Africa

Background

Sub-Saharan Africa as a whole remains the continent with the highest levels of fertility. For decades, the fertility transition was seen as remote, with some exceptions in Eastern and Southern Africa. However, the Demographic and Health Surveys program (DHS), which followed the World Fertility Surveys program (WFS), showed repeatedly that fertility was declining almost everywhere in Africa, especially in urban areas [1]. In their overview of fertility decline using the WFS and DHS surveys, Garenne and Joseph argued that the transition had started almost everywhere in urban areas, in the 1960s for the pioneers and in the 1980s for the latecomers, and that it started some 10 to 20 years later in the rural areas [2]. The speed of fertility decline was found variable across country, from rapid declines, as in urban Kenya, to slow changes in remote places, such as rural West Africa where fertility remains at very high levels and close to natural fertility.

With the emergence of the HIV epidemic in the early 1980s, fears of negative population growth due to increasing mortality were expressed. However, birth rates were still high enough at that time that demographic projections made in the late 1980s indicated that population growth would continue for a long time [3, 4].

Twenty years later, the situation is quite different: fertility has declined dramatically in many areas and much faster than expected, HIV seroprevalence rose to much higher levels than anticipated, AIDS mortality became the leading cause of death in many places, and concerns with replacement level fertility could be expressed.

The situation of South Africa is outstanding in many respects when compared with other African countries. South Africa is far more developed economically, with a strong industrial base, higher income and higher levels of education. However, the average situation hides considerable disparities -- between middle and upper class Whites often living at socio-economic parity with Europeans, and poor Black / Africans in remote rural areas living in conditions similar to those of Africans in other countries of the continent. Certain areas that formed part of the Bantustan system during the apartheid years (the ‘homelands’) were particularly disadvantaged, and benefited from less, and often ineffective, investment in health and education than cities, towns and other rural areas.

Earlier work has documented the onset of fertility decline in South Africa. Mostert showed that fertility has been declining since the late 1960s in South Africa, from levels just below 6 children per woman in 1965-1969 to 3.4 children per woman in 1990-1994 [5].

Similar findings were documented by other authors [6-9]. Reconstruction of fertility trends from the 1998 South African - DHS survey also showed a similar trend [2]. Moultrie and Timaeus, using census and survey data, came to similar conclusions [10]. The onset of fertility decline appeared to occur in parallel with the launching of a large national family planning program in 1974, although fertility seems to have declined somewhat earlier in urban areas, including in the Black / African population [11-13]. The national family planning program rapidly reached rural areas where modern contraceptives were provided in public health clinics at no cost.

Fertility decline in rural areas, especially in the former homelands, is less documented. In their study from the Hlabisa district in KwaZulu-Natal, Camlin and colleagues showed that fertility was declining rapidly at least since the early 1980s, and was reaching levels close to replacement in 2003 [14]. In this study, fertility decline affected all age groups in a similar way, with the exception of adolescent fertility which tended to remain at high levels between 1980 and 2001.

Proper documentation of the fertility decline takes on increasing value in face of the fast increasing HIV/AIDS epidemic in South Africa. Current levels of HIV seroprevalence among pregnant women exceed 20% in most provinces, and reach 40% or more in certain areas of KwaZulu-Natal. The combination of high mortality with low fertility might lead to below replacement fertility levels, and therefore to negative population growth in the long run. These questions remain wide open for several Southern African countries, not only for urban areas, but also increasingly for rural areas.

Aims

This paper aims at documenting the course of the fertility transition and its consequences for net reproduction in a rural area of South Africa, in the context of modern contraception and expanding HIV/AIDS epidemics. The study is part of a comprehensive effort to document health and population changes in post-apartheid rural South Africa, to research their driving factors and to understand their consequences.

