"A Closer Examination of the HIV/Fertility Linkage"

Stacy Sneeringer*

Trevon Logan

DRAFT

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Abstract:

Recent research on African countries suggests their fertility transitions are slowing or reversing. Authors have suggested that this trend change may relate to widespread HIV/AIDS, but speculation abounds as to how HIV/AIDS interacts with fertility in African countries. A virtual morass of behavioral and biological mechanisms can lead to positive or negative correlations between HIV rate and fertility, and these correlations can be opposite on the individual and aggregate levels. This article provides a synopsis of the mechanisms, attempting to describe their relative importance in affecting larger demographic trends. We discuss what outcome measures would be impacted by the different mechanisms, and suggest methods on how to study whether HIV plays a significant role in fertility trends. Case studies of several variables from three countries (Uganda, Burkina Faso, and Zimbabwe) show that fertility declines appear to stall during the height of the epidemics in these countries, and effects are larger depending on extremity of the epidemic. While these results show suggestive evidence of fertility behavior changes in relation to the HIV epidemic, more rigorous empirical analyses are necessary to control for conditional effects.

* Corresponding author. S. Sneeringer is Assistant Professor, Economics, Wellesley College. 106 Central St., Wellesley, MA, 02482. Tel: 781-283-2989. Email: ssneerin@wellesley.edu. T. Logan is Assistant Professor, Economics, Ohio State University. We have benefited from helpful discussions with Akila Weerapana, Adrienne Lucas, Rand Stoneburner, and Vinod Mishra, as well as anonymous reviewers from Macro, International. The authors would like to thank Michael Sinkey, Tejaswi Velayudhan, Deepankur Basu, and Virginia C. Ritter for excellent research assistance. All mistakes are solely our own.

Recent research has suggested a slowing of fertility decline (Casterline, 2003; Westoff and Cross, 2006), or even a reversal of the demographic transition (Kalemli-Ozcan, 2005) in African countries. Given the noted slowing in fertility declines in many African countries, researchers have suggested the role that HIV/AIDS prevalence may play in this demographic trend. Different behavioral and medical mechanisms can lead to positive or negative correlations between HIV and fertility, and these correlations can be opposite on the individual and aggregate levels. The suggested mechanisms relating HIV and fertility on the individual level can be broadly characterized as behavioral and biological (see Notzi, 2002, for a discussion). These pathways are more or less evident at different levels of population analysis; negative relationships between HIV and fertility at the individual level can show a positive relationship at the aggregate level due to varying death rates of low versus high fertility women.

While much has been written with respect to the effects of the HIV epidemic on mortality in African countries, less has considered the relationship between fertility and HIV. This article provides a synopsis of the mechanisms, attempting to describe their relative importance in affecting larger demographic trends. We discuss what outcome measures would be impacted by the different mechanisms, and suggest methods on how to study whether HIV plays a significant role in fertility trends. We also examine trends in HIV prevalence, fertility, and fertility behaviors for three countries (Zimbabwe, Uganda, and Burkina Faso) to understand basic trends.

1 Fertility Change in Response to HIV

In recent years, several authors have compiled excellent overviews of the mechanisms by which fertility may respond to HIV. The Population Division of the U.N. (2002) provides a concise overview of the different mechanisms and the research supporting these mechanisms. Other useful overviews can

be found in Gregson, Zaba, and Hunter (2002); Gregson, Zhuwau, Anderson, and Chandiwana (1997); and Nöel-Miller (2003).

The pathways through which HIV may affect fertility are numerous, and interact at a number of levels. While the reviews mentioned provide much-needed elucidation of the mechanisms, they generally do not provide empirical analysis of how these mechanisms may interact, or how they may affect large-scale trends. While the above-cited reviews provide more detailed literature reviews, a relatively brief overview of these mechanisms is useful for the eventual task of considering them in conjunction.

