

HIV and fertility change in rural Zimbabwe*

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Abstract

Fertility transition and HIV epidemics are currently running parallel in some sub-Saharan African populations. Interactions between the two at the individual and population levels could accentuate or moderate the resulting demographic trends. We review a number of mechanisms through which an HIV epidemic and responses to it can affect birth rates, through the biological and behavioural proximate determinants. Uninfected as well as infected people can be affected and many of the changes could have unintended consequences for fertility at the individual level. Results from a small-scale in-depth study in two rural areas of Zimbabwe are reviewed. These indicate that the local HIV epidemic has begun to influence the proximate determinants of fertility. If observed trends persist, a modest acceleration in the recent decline in birth rates seems plausible.

Fertility transition and deterioration in mortality due to HIV¹ epidemics are perhaps the two most important demographic factors affecting socio-economic development in central, eastern and southern Africa today. Individually, but especially in combination, they can cause dramatic and substantial shifts in the demographic profile of a population, including major changes in population growth and structure, orphanhood, widowhood and household composition. Each is driven itself by socio-economic conditions, including cultural influences, levels of education and income, and patterns of income generation. These conditions affect the proximate determinants of fertility and HIV transmission, between which there is a considerable degree of overlap. Because of this overlap, biological and behavioural changes arising from HIV epidemics can have consequences for fertility trends and family planning practices. Equally, differing or changing attitudes towards fertility and family building strategies can influence the actions taken to reduce risks of HIV infection. An obvious example of this is that the desire to bear children limits the possibilities for avoiding HIV transmission within stable unions.

In this article, we consider the demographic effects of HIV epidemics in sub-Saharan African contexts with particular reference to fertility. We focus on identification of possible ways in which an HIV epidemic and responses to it can affect birth rates, through the proximate determinants; and we review evidence from a small-scale study in rural Zimbabwe

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¹ Throughout this paper HIV refers to HIV-1.

which tentatively suggests that early changes are indeed under way, the net effect of which seems likely to be an intensification of pre-existing downward pressures on total fertility.

HIV as a determinant of socio-demographic change

Theoretical evidence (Anderson, May and McLean 1988; Gregson, Garnett and Anderson 1994; United Nations 1991) and a growing body of empirical evidence (De Cock et al. 1990; Garenne et al. 1995; Gregson, Anderson et al. 1997; Mulder et al. 1994; Sewankambo et al. 1994) demonstrates that HIV epidemics will have a profound effect on the demography of many sub-Saharan populations. However, there is incomplete understanding of the processes through which this effect will occur. An initial framework for examining these processes is set out in Figure 1.

In summary, an HIV epidemic exerts an upward pressure on morbidity and mortality. This has a direct effect on death rates, population structure and population growth, which, in turn, causes changes in the extent and age-pattern of orphanhood and widowhood, and changes in household composition. The epidemic may bring about biological changes which affect birth rates. At the population level, fertility may also be affected by the adjustments in population structure, widowhood patterns and age and sexual-activity-selective mortality.

At the same time, the epidemic triggers responses at the individual and community levels. Changes in social attitudes and cultural norms can lead to behaviour changes which influence birth rates. From a female perspective, these could have both positive and negative effects. For example, reductions in access to education, due to increased emphasis on the female role as carer for the sick (De Bruyn 1992), would be negative and could result in an upward pressure on fertility, through earlier marriage and reduced contraception. On the other hand, the new situation may encourage women to challenge male domination in the spheres of sexual behaviour and family planning (Ankrah 1991). This could lead to lower rates of partner acquisition and/or an increase in contraceptive use, which could reduce fertility. In either case, changes in attitudes and behaviour to avoid HIV and AIDS could lead to changes in the proximate determinants of fertility.

Finally, any changes in attitudes and behaviour brought about by increased sickness and death and AIDS control initiatives are likely to affect the future course of the HIV epidemic: a feedback process which will determine the long-term demographic effect of the epidemic. We will examine possible changes in fertility determinants resulting from HIV epidemics in more detail, but first discuss briefly why it is important to take account of underlying trends in fertility when considering the demographic impact of HIV epidemics.

The influence of fertility change on the demographic effect of HIV epidemics

Fertility declines are now widely accepted as being under way in a number of the more developed areas of sub-Saharan Africa. HIV epidemics could serve to intensify or restrict these declines, but whether or not this is the case, patterns of fertility change will be vital in determining the demographic effect of HIV epidemics.

Figure 1
HIV as a determinant of socio-demographic change

The significance of contemporary fertility trends is illustrated in Figure 2. The graphs show levels of population growth (rate of natural increase) and maternal orphanhood projected using a published mathematical model and epidemiological and demographic estimates for Zimbabwe (Garnett and Anderson 1993, 1994; Gregson et al. 1996). Four scenarios are illustrated. In each case, migration is ignored and non-HIV-related mortality is taken to remain constant. The first is a baseline scenario in which population growth and orphanhood are assumed to remain constant at mid-1980s levels. The second scenario illustrates the effects of fertility decline and is based on the assumption that birth rates are reduced in a linear fashion between 1986 and 1998 at a similar rate to that recorded in the 1988 and 1994 Zimbabwe Demographic and Health Surveys (Mandishona 1989; Parirenyatwa 1995). Here population growth declines from just under three per cent per annum to two per cent but there is little effect on orphanhood. The third scenario assumes constant fertility but takes into account the HIV epidemic which is assumed to peak at around 25 per cent among adults aged 15-49 years in the late 1990s. Population growth declines rapidly before levelling off at around one per cent and there is a steady and substantial increase in orphanhood. Taking fertility decline and the HIV epidemic together—the fourth scenario—population growth dips below zero and orphanhood reaches extremely high levels, because fertility decline intensifies the impact of the HIV epidemic on the age-structure of the population. Among children aged under 15 years, a greater proportion are aged over ten years and thus have a higher cumulative risk of their mothers' having died.