Data and methods

Study area

The Agincourt study area and the Health and Demographic Surveillance System (HDSS) are well described elsewhere, and in other papers in this collection of articles [15-17]. In brief, the study area is located in the north-eastern part of South Africa, near the Kruger National Park and the Mozambican border, and at the boundary between the Limpopo and Mpumalanga provinces. The study population accounted for about 70 000 persons in year 2004 and lives in a sub-district comprising 21 villages of the Bushbuckridge (also called Bohlabela) district.

The population is of the Shangaan (also called Tsonga) ethnic group, a group that has been living for centuries on both sides of the border between South-Africa and Mozambique. Starting in the mid-twentieth century, the population was repeatedly relocated from more fertile surrounding areas into atypical homeland villages as part of the apartheid policy, and until 1994 the area was part of the Gazankulu 'homeland'. Freedom of movement was restricted throughout the apartheid years, with legislation being progressively repealed from the late 1980s.

During the Mozambican civil war (1975-1992), many farmers crossed the border to take refuge in South Africa, with many settling in border areas of Gazankulu during the 1980s. Of the current population of the Agincourt study area, about a third is of Mozambican origin. Mozambicans tended to be poorer and less educated than native South Africans, but have dramatically improved their situation over recent years.

Modern contraception is relatively new in the study area. The 1974 national family planning program reached the study area within a few years of its launching. Since then, a range of modern contraceptive methods are available and free in public health clinics, in particular the oral contraceptive, the IUD and the preferred injectable (Depo-Provera). According to the 1998 DHS survey, restricted to Shangaan living in rural Limpopo province, 45% of ever married women and 59% of never married women who already had intercourse were using modern contraception.

As in most parts of South Africa, HIV/AIDS is raging in Agincourt. The virus arrived around 1990, and the first documented AIDS death in the study area occurred in 1994. Since then, HIV seroprevalence increased dramatically and was estimated at around 25% among

pregnant women in 2004 [18]. AIDS is now the leading cause of death among adults in Agincourt, accounting for 36% of the deaths of women aged 15-49 years.

Studies conducted in the 1980s and 1990s showed that HIV infection lowered period fertility, by some 20% to 40% depending on the survey and the stage of the epidemic [19]. The average of six local studies conducted in Eastern Africa indicates a 24% reduction in GFR and a 32% reduction in TFR [19]. The 2004 Cameroon DHS survey provides recent estimates based on a national population: HIV seropositive women had 24% lower GFR and 37% lower TFR than seronegative women in the three years prior to the survey [Author's calculations]. Furthermore, age specific fertility rates were somewhat higher among HIV seropositive women below age 20, but much lower at age 30-34, indicating complex interactions between age, fertility and HIV infection. The HIV infection has indeed both biological effects on fertility (reducing fecundity, increasing pregnancy losses) and behavioural effects (marriage, contraceptive use, frequency of intercourse, breastfeeding, abstinence) [19].

Data collection

Routine collection of demographic data has been in place in Agincourt since 1992, with an annual census and systematic recording of all births, deaths, in- and out- migrations, plus other events [15-16]. For the analysis of fertility trends, two sources of data were utilized: prospective and retrospective. The retrospective arm of the study is built on full maternity histories of all women in their reproductive ages collected at baseline, as done in retrospective surveys such as the Demographic and Health Surveys (DHS). The prospective arm is the routine collection of new births at each annual census, done by up-dating maternity histories of women present at the previous round, and completing full maternity histories of immigrant women. Chances of missing events are small, although some live births followed by early deaths were probably miscounted in the first few years of the HDSS, and some live births which might have occurred after in-migration (and therefore count as eligible) might have been improperly entered in the maternity history file.

In addition to fertility data, mortality data were used for computing net reproduction rates. Mortality data were also drawn from the routine HDSS. Life tables were computed from census data and death registration data, by calendar year and single year of age for the

prospective period. They allowed to compute the age specific survival rates necessary for the calculations of net reproduction.