1.1 Behavioral Mechanisms

The behavioral mechanisms describe how women of child-bearing age respond to HIV. Behavioral responses are intentional and in this sense distinguishable from biological mechanisms. Research has suggested both directions of fertility change as a behavioral response to HIV, as well as a number of behaviors, dependent on own HIV status and perceived threat in the community. These behavioral responses describe what an individual woman would do in terms of any future births, rather than towards already-born children. This section outlines two behavioral mechanisms suggesting how HIV can lead to fertility responses.

1.1.1 Community Threat Response Behavior

The community threat response behavioral mechanism is the impact on fertility behavior arising from a perceived threat of HIV. This community behavior is generally described in relation to people who do not know their actual HIV status, but who may or may not be HIV-positive. This behavioral mechanism can be described in more detail by elucidating several steps. The first step requires an occurrence or situation that is out of the ordinary. This could be either an elevated mortality or

morbidity known to be attributable to HIV/AIDS, or increased information on the disease and its transmission. In an area with a low HIV prevalence, people may not notice anything unusual, particularly in a context of high mortality. Documentation of this stage would occur through either mortality or morbidity data that is in excess of some baseline.

The second step in the behavioral mechanism is perception of a heightened threat. If the occurrence is not perceived as unordinary, or is unknown, then people may not change their behavior surrounding it. A change in threat perception could also occur via wide-scale dissemination of information on HIV and its transmission. This activity could spur people to behave differently, regardless of any actual occurrence of HIV-related morbidity or mortality. In this case, the first event would not necessarily need to happen in one's own community.

The threat could come in many forms, each leading to a slightly different next step. If a woman sees heightened mortality that she can reasonably attribute to HIV, she may worry about herself, her children, and/or her partner. She may also worry about her own contraction of the virus, and in that sense the threat is to her own health and community status, as well as the health of any future birth. In the sense of her own contraction, she be concerned that she may die before her children are old enough to care for themselves. She may consider that if she contracts the virus, her ability to bear children may be impacted. If her community status relies heavily on her fertility, she may perceive contraction as a threat to her standing if it relates to her ability to procreate. If she perceives a heighted risk of contraction, she may also perceive a heightened risk to the well-being of any future child.

Another threat may be to the woman's partner, or availability of a partner. If a woman has a partner, she may worry about his contraction, particularly if she believes him to have sex with people

other than herself. If she does not have a partner, she may perceive a threat to the availability of partners if she believes the men are dying or becoming infected.

Once the threat has been perceived, it would need to be translated into a change in fertility desires. This presupposes an understanding of fertility as something that can be desired or not, rather than a foregone conclusion. One behavioral model suggests that women respond to elevated mortality related to AIDS by desiring more children, in order to increase the chance that more will live to adulthood. The nature of this "insurance policy" mechanism may differ based on the motivation for having children in the first place. If children are viewed as care-takers of the elderly, then it is important for children to survive to adulthood. Because women may finish their child-bearing years before their children reach adulthood, they may have more children in the expectation that more will die in early adulthood.

Another response yielding more children due to heightened threat of HIV arises through replacement activities. HIV may yield higher child mortality due to illness. The mother may then desire to conceive another child in order to "replace" the child that has died. The behavioral mechanism in which women have more children in order to replace children who have died, or insure themselves against possible higher child mortality in the future, has been explored by a number of authors. Using different countries and methods, these authors find mixed results for a replacement or insurance response to HIV prevalence. Greiser and coauthors (2001) use qualitative methods in Zimbabwe to suggest a weak replacement response to childhood mortality, while Gyimah and Rajulton (2004) econometrically find a strong intentional replacement behavior in Ghana and Kenya. Kalemli-Ozcan (2005) uses cross-country regressions to suggest an insurance behavioral mechanism via a positive correlation between HIV and the total fertility rate.

The opposite desire could also be the case; women who perceive a higher risk of death may desire fewer children. In the belief that no one will be able to take care of the children, women may desire lower fertility. For example, Greiser and coauthors (2001) in qualitative evidence from Zimbabwe find that couples are more likely to want fewer children in response to fears of their own HIV-related mortality.