If women with HIV infection have reduced birth rates (Serwadda et al. 1997), the effect of the epidemic on population growth would be slightly greater than indicated, the reduction in fertility outweighing the drop in early-childhood mortality, but the rise in orphanhood would be less marked (Gregson et al. 1994:84).

In the cases of population growth and orphanhood, the effect of fertility decline is to magnify that of HIV-related mortality. However, in other respects the effects can offset each other. For example, declining fertility tends to moderate the extent to which an HIV epidemic reduces the mean age of the working population (say 15-64 years).

Socio-economic and proximate determinants of fertility and HIV and AIDS epidemics

In demography, there is a well established theory of intermediate or proximate determinants of fertility through which the influence of the ultimate structural and socio-economic determinants is mediated (Davis and Blake 1956; Bongaarts and Potter 1983; Bongaarts, Frank and Lesthaeghe 1984). Possible pathways through which an HIV epidemic could influence fertility through these proximate determinants are examined in the next section. However, there is a similar set of biological and behavioural factors which mediate the spread and effect of HIV infections within a population (Mason 1994). The relationship is summarized in Figure 3. As with fertility, for any given underlying demographic profile, one or more of the proximate determinants must differ or vary if the impact of HIV is to differ between populations or within the same population over time. Variations in levels of proximate determinants such as sexual behaviour patterns and the length of the incubation and infectious periods account for differences in the speed, shape and ultimate size of HIV and AIDS epidemics in different populations (Jacquez et al. 1988; Anderson, Gupta and Ng 1990; Gregson et al. 1994). To have an impact, AIDS prevention strategies must bring about changes in at least one of the proximate determinants of HIV epidemics by appropriately addressing the underlying socio-economic causes.

Figure 2
Demographic impact of HIV and fertility decline

Figure 3
Socio-economic and proximate determinants of HIV-1 and AIDS epidemics

A list of the principal proximate determinants of HIV and AIDS epidemics is given in a previous paper (Blair Research Institute 1996; Gregson et al. 1996). Our interest here is in highlighting the areas of overlap between proximate determinants of HIV and AIDS epidemics, on the one hand, and those of fertility, on the other. The extent of overlap is considerable (Table 1) and similar socio-economic factors such as culture, education, religion and income differentials are likely to be important in each case. Clearly changes in the proximate determinants of HIV and AIDS are likely to result in changes in fertility and *vice versa*.

Table 1
Common proximate determinants of HIV-1 and fertility

Determinants	Role re HIV-1	Role re fertility
Sexual unions	High numbers of partners tend to increase the chance of acquiring infection; extent depending on sexual mixing patterns	Fertility generally concentrated in stable unions; polygyny can result in lower fertility
Sexual abstinence and coital frequency	Low frequency of sex reduces the risk of infection	Low frequency of sex reduces the chance of conception
Lactation	Increases chances of vertical transmission	Extends postpartum amenorrhoea
Condom use	Regular use reduces the risk of infection	Regular use reduces the chance of conception
Injections	Can transmit HIV-1 if needles are contaminated from earlier use	Injectables can be used as contraceptives
Sterility and natural fecundity	STDs' co-factor role in sexual transmission	STDs - and possibly HIV-1 - cause sterility
	Malnutrition may increase susceptibility to infection and reduce the incubation period to AIDS	Malnutrition may reduce natural fecundity

The effects of each factor are considered here in isolation. In practice, of course, they may interact.

Pathways for an influence of HIV on fertility

There is mounting evidence for associations between HIV infection and reduced fertility in sub-Saharan African populations (Batter et al. 1994; Sewankambo et al. 1994; Serwadda et al. 1997). Infertility may be a risk factor for HIV infection (Boerma, Urassa and Isingo 1996). However, it also seems likely that HIV itself can result in lower fertility among infected individuals. In a recent analysis of a large-scale population-based study in Uganda, Serwadda et al. (1997) found a 52 per cent lower adjusted risk of pregnancy among women with HIV infection (but without syphilis) compared to women without HIV. As was the case in an earlier small-scale study in Zaire, women with more advanced disease had the lowest pregnancy rates but there was also evidence for subfecundity among those with asymptomatic infections (Ryder et al. 1991). The authors suggested that higher levels of spontaneous

abortions and stillbirths could be important in explaining their findings. Other possibilities include increased amenorrhoea (Widy-Wirski et al. 1988), reduced spermatozoa among male partners (Martin et al. 1991) and reductions in coital frequency during periods of sickness.

At the population level, lower fertility among women with HIV infection can, in some circumstances, result in an overall increase in birth rates, over time (Zaba and Collumbien 1996). For example, this could occur where women with lower fertility due to other sexually transmitted infections are more likely to acquire HIV infection and thus suffer higher mortality. It is also important to recognize that biomedical and behavioural responses to HIV epidemics which affect birth rates can extend to persons not infected themselves. The substantial reduction in fertility experienced by HIV-infected women notwithstanding, behaviour changes could emerge as being more important than biological changes at the population level: more people being involved and the effects being longer-term. Relatively few people infected with HIV in sub-Saharan Africa are likely to be aware of their condition until the later stages, which are typically very short. Unless counselling and testing services become widely available and accepted, it seems unlikely that behaviour change will be significantly more extensive among people infected with HIV than in the rest of the population.