All rates were calculated per person-years at risk (in fact per person-day originally), and formulae to calculate age specific fertility rates, age specific death rates, general fertility rates, total fertility rates and net reproduction rates are standard formulae found in any demographic text book. The age specific fertility rate (ASFR) is the incidence of live births per female population of a given age group per year; the general fertility rates (GFR) is the incidence of live births per female population in their reproductive ages (15-49 years); the total fertility rate (TFR) is the mean number of live births for women who survive the reproductive period (in this study age 12-49 years); the net reproduction rate (NRR) is the mean number of female births in the next generation produced by females born in the previous generation: it includes a fertility component (children born during the reproductive period), a mortality component (survival from birth to the reproductive ages) and a sex ratio at birth. For all calculations, the sex ratio at birth was taken as 1.00, the average for South Africa over the 1991-2002 period. In Agincourt, the sex ratio at birth averaged 0.985 [95% CI= 0.959-1.013] over the 1992-2004 period, a value not significantly different from 1. The sex ratio at birth is commonly low and close to 1 in southern Africa [20]. Tables are presented in 5-year age groups starting at age 12, to better capture adolescent fertility, and as recommended by other authors [21].

Comparisons were made with other sources of data: censuses and surveys. Each time the same ethnic group was selected: speaking the same language (XiTsonga), living in the same province (Limpopo) and in rural areas. Due to a strong geographical concentration, a majority of the rural Shangaan of Limpopo live indeed in the Bushbuckridge district. Data from the 1996 and 2001 Census (10% samples provided by the IPUMS project), allowed to compute completed family size by birth cohort, and general fertility rate by applying the reverse survival method to the births of the past three years. Data from the 1998 DHS survey allowed to compute directly fertility rates, but were based on a small sample of 225 women, with wide confidence intervals. Comparisons with these other data sources, or with the Africa Center DSS system in Hlabisa district in KwaZulu-Natal, showed that Agincourt data on fertility levels and trends are comparable to others (see below in the “Results” section).

Results

Population dynamics

The study area had positive population growth at baseline (1992-1993): birth rates exceeded death rates by far (30.9 per 1000 versus 5.0 per 1000), and in-migration more than compensated out-migration flows (82.5 per 1000 versus 62.5 per 1000). As a result population was growing quite rapidly (Table 1). The situation changed dramatically over time: birth rates declined to 21.0 per 1000 in the last two years (2003-2004); death rates increased to 10.9 per 1000 primarily as a result of the HIV/AIDS epidemic; out-migration always exceeded in-migration after 1994 when people had the freedom to move away from the former homeland areas and to settle elsewhere. As a result, population growth essentially halted, and indeed was negative in year 2002 and close to zero thereafter. Total population of the study area stabilized at around 70 000 persons, some 10 000 more than at baseline.

Fertility decline

The history of fertility decline in the study area was reconstructed by comparing retrospective and prospective data (Figure 1). The Completed Family Size (CFS) for cohorts born before 1950 was estimated at 5.12 children per women, a value almost identical to that of the 1996 census (CFS= 5.17) for the cohorts born between 1910 and 1949 in the same population. The Total Fertility Rate was estimated at 6.0 children per woman in the late 1970s and seems to have started to decline around 1980. However, the fertility decline was halted by the influx of Mozambican refugees who came in large numbers in the early to mid-1980s into the study area, fleeing the civil war across the border. They had a higher fertility than the native South Africans, even though both belong to the same *shangaan* ethnic group.

The fertility decline resumed soon afterwards, for both South Africans and Mozambicans, and the TFR was about 4.0 children per woman at baseline (1992-1993). Note that prospective and retrospective data are fully compatible just before and just after the first census (1992). The fertility continued to decline during the prospective period, and the TFR equalled 2.3 children per woman in 2004. The fertility level appeared somewhat lower than the trend in the mid 1990s for unknown reasons, as if the fertility decline had come to a stall for a few years, though differences were small. Furthermore, census data also showed a stagnation of fertility between 1996 and 1999, with a General Fertility Rate (GFR) of 97 per

1000 in 1996 and 101 per 1000 in 1999, values almost identical to corresponding values in the Agincourt DSS (99 and 102 per 1000 respectively).