Once a desire has been realized, a woman must take some action to put her desire into practice. These actions will be constrained by knowledge of practices that will increase or decrease fertility, availability of contraceptive methods, and ability to practice fertility control. Practices that can alter fertility roughly follow the classic proximate determinants of fertility. These include traditional and modern methods of contraception, age at first marriage or coitus, divorce, breastfeeding, coital frequency, and sterilization. In terms of modern contraceptive methods, the desire to change fertility will only be witnessed via this method when it is available. Breastfeeding and postpartum abstinence can be extended in order to lower fertility.

The ability to change coital frequency and type of sexual act will depend not only on desire, but on ability to control the situation. Women may be subject to violence, domestic or otherwise, that constrains their ability engage in behaviors to limit their fertility (see Rutenberg 2000 for a discussion).

Finally, the outcome may be changes in fertility. This supposes no other events occur simultaneously that mitigate changes to fertility choices, including HIV contraction. Additionally, desire to increase childbearing will only manifest in actual increased fertility with the availability of a sexual partner with healthy sperm.

1.1.2 Own Seropositive Status Behavioral Mechanism

Another behavioral pathway occurs with women who know they are HIV-positive. These behaviors are separate from any ability to conceive or carry a fetus to term. The evidence has been mixed with respect to how women who know they are HIV-positive respond in terms of their fertility. Women who are HIV-positive may decide to have fewer children, separate from any biological mechanism.

Another suggested response is that women who learn of their HIV-positive status will actually increase their desire to have children (Setel, 1995). This may be due to a wish to maintain the appearance of health and fecundity, given the strong connection between child-bearing and community standing in many African countries. A positive fertility response may also manifest if a woman decides to have her desired number of children more quickly, believing that she will eventually become unable to conceive. Importantly, there will probably be a bigger disjoint between desire and manifestation for HIV-positive women due to health and mortality.

In order for either of these pathways to be followed, a woman would need to first be tested, and then to know about the results to her test. Most research suggests that knowledge of own status is rare, hence it is unlikely that the behavioral mechanisms in response to own seropositive status would have much impact on larger fertility trends. For example, the highest HIV prevalence is 30 percent (Botswana), while knowledge of seropositive status could at a maximum be 10 percent. Therefore, at most 3 percent of women will even be able to respond to their status in the above-described methods. Additionally, a series of studies also find that women who become aware of their HIV-positive status do not adjust their fertility behaviors (see Noel-Miller 2003 and Rutenberg 2000 for discussions).

1.2 Biological Mechanisms

A biological linkage between HIV and fertility is another mechanism through which the two rates may be related. This can be further broken down into three possible mechanisms. First, HIV-positive women may have lower fertility because they are biologically less able to conceive, usually because immune-suppression leads to accompanying sexually transmitted infections.

1.2.1 Fecundity

Women's ability to conceive and carry fetuses to term may be hurt by HIV contraction (see Gray et al. 1998). While HIV itself may not decrease fecundity, it increases the probability of contracting other sexually transmitted infections (STIs). These STIs, such as gonorrhea and syphilis, are associated with infecundity. Further, women who have advanced to AIDS may not have the physical capacity to carry a fetus to term. The U.N. Population Division estimates that HIV infection yields a 25 to 40 percent reduction in fertility (2002).

Separating the ability to give birth from behavioral responses to HIV status has been difficult. The biological mechanism is explored most thoroughly by Lewis and coauthors (2004), who compare fertility of HIV-infected with uninfected women, as well as changes in fertility related to HIV of in uninfected women. They find that HIV-infected women have lower fertility than those not infected by the virus, except in the 15-19 age group. The authors assert that as infected women get older, they are less likely to have children because of the increased likelihood of them passing on the disease, and because they are more likely to be aware they are infected. This research shows no correlation between HIV prevalence and trends in fertility intention, and only a weak association between the stage of the epidemic and fertility trends.