At the individual level, it is helpful to differentiate between deliberate and unintended fertility effects. It is sometimes suggested that couples will seek to accelerate their childbearing for fear that they might not live throughout the normal reproductive lifespan (Setel 1996). This seems especially plausible in societies which emphasize the importance of childbearing. However, other concerns such as reduced survival chances of the child, the adverse effects of orphanhood on the child and the broader health consequences of rapid childbearing for the woman may often be paramount, particularly where the woman or couple already has children. Most cultures emphasize succession by living children and in Zimbabwe, at least, while most people have heard that HIV can be transmitted from a mother to a child at birth, relatively few realize that there is a more than 50-50 chance that this will not occur. In many populations, conscious control of fertility remains unusual and the possibilities for deliberate acceleration of childbearing are clearly limited.

Irrespective of whether individuals alter behaviour with the intention of influencing their rate of childbearing, broader changes, instituted primarily to reduce the risks of HIV transmission, may have this consequence. Increases in abstinence and condom use would tend to reduce fertility, particularly where effective contraceptives have not been widely used in the past. Conversely, earlier and more effective treatment for other sexually transmitted diseases or early termination of breastfeeding would tend to increase fertility. It seems quite plausible that it will be changes of this nature, which will involve currently uninfected as well as infected individuals, which will be most significant in determining the extent of effect of the HIV epidemic on fertility at the population level.

In an earlier paper we identified a large number of potential mechanisms through which an HIV epidemic could come to influence birth rates at the population level through the proximate determinants (Table 2). On the basis of the very limited empirical evidence available at the time, it appeared that HIV epidemics were most likely to have a depressing effect on fertility, at least in the short to medium term. Increasing use of contraception, shorter periods within childbearing unions and reductions in fecundity seemed most likely to outweigh reductions in breastfeeding and postpartum abstinence (Gregson 1994). However, for any given population, the effect on fertility and the significance of different pathways would depend on socio-economic factors and the current stage of fertility transition within that population.

Table 2
Hypothesized mechanisms for interaction between the HIV-1 and AIDS epidemics and the proximate determinants of fertility in sub-Saharan African settings

Proximate determinants of fertility	Possible mechanism for interaction	Hypothesized effect on fertility
Marriage: exposure to sexual relations		
	Delayed onset of sexual relations	-ve
	Reduction in premarital sexual relations	-ve
	Delayed marriage-possibly resulting in increased non-marriage	-ve
	Reduced polygyny	+ve
	Increased divorce	-ve
	Increased widowhood	-ve
	Reduced remarriage	-ve
Contraception and abortion		
	Reduced desired family size due to fear of passing on infection or leaving orphans	-ve
	Increased desired family size to ensure survival of preferred minimum and increasing 'replacement effect' due to HIV-1 related child mortality	+ve
	Increased condom use to protect against HIV-1/STDs	-ve
	Switching of family planning method from pill to condom	+ve
	Increased abortion to avoid bearing an infected child or potential orphan	-ve
Breastfeeding and postpartum abstinence		
	Reduction in breastfeeding due to concerns re vertical transmission of HIV-1 infection	+ve
	Reduction in postpartum abstinence to avoid regular partners having other relationships and contracting HIV-1 infection	+ve
	Reductions in breastfeeding and postpartum abstinence due to increase in infant mortality (natural 'replacement effect')	+ve
Pathological sterility		
	HIV-1 induced sterility	-ve
	Reduction in existing STDs due to greater condom use, lower partner change rates and increased access and resort to treatment	+ve
Natural fecundity		
	Increase in spontaneous abortions and stillbirths	-ve
	Reduced coital frequency due to increased morbidity	-ve
	Reduction in spousal separation due to HIV-1 control interventions by employers	+ve
	Reduced nutrition, deteriorating health and decreased spermatozoa	-ve

Adapted from Gregson (1994)

HIV and fertility change in rural Zimbabwe

Manicaland study of HIV and fertility

An epidemiological and demographic study was conducted in two rural areas, the Honde and Rusitu valleys, of Manicaland, the eastern province of Zimbabwe, between 1993 and 1995. The objectives of the study were to establish and describe the extent and demographic impact of the HIV epidemic in rural areas and to improve understanding of factors affecting the spread of the epidemic into and within rural populations. Concerning demographic impact, there was particular interest in investigating possible effects of the HIV epidemic on the proximate determinants of fertility and a number of results were obtained which may provide pointers to the nature of these effects.

The principal survey, carried out between November 1993 and June 1994, comprised an initial *de jure* household census in the growth points (small commercial centres) at Hauna and Dzingire and the immediately surrounding areas in the Honde and Rusitu valleys, followed by detailed interviews with women of childbearing age, 13-49 years, on fertility and HIV-related topics. Four hundred and thirty-one households were enumerated in the Honde Valley and 498 in the Rusitu Valley. Coverage was estimated at over 95 per cent in both locations. In Honde 593 women (95% of those listed as eligible in the household questionnaires) and in Rusitu 644 women (97%) were interviewed in depth.

The household questionnaire covered basic socio-demographic details such as age, sex, education level, for each person enumerated, and background socio-economic indicators for the household. Individual questionnaires were modelled on forms used in Demographic and Health Surveys (IRD/Macro International Inc. 1990), subject to the substitution of more detailed knowledge, attitudes, beliefs and practices (KABP) questions on HIV and AIDS for the usual section on infant and child health (Gregson et al. 1996). The individual questionnaires included standard DHS birth history schedules, from which fertility and infant mortality indices were calculated for recent periods.

At the same time that the population-based survey was being conducted, HIV surveillance was undertaken at antenatal clinics in each of the study areas. For ethical reasons, it was not possible to link these data to the main survey data, but some basic details on socio-demographic characteristics—age, education, marital status and parity—were obtained for each participant. Inability to link HIV results with data from the population-based survey was a disadvantage but not a fundamental one, since our principal aim was to investigate the impact of the HIV epidemic on the demography of the population as a whole.