The decline from 6.0 to 2.3 children per woman describes an almost complete course of the fertility transition over a 25 year period (1979-2004), which is remarkable for a rural area of Africa.

Age pattern of fertility decline

Both prospective and retrospective data provide the age pattern of fertility (Figure 2). Since the onset of the fertility transition, fertility rates declined in a proportionate way at all ages, although adolescent fertility remained high for a long time and started to decline as in other age groups only in the mid-1990s. Note that the pattern of decline for adolescents is not as smooth as for the other age groups primarily because of smaller numbers (average of 119 births per year in the 12-16 age group). During the prospective period, fertility rates were reduced by 39%, and there was no statistically significant difference of the ratio of fertility decline between the age groups studied. However, the fertility decline at older ages (-46% at age 35-49) was somewhat faster than at younger ages (-36% at age 12-34), the difference being borderline when the larger groups were considered (P= 0.081).

A proportionate decline at all ages is typical of successful introduction of modern family planning methods in natural fertility situations, and is commonly found in countries with a significant fertility decline such as Kenya or Zimbabwe, and found in virtually all recent DHS reports of African countries. Indeed, when modern contraceptive methods are proposed anew, they are likely to be adopted for a variety of reasons by those in need (avoiding a teenage pregnancy, spacing two births, limiting family size), and likely to reach all age groups, although this is not necessarily the case in other parts of the world. This argument was already proposed by Caldwell and colleagues already in the 1980's [22], and has been confirmed by recent DHS data.

Net reproduction

The net reproduction rate (NRR) was probably high in pre-transitional years, though was not formally computed since no life table was available prior to 1992. The net reproduction rate was estimated at 1.76 at baseline (1992-1993), and declined steadily over the study period to reach 1.02 in 2003-2004 (Table 2, Figure 3). This is primarily due to the

fertility decline documented above, but also, to a lesser extent, to the mortality increase associated with HIV/AIDS. Survival of women at age 47-50 declined from 0.87 at baseline to 0.62 eleven years later. This decline in survival rates had an impact on net reproduction, even though the highest burden of mortality is concentrated after the mean age at child-bearing. We estimated that about three fourths of the decline in net reproduction rate were due to fertility decline and about one fourth to mortality increase.

A net reproduction rate below one means that, in the long run, population size will decline because of natural causes (excluding the effect of migration). In order to evaluate the possible effect in the Agincourt population, we projected current trends in age specific fertility and mortality rates for the next six years: the net reproduction rate was expected to fall to 0.63 by year 2010, which would induce a marked decline in population size.

Discussion

Reaching below replacement fertility level is a new situation for rural areas of Africa. For a long time fertility was considered very high and resistant to decline in the whole continent. Cases of fertility decline were assumed to be restricted to urban areas and to more educated women. This is not the case any longer, and situations of a net reproduction rate close to 1 or even lower are probably prevalent in urban areas and in many rural areas of South Africa. Even in KwaZulu-Natal, where fertility is somewhat higher, the net reproduction rate is also reaching below replacement levels [14].

The speed of fertility decline in Agincourt is remarkable and consistent over the years, despite many dramatic social changes: influx of Mozambican refugees, opening of the political regime in 1994, increasing education and new economic and employment opportunities around the area. A comparison with rural Kenya gives a scale for measuring the magnitude of the changes in Agincourt. In rural Kenya, the total fertility rate was higher than in Agincourt in the 1960s, just above 8 children per woman in 1969, and declined to about 5.5 in 1999. Since then, fertility decline seems to have stalled, at least in recent years (2000-2003), for reasons that need to be further explored [23]. In Agincourt, the baseline level was lower (6 children), but the full course of the transition was completed in less time, reaching to below replacement levels.