1.2.2 Spermatozoa Production

A second biological linkage arises through the male partner. HIV is linked to lower production of sperm but not semen (see U.N. Population Division, 2002).

1.2.3 Death

The third biological linkage is death. If a woman dies from HIV, then she cannot bear future children. While the effect of death on fertility is a moot point at the individual level, it plays an important role at the aggregate level. Earlier research on the linkage between HIV and fertility focused predominantly on this aspect (Gregson 1994). This effect of HIV on fertility could dampen the crude birth rate in times of high AIDS-related mortality.

A more nuanced mechanism by which death could affect not just crude birth rate but also age-specific fertility rates is via fertility-selected death. Seropositive women may have lower fertility due to the accompanying STIs that in a period before HIV did not kill them. However, these women are also more likely to die, leaving higher fertility women in the population. Alternatively, women with HIV may be more likely to be the ones with higher fertility in a period before HIV, and by dying they leave lower fertility women in the population. These effects could only be witnessed at the aggregate level when comparing age-specific fertility rates before and after a period of epidemic. In order to estimate which effect dominates, it would be necessary to compare age-specific birth rates before and after epidemic, netting out any concurrent effects on fertility rates, such as education and income.

1.3 Which Mechanisms Would Matter Most?

Which effects would have the largest impacts, when considering demographic transition? Given the small percentage of people who know about their sero-status, any behavioral response to it will likely not be large enough to impact aggregate trends. If any behavioral response to HIV impacts larger

trends, it will be the community threat response. The magnitude of any community threat response will be constrained by availability and effectiveness of methods to control fertility.

A lowered fertility rate due to HIV-contraction will affect the age groups where HIV prevalence is highest. The estimates suggest that the biological constraints due to HIV contraction lower fertility rates by 25 to 40 percent. At a maximum, 30 percent of women have HIV; therefore the total fertility rate could be lowered by 7.5 to 12 percent. This would be larger for certain age groups where HIV prevalence is higher.

The removal of a significant portion of the child-bearing-age population may or may not have an impact on the total fertility rate (TFR) or individual age-specific fertility rates (ASFRs). Each ASFR could remain the same in the presence of high mortality if the women who die do not have significantly different fertility rates than the women who live. If high fertility women die, then TFR or ASFR may increase (all else constant), and if low fertility women die, then TFR or ASFR may decline (all else constant). The magnitude of the change in the TFR or ASFR will only be as large as the selection.

1.4 Measurement of Mechanisms

Identification of the various mechanisms would require longitudinal data of patterns at different points in time before and during the spread of HIV in a country. Pre-epidemic levels would be necessary to establish the "baseline"; ideally, several pre-epidemic time periods would be necessary to identify trends that could be assumed constant in the absence of epidemic. Changes in fertility and behavioral patterns outside of the trend could therefore be more plausibly due to HIV.

The first problem would be identifying whether there actually are any differences in fertility patterns before and during the different stages of epidemic. If different aggregate patterns occur before and after epidemic, then the case is stronger for an effect of HIV on aggregate fertility levels.

However, even if no aggregate trends are evident, it may still be the case that HIV impacts fertility. As noted above, aggregate trends may mask individual changes, particularly in the presence of shifting samples. Discerning conflicting trends at the individual and aggregate levels would therefore require understanding of both sample changes and individual effects.

Examination of changes in TFR and ASFR will not provide an indication of whether the change is due to a change in the sample or a behavioral change in those still living. Without knowledge of the medical characteristics of HIV positive women, it would be difficult to understand what aspect of any change in fertility is due to behavior and what is biological. The only method of estimating the biological factors would be in a scenario in which behavior is constant. It would therefore be necessary to first identify whether behavioral changes are occurring. If no behavior change is obvious, then any change in fertility (net of other trends attributable to other proximate determinants of fertility) could be attributed to biological mechanisms.