A follow-up survey of all households containing children in 1994 (745/929) was conducted between March and April 1995. In this survey, information was obtained on orphanhood, together with details of the survivorship status of individuals resident in each household in 1994. This information was used to estimate contemporary and past levels of adult mortality.

Parallel with these surveys, a small number of in-depth studies were carried out using key-informant interviews, focus-group discussions, personal observation and other ethnographic techniques. Findings from these studies were used in the design of the survey questionnaires and in interpretation of the statistical results. Finally, data were extracted from secondary sources, principally vital registration records, national and provincial Census reports, and Demographic and Health Survey reports, so that the highly localized results could be placed in a broader context.

Extent and mortality effect of the HIV epidemic in rural Zimbabwe

Full details of all methods used in data collection and analysis and detailed accounts of the results on HIV prevalence and mortality change are available elsewhere (Gregson et al. 1996; Gregson, Anderson et al. 1997). However, given that our interest here is in examining

fertility-related behaviour changes which may have resulted from the HIV epidemic, and that the extent of the epidemic and its effect on morbidity may be important in influencing the timing and nature of these changes, these changes are briefly summarized.

HIV prevalence levels among pregnant women were 24.1 per cent in the Honde Valley and 14.2 per cent in the Rusitu Valley. Among these women, those in their twenties and divorcees and single women were particularly likely to be infected. It is questionable how reliable these estimates are of levels in the general population (Gregson et al. 1995). However, given subfecundity among women with HIV infection of the order of that recorded in Uganda (Serwadda et al. 1997), the net bias due to selection effects would be modest. Mortality has increased in both study areas over the last five years, with the HIV epidemic being the most likely cause. The increases are most pronounced in the Honde Valley, where HIV levels are higher, and among men in the principal sexually-active age groups. District registry records indicate that most of the excess mortality is attributable to HIV-associated diseases. There was also evidence of a recent rise in orphanhood in the study populations (Gregson, Anderson et al. 1997).

Recent trends in fertility and its determinants

Survey results indicate that birth rates have been declining in rural Manicaland during the late 1980s and early 1990s (Figure 4). Total fertility (TFR) up to exact age 45 years declined from 5.84 live births per woman in 1984-89 to 4.98 in 1989-94 in the Honde Valley. The equivalent figures for the Rusitu Valley are 6.51 and 5.15. In each area, birth rates were lower during the most recent period at all ages. Fertility declines were seen in more and less urban locations and across women of different education levels and religious groups (Table 3). These findings are in broad agreement with recent national-level results for rural areas of Zimbabwe (Parienyatwa 1995).

While there are indications that HIV and AIDS will become more influential in the future and may serve to intensify existing downward pressures on fertility, there appears to have been relatively little impact on birth rates in rural areas to date. This is plausible in that the epidemic seems to have spread into these areas very recently (since the late 1980s) and has only begun to affect morbidity and mortality in a noticeable way in the last two to three years. More important factors underpinning the recent decline in birth rates in rural Zimbabwe appear to have included increased female education, improvements in awareness of family planning methods following national media-based campaigns, and increased availability of modern contraceptives through local health clinics and community-based distributors. Religion may act as an obstacle to the use of effective contraception in some localities.

Table 3
Total fertility rate (ages 15-44) by period, site, religion, education, and proximity to growth point

Control Variable	Honde Valley			Rusitu Valley		
	1984-89	1989-94	Women in 1994	1984-89	1989-94	Women in 1994
All women	5.84	4.98	540	6.51	5.15	573
Religion						
Apostolic and Zionist	8.08	7.01	165	7.41	5.24	221
Other churches	4.96	3.95	375	6.19	4.96	352
Education						
Primary or less	6.50	5.56	269	7.00	5.65	305
Secondary or higher	5.23	3.67	241	4.56	3.92	238
Growth point						
Inside	4.7	4.0	198	5.81	4.16	64
Outside	6.2	5.2	307	6.61	5.20	472

In a Poisson regression analysis, female education ($p = 0.002$) and religious affiliation ($p = 0.014$) were found to be associated with differentials in numbers of births in the last five years, among women currently aged 15-49 years. Regular access to newspapers and radio showed non-significant negative influences in the analysis. More educated women were most likely to have started to reduce their fertility earliest and continue to have lower birth rates. The overall decline in fertility reflects a substantial increase in the proportion of women experiencing secondary education since Independence in 1980, as well as a diffusion effect to less educated women. In both study areas, only one in ten of the women aged over 35 years had received any secondary education, as compared to two-thirds of those aged under 25 years. The higher birth rates among women from Apostolic and Zionist churches reflect disapproval by leaders of some of these churches of the use of medicines, including contraceptives (Gregson, Zhuwau et al. 1997).

There was no significant relationship between HIV-related variables and birth rates in the five years preceding the survey. However, there were statistical associations with some of the proximate determinants of fertility. The HIV variables used and the nature of the associations recorded are reviewed in the following two sections.

Indices of knowledge, experience and risk of HIV and AIDS

Indices were constructed from survey data to reflect respondents' knowledge (KNOWLEDGE), personal experience (EXPERIENCE) of HIV and AIDS, and sense of personal risk of infection (RISK). These indices were tested for possible associations with the proximate determinants of fertility, controlling for other factors typically associated with these determinants. Such associations would provide *prima facie* evidence for emerging changes in behaviour which would affect fertility; evidence which, while indirect, would not be biased by any tendency to exaggerate behaviour changes made in response to AIDS.