The other factor of importance in Agincourt is HIV/AIDS, since the disease has a direct effect on fertility. This effect has probably remained relatively small over the study period. However, in the recent years, some 25% HIV positive pregnant women and a 35%

negative effect of HIV on TFR could produce a 9% fertility decline, about a fifth of the total decline observed during the prospective period. And the effect of HIV/AIDS on fertility might become more important in the future, unless appropriate treatment and prevention measures are taken to mitigate its impact.

Equally important for net reproduction is the mortality effect due to HIV/AIDS [24]. Seroprevalence is already high at young ages in Agincourt, and many women are now dying before age 30, which is close to the average age at marriage in the study area. Even though women have births before the first marriage, and many in their teenage years, high and early mortality is likely to have an increasing effect in the future, unless HAART treatments[1] become widely available and used by women in their reproductive ages [25].

The effect of HIV/AIDS on cohort fertility might be even higher than that on period fertility discussed above. In Agincourt, women who died of HIV/AIDS between 1995 and 2003 were 33 years old on the average, and had completed only 70% of their potential CFS. Furthermore, women who died of HIV/AIDS had only 1.33 children ever born at time of death, a much lower value than that of their healthy counterparts of the same generations, which means that HIV infected women would bear roughly half of their potential offspring before they pass away. Combining a low CFS and a high HIV seroprevalence rate would rapidly lead to very low cohort net reproduction rates.

An unexpected effect of the current situation is to provide very young women with an indirect incentive to deliver a child as early as possible, in order to have children before being infected by HIV. Although this has been mentioned in interviews conducted by Zwang in the study area, it does not seem to translate as yet into numbers at the demographic level [26]. Fertility rates among adolescents continued to decline over the years, probably because more and more adolescent girls utilise modern contraception.

The future of population growth in Agincourt looks bleak. However many things may happen to change the current course. In particular, hopes for the proper introduction and take-up of anti-retroviral therapy are high, and this could demonstrably change the course of the epidemic and its demographic impact.

Continuing to monitor the fertility trends seems to be a priority for reproductive health research in the study area. It also seems important to start studying the demographic and economic consequences of below replacement fertility for rural areas of South Africa.

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[1] HAART: highly active anti-retroviral therapy

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Table 1: Population dynamics in Agincourt, 1992-2004 (prospective study)

	First 2 years	3-year period			Last 2 years
	1992-1993	1994-1996	1997-1999	2000-2002	2003-2004
Mean population	59953	64326	67259	69059	69875
Birth rate	30.9	25.9	25.6	23.7	21.0
Death rate	5.0	5.1	5.8	8.5	10.9
In-migration rate	82.5	62.6	65.9	73.3	56.1
Out-migration rate	65.2	75.9	74.9	86.7	60.0
Rate of natural increase	25.9	20.8	19.8	15.2	10.0
Net migration rate	17.3	-13.4	-9.0	-13.4	-3.9
Population growth rate	43.2	7.5	10.8	1.9	6.1

Note: Updated after the 2004 census. First year (1992) and last year (2004) are incomplete calendar years. All rates are per 1000 person-years.

Table 2: Trends in fertility, survival and net reproduction rates, Agincourt 1992-2004 (prospective study)