Discerning changes in behavior would require examining variables related to fertility desires and actions at different stages of the AIDS epidemic in a country. Perception of a heightened threat of mortality or of any threat from HIV could arise from the DHS survey questions asking about knowledge of HIV or deaths from HIV.

Changes in desires for children could be estimated via questions in wanted children or intention to have another child. Although these types of questions have been found to be problematic, they are the only measures of intent.

Availability of methods to alter fertility could come from DHS data as well. The use of contraception provides a measure of availability, but low use may occur in an environment of ready

availability. It would therefore be necessary to examine not use but knowledge of contraceptive methods, as well as presence of family planning clinics.

Actions to put fertility desires into effect could be estimated using a number of measures. The changing use and type of contraception could be garnered from DHS survey questions. The outcomes of fertility control measures could also be witnessed via birth spacing. In addition, age at first marriage, prevalence and date of sterilization, and rates of remarriage and divorce could also serve to indicate (particularly in conjunction with other measures) changes in fertility behaviors.

If no behavioral responses are evident (net of other trends and confounding factors), then the next step would examine fertility-selected death from AIDS. In order to discern whether women with high versus low fertility are more likely to die from AIDS, it would be necessary to examine death records by fertility and age. If women who die from AIDS had fertility histories suggesting either higher or lower than average total lifetime fertility (net of other effects on fertility), this would imply that HIV has an impact on sample. This sampling would therefore affect overall fertility rates, specifically ASFR and TFR. One could then create pseudo-fertility patterns for the women who died if they had lived. Comparison of what fertility would have been had these women not died with observed fertility would then provide a measure of how much fertility-selected death affected overall rates.

In the absence of death records with fertility histories on them, the next best alternative would be death records by age. Without fertility histories, it would be necessary to ascribe rates by age alone. Thus, women aged 20-24 who died from AIDS-related illnesses would be assigned the same fertility schedule as the 20-24 year olds who lived. Fertility trends by age are much more readily available. This would not have impacts on ASFRs or TFR but would have impacts on measures of fertility that account for the age structure of the population (like the net and gross reproduction rates).

2 Case Studies

In order to provide some understanding of the trends in fertility preferences, practices, and results in response to HIV, we examine measures from three countries in relation to their HIV epidemics. The three countries are Zimbabwe, Uganda, and Burkina Faso. These three countries have witnessed different magnitudes of epidemics occurring at slightly different times. For each country, we examine trends in estimated HIV prevalence, ideal number of children, age at first intercourse, birth, and marriage, sexual activity, contraceptive use, and fertility.

The fertility data for these case studies comes from 11 Demographic and Health Surveys (DHSs). The DHS provide nationally representative, high-quality data that are comparable over time. Zimbabwe and Uganda both have had four surveys, while Burkina Faso has had three. Table 1 provides the dates and sample sizes of the surveys.

2.1 Zimbabwe

2.1.1 Trends in HIV Prevalence

Zimbabwe has witnessed a severe epidemic with prevalence rates climbing to nearly 30 percent of women. Fig. 1 shows estimated prevalence rates between 1982 and 2006 for all people in the reproductive years (15-49), women in the reproductive years, and all aged 15 to 24. Prevalence appears to have leveled off at a very high rate. The figure also shows the dates of the four DHS surveys for Zimbabwe, to illustrate the dates of our data. Fertility is relatively high in Zimbabwe, but not the highest of the sub-Saharan African countries. Matching the total fertility rates (TFRs) of the DHS surveys with the strength of the epidemic, we see that TFR declines between 1988 and 1999, only to level off or even rise in 2005/2006. This slowing of fertility decline has been witnessed in other sub-Saharan countries, illustrates the possible relationship between the HIV epidemic and fertility trends.