Figure 4
General fertility rate (GFR) for women aged 13-39 years, by study site, 1972-94: 3 year averages

The KNOWLEDGE variable was constructed as an index (range 0.00-1.00) using responses to questions on risk factors and modes of HIV transmission, symptoms of AIDS, time taken for AIDS to develop and the existence of a cure for AIDS. For the questions on modes of transmission, women were asked first to say how they thought HIV could be transmitted. Where a possible mode of transmission (including a number of false modes) was not mentioned spontaneously, the woman was asked whether she thought HIV could be transmitted in this way. If she said 'yes' or 'no' this was recorded as a prompted response. Otherwise her response was recorded as 'don't know'. Many of the women may have made a guess when prompted, so that greater weight in the index was given to 'spontaneous-yes' and 'prompted-no' responses.

The median score on the KNOWLEDGE index was 0.43. In a multivariate logistic regression analysis, greater knowledge about HIV and AIDS was associated with increased education ($p < 0.001$), regular newspaper reading ($p < 0.001$), radio and television exposure ($p = 0.002$), and travel to urban areas ($p < 0.001$). For women in a stable union, partner's travel to urban areas was also associated with greater knowledge ($p = 0.015$). Members of Apostolic churches generally had poorer knowledge ($p < 0.001$).

The EXPERIENCE variable was also constructed as an index (range 0.00-1.00), this time using responses to questions on knowledge of persons with AIDS or having died from AIDS. Greater weight was given within the index to knowledge of household members or close family members who had AIDS. A score was also given when the respondent said she was caring for an orphan whose last parent died of AIDS (0.20) or from an illness with HIV-related symptoms (0.05-0.10). Higher scores were recorded for women who live in more urban locations ($p = 0.040$) and who have regular access to radio or television ($p = 0.035$).

In the questions on personal risk perception, respondents were asked initially whether they felt in danger of becoming infected with HIV themselves. Women who indicated that they did feel in danger were asked to state the principal reason, as this was considered to be a crucial factor in determining any possible behaviour response. Precoded response options given on the questionnaire were: (1) respondent has had multiple sex partners; (2) husband has had multiple sex partners; (3) friends and relatives dying of AIDS; and (4) other reasons. The RISK variable was set to unity, from a default value of zero, where a positive response was received for the initial question and response (3) was given to the subsidiary question. Two per cent of women felt in danger of HIV infection because they had multiple sex partners, and 19 per cent because their regular partners had multiple sex partners. Fifty-seven per cent said they did not feel in danger and ten per cent said they felt in danger because friends and relatives were dying (RISK).

The RISK variable was defined in this way so as to distinguish the effects on the behavioural proximate determinants of fertility, of general awareness of the risk of HIV infection from the effects of a sense of danger due to the respondents' own personal circumstances: the question is whether fewer people in the population, as a whole, are practising activities which carry a high risk of HIV transmission because of increasing awareness, rather than whether people who feel in danger of infection are those who practise high-risk activities. As the level of general awareness of the effects of HIV and AIDS rises, the effect of associations between greater awareness and lower levels of high-risk activity at the population level might be expected to grow. To the extent that these new patterns of behaviour affect the proximate determinants of fertility, it would also be expected that birth rates would be affected.

In a logistic regression analysis, women who are not currently married ($p < 0.001$), women with regular access to radio or television ($p = 0.015$), and women with recent contact with medical services ($p = 0.014$) all tended to be more conscious of the risks of HIV and AIDS. After controlling for these other variables, better knowledge - KNOWLEDGE - ($p = 0.076$) and closer personal experience of AIDS - EXPERIENCE - ($p = 0.043$) were both weakly associated with greater awareness of the risks.

Associations between HIV variables and the proximate determinants of fertility

Associations in the survey data between HIV and AIDS-related variables and attitudes and practices affecting the proximate determinants of fertility are summarized in Table 4. In each case, controls were introduced for age, education, religion and regular newspaper reading, other factors associated with differentials in the outcome variables. In most cases, the RISK variable showed the strongest associations.

Table 4
Associations between increased knowledge and enhanced sense of personal risk of HIV-1 infection and attitudes and practices in regard to fertility, among women aged 15-49 years, Manicaland, Zimbabwe, 1994

Fertility attitudes and practices	n	KNOWLEDGE		RISK	
		OR	p ^a	OR	p ^a
Attitudes					
Desired family size under 4	1054	3.2	0.088	1.8	0.031
Preference for delay in timing of next birth after an infant death	1099	2.3	0.096	-	NS
Practices					
Experienced first sexual intercourse	447	-	NS	0.2	0.005
Experienced first marriage	437	-	NS	0.3	0.005
Remarriage following divorce in the last five years	64	-	NS	4.8	0.046
Condom use for family planning	315	23.4	0.034	-	NS
Breastfeeding: did not breastfeed last or previous birth	563	-	NS	4.4	0.015
Postpartum abstinence period curtailed	429	-	NS	3.5	0.014

^aMultivariate logistic regression analyses controlling for age, education, religion and regular newspaper reading. Women aged 15-22 years and 16-23 years, respectively, were included in the tests on experience of first intercourse and first union (cohabiting or over 6 months). Interactions between the effect of the KNOWLEDGE and RISK variables were tested but proved non-significant in each case. Personal EXPERIENCE of AIDS was positively associated with condom use ($p=0.031$) but not with any of the other fertility determinants. NS indicates results which were not significant at the $p<0.1$ level. Results where $p>0.05$ are provided for information, but are not regarded as being statistically significant.

Sexual unions

Marriage, broadly defined to include cohabiting and long-term sexual unions (6 months or more), is a universal experience for women in both study areas. Only one woman over 35 years of age was recorded as never having married. Survey results suggest that the recent trend has been towards later entry into a union: 53 per cent of women currently in their twenties had entered a union by age 20 years compared to 61 per cent of women now aged over 30 years ($p < 0.025$). Reductions in the frequency of marriage due to concerns about AIDS have been reported by respondents in focus-group studies in Uganda (Mukiza-Gapere and Ntozi 1996). In the current case, higher levels of female education appear to have been the principal factor but results from a logistic regression analysis suggest that the HIV RISK variable has a strong independent effect. This effect was strongest in less educated women. Very similar results were obtained for age at first sexual intercourse.