Age group	First 2 years 1992-1993	1994-1996	3-year period 1997-1999	2000-2002	Last 2 years 2003-2004
	Fertility rates				
12-16	0.1729	0.1525	0.1463	0.1500	0.1219
17-21	0.7573	0.6374	0.6230	0.5870	0.4992
22-26	0.7693	0.5849	0.6656	0.5800	0.5261
27-31	0.7495	0.6262	0.5771	0.5396	0.4700
32-36	0.5958	0.5629	0.5080	0.4499	0.3911
37-41	0.5138	0.3743	0.3582	0.3275	0.2990
42-46	0.1911	0.1759	0.1649	0.1290	0.1152
47-50	0.0405	0.0492	0.0352	0.0319	0.0123
	Survival rates				
12-16	0.9500	0.9651	0.9499	0.9390	0.9289
17-21	0.9441	0.9592	0.9446	0.9322	0.9208
22-26	0.9418	0.9531	0.9328	0.9129	0.8962
27-31	0.9335	0.9455	0.9180	0.8824	0.8388
32-36	0.9160	0.9325	0.8999	0.8385	0.7817
37-41	0.9018	0.9162	0.8737	0.7969	0.7228
42-46	0.8836	0.8986	0.8423	0.7586	0.6657
47-50	0.8706	0.8832	0.8227	0.7246	0.6246
	Net reproduction rates				
12-16	0.082	0.074	0.069	0.070	0.057
17-21	0.357	0.306	0.294	0.274	0.230
22-26	0.362	0.279	0.310	0.265	0.236
27-31	0.350	0.296	0.265	0.238	0.197
32-36	0.273	0.262	0.229	0.189	0.153
37-41	0.232	0.171	0.156	0.130	0.108
42-46	0.084	0.079	0.069	0.049	0.038
47-50	0.018	0.022	0.014	0.012	0.004
Total	1.758	1.489	1.408	1.226	1.022

Figure 1: Fertility trends in Agincourt, 1974-2004 (retrospective and prospective study)