2.1.2 Trends in Fertility Preferences

The first variable to examine in order to discern whether HIV may be having some impact on fertility in Zimbabwe is the number of children that women in their reproductive years state that they desire. The stated ideal number of children is declining for all ages between 1988 and 2006 for Zimbabwe (Fig. 2). As is evident, the ideal number of children increases with age, suggesting that women adjust their ideal number depending on how many they have. The decline between 2001 and 2005-2006 appears smaller than the prior declines. The overall average falls from 4.9 in 1988/1989 to 3.9 in 1999, but then only drops to 3.8 in 2006. This suggests that women are leveling off in terms of the number of children they would like. Ideal number of children may remain the same if death rates are remaining the same, if women would like some ideal number of children for the purposes of having a specific number of adult children.

2.1.3 Trends in Age at First Intercourse, Birth, and Marriage

In order to begin to understand whether women are changing their practices surrounding their fertility in accordance with their constancy in number desired, we can examine several measures. Fig. 3 shows the average age at first sexual intercourse, first marriage, and first birth. These all increased between 1999 and 2005/2006 by nearly the same amount. In the earlier periods, there are fewer changes. When the HIV epidemic is growing in the country, the ages at which women begin their reproductive behavior remains constant; after the epidemic leveled off, the ages grew. This could be read as the adoption of preventive practices, or could be a reflection of other trends, such as increased education for women or rising income.

A second method of discerning trends in the start of reproductive behavior is to examine the trends in the percentage of women who have had sexual intercourse, been married, or given birth by

the age of 15 (Fig. 4). The percent that have had sex by the age of 15 follows the same trend as the fall in the age at first intercourse – remaining constant as the epidemic sets in and then falling as it levels. However, the percentages married or who have given birth by age 15 fall in the period of the epidemic's initial surge, but then remain constant in the period of the epidemic's plateau.

The percentage of women who are married can also provide an indication of reproductive activity, as well as a possible indicator in reduction of sexual partners. Fig. 5 shows trends in the percentage of women married, by age group. These drop over time, and then remain fairly constant between 1999 and 2005/2006. Between 1991 and 1994 the percentage married drops from 61% to 56%, but then remains constant until 2005/2006 at 56%. This could be reflective of changes in behavior, or it could reflect something else, like a changing age structure of the population or a reduction in possible marriage partners (due to mortality from the epidemic).

2.1.4 Trends in Sexual Activity

One method of reducing fertility and also avoiding HIV contraction is by having less sex. Fig. 6 shows the percentage of women who have had sexual intercourse in the past 4 weeks, by urban and rural status. These are comparable for both groups, and tend to fall over time.

2.1.5 Trends in Contraceptive Use

Figures 7 through 9 show trends in contraceptive use. Modern contraception constitutes the majority of use, and trends in its use are increasing over time for most examined groups. The only declining use occurs in 2005/2006 for sexually active urban women (Fig. 9), and also for two age groups: 15-19 and 35-39 (Fig. 8).

A mechanism that can contribute both to fertility levels and HIV prevalence is condom use. Fig. 10 shows the percentage of sexually active women in urban versus rural locations that report current condom use. Noticeably, these numbers are very low; the highest percentage is 3.1, for urban women in 1999. In the time period that the HIV epidemic has leveled off, condom use declines to even lower levels. This suggests that condom use is not playing a particularly strong role in trends related to HIV and fertility.

2.1.6 Trends in Fertility

While the TFR can provide one indication of fertility, we also examine other indicators to provide a fuller picture. Fig. 11 shows trends in 5-year age-specific fertility rates (ASFRs).[2] The trends in ASFRs reflect the slowing of the decline in the TFR. Two age groups that see no decline between 2001 and 2005/2006 are ages 15-19 and 40-49, although these are generally lower-fertility groups and would not be driving the entirety of the trend in TFR.

We also examine urban versus rural period TFR. Fig. 12 shows that urban TFR has declined (although not steadily), but rural TFR shows an increase.