Five per cent of women aged 13-49 years were divorced or separated from their spouses at the time of the survey. In Rusitu Valley, this figure rises to ten per cent among women in their twenties and thirties. The mean age at divorce was 26.1 years in Honde and 27.6 years in Rusitu. Six per cent of women in Honde and 11 per cent in Rusitu reported a divorce or separation in the five years preceding the survey. The lower rate in Honde Valley reflects the greater representation of a particular Apostolic church which prohibits divorce.

Women who experienced a divorce were more likely to report a sense of personal risk of infection than other women ($p < 0.001$). Divorcees are also more likely to become involved in prostitution, so it is difficult to tell whether this association results from experiences before or after divorce. However, it is interesting that divorcees who felt at 'RISK' were more likely to have remarried (Table 4). Older and more educated women were less likely to have remarried. Overall, fewer than 25 per cent of divorcees remarried within three years, a similar rate of remarriage to that recorded for widows. Risk of HIV transmission was the most common (unprompted) reason given for why remarriage after divorce might be difficult. However, most women thought there would be no problem and the absolute proportions are relatively small: nine per cent of all women; five per cent of divorcees. Eleven per cent of respondents thought remarriage after widowhood would be inadvisable because of the HIV risk compared to 45 per cent who said it would be inadvisable because of concerns about their children. Concerns about the HIV risk were higher among single women (19%) who are typically younger and more educated, and have no children.

Fertility preferences and use of contraception

The mean numbers of children wanted in a lifetime, reported by women in the Honde and Rusitu valleys, were 4.43 and 5.15, respectively. In both areas the modal value was four. More educated women generally wanted fewer children, while older women and Apostolic women tended to have higher desired family sizes. When asked directly, half of the women interviewed said they now wanted to have fewer children because of AIDS and almost as many (46%) said they would now prefer to have their next child later. Very few (3%) reported an increase in desired family size, despite the widespread belief that infant survival chances have been reduced by AIDS. While these responses may reflect the pre-AIDS trend towards wanting fewer children and the feeling that 'times are hard', which have been increased by the 1992 drought and the Economic Structural Adjustment Programme, the admittedly weak associations between the HIV KNOWLEDGE and RISK variables, and lower desired family sizes and preference for delay in the timing of the next birth after an infant death (Table 4), lend a degree of credence to the possibility of an additional AIDS effect.

The lack of evidence for a conscious replacement effect was unexpected but is supported by other aspects of the data. Only 13 per cent of women said they would want to have the next birth sooner if an infant or child died. Women who had experienced a miscarriage, abortion or stillbirth in the last five years were twice as likely to be using a modern method of contraception as other women ($p = 0.025$). A similar result was obtained in a study in the Gambia, where women said they wished to delay the next pregnancy to allow their bodies to recover from whatever illness had caused the death of the child (Bledsoe 1995). In focus groups in the Honde and Rusitu valleys, participants stated that infant and child deaths could be caused by angry spirits. They believed that a subsequent child might also die if a reasonable time period was not allowed for the spirit to be appeased. The thought that the child could have died of AIDS and that subsequent children would suffer the same fate could be another, possibly related, explanation for preference for a delay in the current context.

Most respondents (83%) said women with HIV should stop childbearing because of the risks of vertical transmission and the adverse consequences of orphanhood. Only one per cent said women should accelerate their childbearing if they discovered they were infected. However, in a real-life situation, where traditional religion holds that dying without leaving successors bars acceptance as an ancestral spirit, women without children may still be expected to attempt to accelerate childbearing.

Use of modern methods of contraception is now common in Zimbabwe, even in rural areas (Parienyatwa 1995). Over half of non-Apostolics interviewed in the study had used a modern method at some time in their lives. Almost a third were currently using a modern method. In younger cohorts, the figures are even higher: for example, 85 per cent of women aged 25-29 years in Rusitu reported ever-use and 54 per cent reported current use. The contraceptive pill is the most commonly used method (37% ever-use) but there is some evidence that condoms are becoming more popular. Demographic and Health Surveys in Zimbabwe have recorded an increase in ever-use of condoms from 13 per cent to 21 per cent between 1988 and 1994 (Mandishona 1989; Parienyatwa 1995). In our own survey, 21 per cent of women reported lifetime use for family planning purposes and four per cent reported current use. Women who were better informed about HIV and AIDS (KNOWLEDGE) and who were currently using a modern method were more likely to have chosen condoms as their method of contraception (Table 4). In the same logistic regression analysis, closer personal experience of AIDS (EXPERIENCE) was also positively associated with choice of condoms for family planning ($p = 0.031$). A further three per cent of respondents reported current use of condoms in the family planning section of the interview as protection against HIV or other STDs. Forty-three women (6%) who currently had a sexual partner reported a change of contraceptive method since hearing about AIDS. Of these women 41 were using condoms after the change—15 in combination with the contraceptive pill—compared to five before.

Breastfeeding and postpartum abstinence

Breastfeeding and postpartum abstinence are both widely practised in Zimbabwe. Median periods of breastfeeding following penultimate births occurring within the five years before the survey extended to 19 months in each study area. The median period of abstinence was six months. In each location, younger women and more educated women tended to breastfeed and abstain for shorter periods.