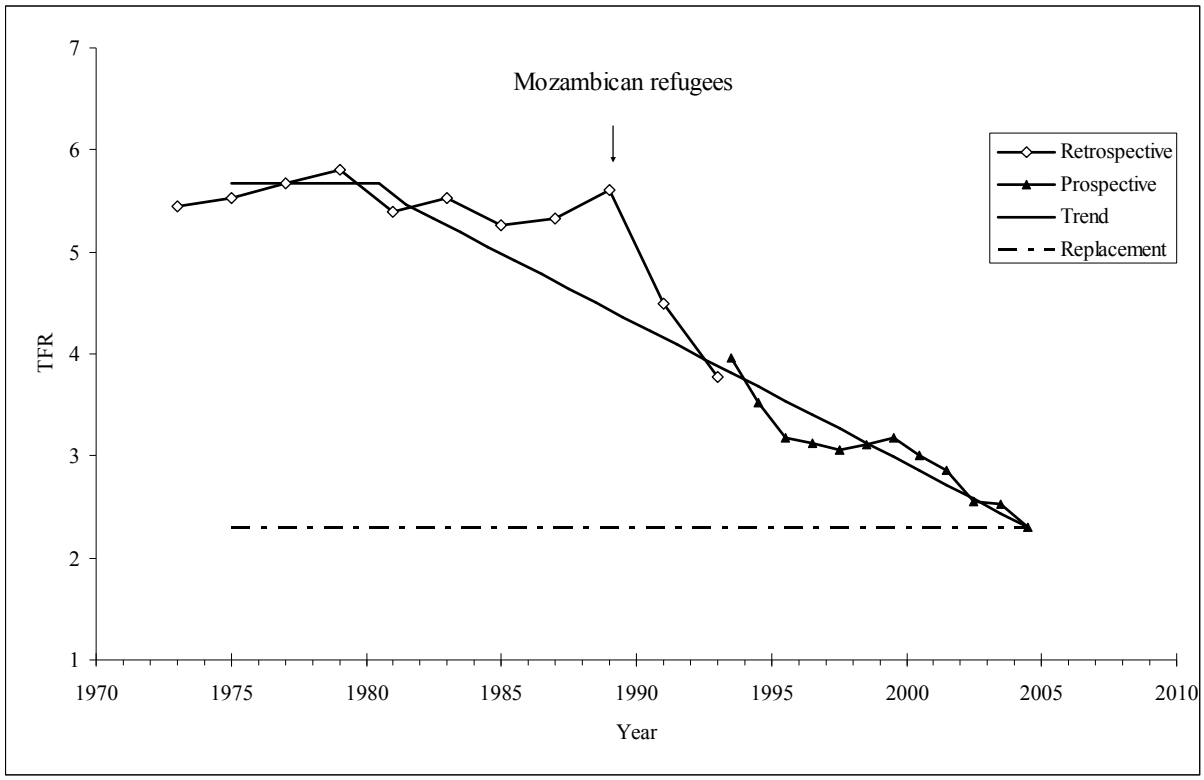

Figure 2: Age pattern of fertility decline, Agincourt 1992-2004, and comparison with pretransitional situation 1970-1979.

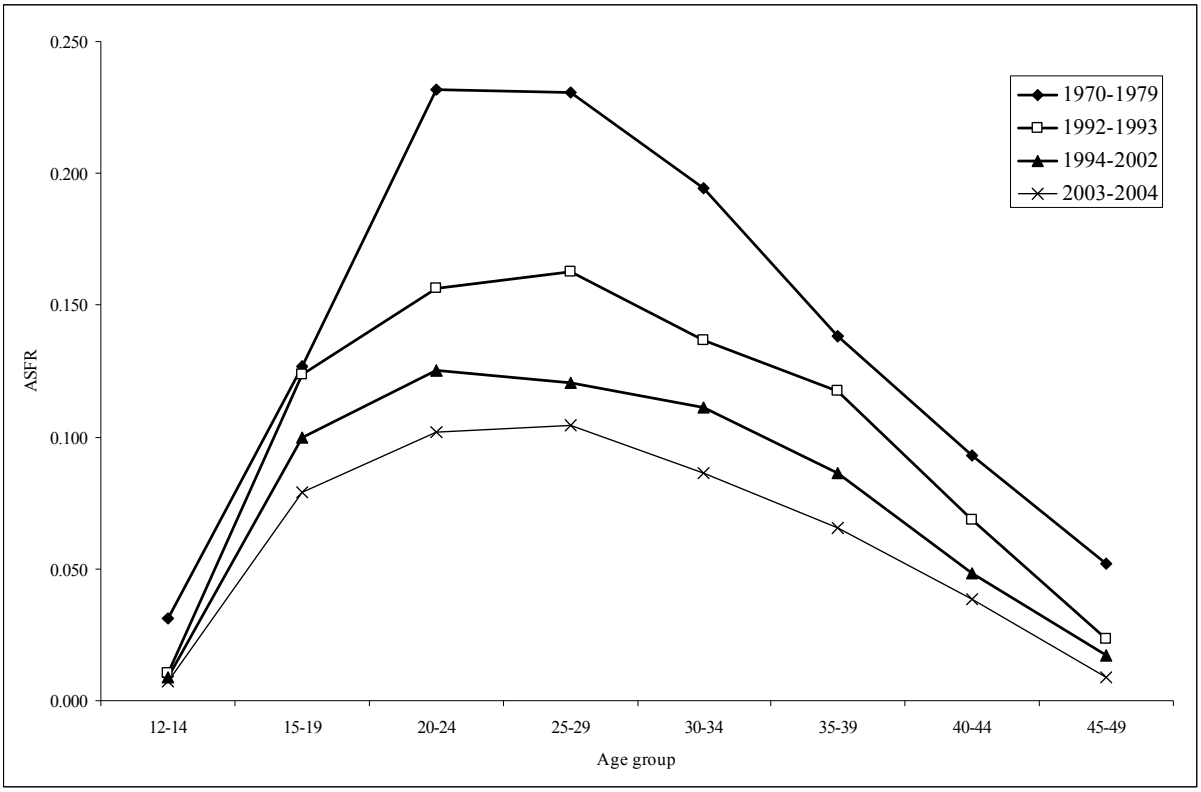

Figure 3: Trends in net reproduction rate, Agincourt 1992-2004, and projections to 2010.