Seventy-one women (6%) stated without prompting that vertical transmission of HIV infection could be a problem with breastfeeding. A similar proportion mentioned the concern that breastmilk might be bad for the health of the child because of contamination following sexual intercourse. Women who mentioned the risk of HIV transmission were more likely to have avoided breastfeeding a child born in the previous five years (Table 4).

The principal reasons given for postpartum abstinence were maternal health (26%), child health (33%) and temporary absence of partner (20%). Women who had experienced a birth in the previous five years were asked how long they had abstained after the most recent birth and then what they considered to be the ideal abstinence period. Thirty per cent (134/439) of these women reported recommencing sexual activity before the ideal time interval had passed; 49 of these women (9%) said without prompting that they had done this to avoid their husbands having other partners.

Given the high level of tolerance of men's extramarital partners in the pre-AIDS era, it may be supposed that fear of HIV infection was a common concern here. On the other hand, in an environment where polygyny is practised and tensions between wives are common, some women may have feared that their husbands could take additional wives. Tests were therefore carried out to see whether women who reported a sense of risk of HIV infection were more likely to resume sexual relations earlier than they would ideally have wanted. Separate tests were conducted for all most recent births and for births where sex had been resumed. The possible effect of perceived risk of infection was tested for all instances where sex had been resumed early and for those where this was said to have been done because of the risk of the husband having other partners. Even when the restriction was applied, women who felt at risk of HIV infection (RISK) were more likely to have resumed sex early ($p = 0.038$).

Finally, the reality of women's concerns regarding their husbands' infidelity should be stressed. In focus-group discussions with men in the Rusitu Valley, abstinence on the part of their wives was one of the two reasons cited for their need to have casual affairs. In many cases, these affairs were with prostitutes contacted while drinking at beer halls.

Pathological sterility and natural fecundity

Sexually transmitted diseases (STDs) such as *Neisseria Gonorrhoea* and *Chlamydia Trachomatis*, which are common in sub-Saharan countries, including Zimbabwe, can result in pelvic inflammatory disease and lead to primary or secondary infertility (Frank 1983; Cates, Rolfs and Aral 1993). In 1990, more than one million STD infections were reported as treated at public health facilities in Zimbabwe. High incidence rates have been reported in rural as well as urban areas (Le Bacq et al. 1993). Many additional cases go unrecognized and untreated owing to the absence of visible symptoms. However, many of the reported cases are repeat cases. In Manicaland province, the reported case rate among men and women aged 15-59 years is almost 15 per cent per annum (National AIDS Co-ordination Programme 1994). Urethral discharges and genital ulcers are both common. In the study areas, 11 per cent of women reported that they or their partners had attended an STD clinic at some point in their lives. The figure was low in both areas, possibly reflecting under-reporting due to the stigma of these diseases, but especially so in the Honde Valley (9% as against 13% in Rusitu), where Apostolics are unlikely to attend clinics for treatment and may, in any event, be less affected by STDs because of their more restrictive behaviour code (Gregson, Zhuwau et al. 1997).

Of the 421 women in the survey aged 30 years or over, only five reported not having had any children (1%). This finding is consistent with results from other studies in sub-Saharan Africa, including Zimbabwe, which have shown low levels of primary sterility, even in the presence of STDs (Mandishona 1989; Larsen 1994). An analysis of the prevalence of secondary sterility has not been attempted in the current study. Nationally, it has been estimated that age-specific sterility rates may be substantial (Larsen 1994). Not all of this sterility is due to STDs, of course: at later ages natural infecundability becomes an increasingly important factor (Knodel and Wilson 1981). Nonetheless, earlier and more effective treatment of STDs, on a widespread basis, introduced as part of the drive to counter

the spread of HIV, clearly has the potential to increase fecundity levels significantly. HIV prevention programs have achieved substantial reductions in STD cases in some locations in Zimbabwe (Wilson et al. 1994), but, to date, these programs have generally been limited to urban areas.

HIV infection has been found to be associated with adverse pregnancy outcome in a number of studies (Johnson et al. 1986; Ndinya-Achola et al. 1990; Miotti et al. 1991). In the current survey, 12 per cent of women aged 15-49 years reported ever having had an abortion or stillbirth. Women who reported ever visiting an STD clinic or who said they felt in danger of HIV infection due to multiple partners—taken here as risk factors for HIV infection—were more likely to report a pregnancy loss of this kind (OR: 2.68, $p = 0.024$, $n = 743$).

The HIV-related variables were tested in a model of the socio-demographic determinants of coital frequency but there was no evidence of an association. The principal hypothesis here was that increased morbidity would reduce coital frequency among persons infected with HIV. However, HIV-related morbidity remains low in the study populations, in absolute terms, and it was not possible to analyse the data by current serostatus directly.

Discussion and conclusions

In this article we have shown that the demographic effects of HIV epidemics in sub-Saharan African populations can be extensive and complicated. Contemporary fertility trends can have a major influence on the nature of many of these effects, through the complexities of population dynamics. Furthermore, attitudes and practices surrounding reproduction can influence the pattern of risk-behaviour for HIV transmission and the nature of the behaviour changes most likely to be adopted. Equally, behaviour, and indeed biological, changes associated with HIV prevention can result in shifts in the proximate determinants of fertility. We have shown that, in theory at least, there are numerous pathways through which such shifts can arise. These can include changes which affect birth rates deliberately and in unwanted or otherwise unintended ways. In many instances, uninfected individuals are as likely to modify behaviour as infected people.

In a case study in rural Zimbabwe we found associations between HIV variables and aspects of the proximate determinants of fertility which provide tentative *prima facie* evidence for causal linkages. These associations are consistent with findings from a recent study in Uganda, where delayed sexual activity and marriage and increased condom use, particularly in casual relationships, were recorded in areas of high but declining HIV prevalence (Asiimwe-Okiror et al. n.d.). However, firm conclusions cannot be drawn in the current case, in view of the methodological problems in deriving results on behaviour change from cross-sectional survey data using HIV indicators of the form used here. For example, women with greater knowledge and awareness of HIV could be more modern or 'progressive' in outlook and thus more likely to marry later, bottlefeed rather than breastfeed and so on. This possibility has been addressed in the analyses by introducing controls for age, education, religion and newspaper reading, but some residual effect may remain. A further problem is that we have had to use current status indicators for knowledge, experience and awareness of risk for levels in the recent past. In mitigation, the retrospective periods of study are relatively short, five years or less in most cases, while public awareness campaigns have been under way in Zimbabwe since 1987. Furthermore, recent changes would generally be expected to make associations with the proximate determinants of fertility *more* difficult to detect. A strength of the approach adopted is that the outcome fertility-related variables are based on information given in interviews before the subject of AIDS was raised. This avoids a common problem in KABP studies, whereby questions on behaviour are linked in respondents' minds to information received on steps they should take to prevent HIV infection.

The surveys carried out in the current study are small-scale, reporting bias may affect some of the results and the underlying social processes are known to be complex. While HIV prevalence has reached high levels in women at antenatal clinics, the cumulative effect of the epidemic on morbidity and mortality has been modest so far. Personal experience and awareness of the risks of infection are likely to be heightened and become more widespread as the AIDS epidemic develops. Gaps in knowledge will be filled. The changes in attitudes and behaviour observed here may therefore become more common but there may also be modifications as the epidemic intensifies. At the same time, other fertility determinants, notably education and religion, will remain influential. Over the next 10-15 years, increasing education levels among older women will depress birth rates.

The ultimate extent and net effect of changes in the proximate determinants on fertility can only really be guessed. Compensating adjustments might be expected, particularly in view of the existing high levels of contraceptive use in Zimbabwe. Given the natural desire to have children—reinforced in Shona culture by the ancestral spirit belief system—but typically moderate contemporary desired family sizes and birth rates, any deferral of initial sexual activity may result in delayed marriage and later commencement of childbearing, but have little net effect on total fertility.

Husbands appear to be infected earlier in the epidemic than wives in most cases (Gregson, Anderson et al. 1997). Significant increases in the incidence of widowhood therefore seem inevitable. However, many of the women who experience widowhood may not live very long after the deaths of their husbands. The effect on divorce is not yet clear. In both cases, remarriage is currently relatively unusual. Widows appear even less likely to remarry in the AIDS era. Divorcees may be more likely to remarry. If this turns out to be the case, the net effect on time spent outside stable unions—where birth rates were recorded as being lower—would be relatively small. Total fertility would be little affected, although increased proportions of women would not survive the full potential childbearing lifespan.

Contraceptive use is already increasing. This trend may be accelerated by more open discussion of contraception in public and in private, because of AIDS education programs. To the extent that couples come to suspect or be told that they are infected with HIV, contraceptive use to prevent further births may become more common. This effect may be seen more widely if it is true that the HIV epidemic is causing couples to want fewer children. Significant reductions in contraceptive use due to couples seeking to 'insure' against increased infant and child mortality or 'replace' children who died appear to be unlikely. Nonetheless it is hard to believe that women or couples with no children will not seek to ensure that they have some successors, particularly when it becomes more widely known that there is perhaps a two-in-three chance that the child of an infected mother will not itself be infected. Any natural replacement effect, due to increased early childhood mortality, will be modest in populations where contraceptive use is common.

Similarly, women who breastfeed or abstain for shorter periods after giving birth may be expected to use contraception to delay the next birth. Few women in the current study relied on the contraceptive effect of breastfeeding and a number of women were breastfeeding and using modern family planning methods simultaneously. If the wider health benefits of breastfeeding are stressed in future HIV control and family planning programs in line with current World Health Organization (1992) guidance it may be possible to forestall further reductions. However, this is an issue that will require careful and sensitive handling. Further declines in postpartum abstinence will be relatively unimportant in relation to fertility in Zimbabwe, as periods are already short and contraception is frequently adopted on resumption of sexual activity.

Increases in fecundity could occur where better treatment of STDs is instituted. However, where STD control is achieved through increases in condom, and thus contraceptive, use,

there could be little net effect on birth rates. On the contrary, some reductions in fecundity are most likely, because of reduced coital frequency among sick individuals and the biological effects of HIV infection.

The above is essentially informed speculation. If the interpretation suggested is true, the most plausible outcome seems to be a modest acceleration in the pace of fertility decline in rural Manicaland. This could result from delayed marriage and childbearing, further increases in contraceptive use and reduced fecundity among those with HIV infection. There may also be an increased concentration of births into the age-range 25-34 years: a slight upward shift in the peak age at childbearing. In an extended epidemic, this would result in more women dying before completing their intended childbearing and a further downward pressure on the crude birth rate and population growth. This prognosis is largely society-specific. Similar changes could be seen elsewhere but the net effect may differ substantially. For example, populations where contraceptive availability and acceptance are low could experience increases in fertility, if breastfeeding and abstinence periods were to be eroded and behaviour changes led to reductions in STDs. This would be especially likely in populations where there is a strong conscious replacement effect.

Further studies are required to confirm or correct these findings and to assess the effect of HIV on fertility at different stages of epidemics, in different cultural settings, and in populations at different stages of the fertility transition. Prospective comparative studies which monitor not only changes in birth rates among infected and uninfected individuals but also changes in the proximate determinants of fertility within each group may prove most fruitful. Where such studies are attempted, they should incorporate effective controls for possible confounding factors, such as the presence of other STDs and socio-demographic risk-factors for HIV infection and fertility change.

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