Because the period TFR is a synthetic measure, we also examine cohort-specific fertility. Fig. 13 shows the cumulative number of births by mother's birth cohort. For example, women born between 1941 and 1950 had on average 6.75 births by age 45-49. Women born in this earliest cohort (1941-1950) would have lived most of their reproductive lives without the epidemic. The women born between 1951 and 1960 would have been between 30 and 39 when the epidemic began to grow in 1990. The third cohort (1961-1970) would have been between 20 and 29 when the epidemic began,

[2] An interpretation of one of these rates is the following: In 1988/1989, women aged 20-24 had on average 1.3 births in that five-year interval. These rates are *not* multiplied by 1,000, as age-specific fertility rates occasionally are.

and might have reacted in the remainder of their reproductive years. After age 29, this cohort's cumulative number of births appears to diverge from the pattern of the previous two cohorts by becoming more linear. This suggests a dampening of fertility. The cohort born between 1971 and 1980 would have been the first to experience most of their reproductive lives in the shadow of the epidemic. In 1994 when the epidemic peaks, this birth cohort would have been between 14 and 23. This cohort appears to be following the trend of the previous cohort; the data point showing births between 35 and 39 may reflect a small sample size rather than a divergence from the trend.

Finally, to understand whether women are instituting behaviors suggesting a "speeding up" of fertility, we examine birth spacing (Fig. 14). For all parities shown, birth spacing is increasing over time.

2.1.7 Summary of Zimbabwe

Examination of the trends in Zimbabwe provides mixed evidence as to the cause of the fertility decline stalling. On the one hand, there are many indicators that suggest that fertility decline should continue. These include increases at age at first intercourse, birth, and marriage during the time period in which the fertility decline slows down. Sexual activity has declined, and contraceptive use is up for most groups except for 15-19 year olds, 35-39 year olds, and urban women. Birth spacing is increasing, and cohort fertility is declining.

On the other hand, there are indicators that could suggest a stall in the fertility transition. Ideal number of children and the percentage married both slow their declines. Contraceptive use falls or remains constant for 35-39 year olds, 15-19 year olds. Urban modern method use falls. Condom use falls, although it wasn't high to begin with.

Overall, these different trends suggest that there are some behavioral changes contributing to the stall in the fertility transition. Despite rural women's increase in contraceptive use and decline in

sexual activity, it is their fertility that appears to drive the slow-down. Overall, the trends suggest that women are attempting to avoid HIV (by being married, having less sex, increasing age at first intercourse), but still are deciding to have many children, as evidenced by their stated ideal number of children not declining and the total fertility rates.

2.2 Uganda

2.2.1 Trends in HIV Prevalence

Uganda's epidemic has shown a different trend than Zimbabwe's and has a different course, perhaps due to heavy intervention. Fig. 15 shows the estimated progression of the epidemic in the country, with prevalence rate for women reaching 16% at its peak. Like the case of Zimbabwe, the decline in TFR apparently slows with the leveling off of the epidemic. Uganda's very high TFR of 8.1 in 1988/1989 falls to 7.1 by 1995, but then only drops to 6.9 by 2006.

2.2.2 Trends in Fertility Preferences

Again like Zimbabwe, the stated ideal number of children slows its decline with the slowing of the decline in TFR (Fig. 14). This appears to drop a great deal between 1988/1989 and 1995, after which the decline is less marked. From an overall average of 6.5 children in 1988/1989, this drops to 4.8 in 2000/2001, but remains constant until 2006.

2.2.3 Trends in Age at First Intercourse, Birth, and Marriage

Like Zimbabwe, the ages at first intercourse, first marriage, and first birth increase only when HIV prevalence has leveled off. Fig. 17 reveals these ages to be increasing, although not by a great deal except for age at first sexual intercourse, which increases over half a year between 2000/2001 and 2006.

The percentage of women who have had sex, given birth, or married by the age of 15 drops fairly steadily.

Marriage rates for all women show a fluctuating pattern in Uganda (Fig. 19). Between 1988/1989 and 1995 the percentage of women who are married increases for all age groups from an overall percentage of 54% to 64%. After this increase, however, the overall percentage married drops to 45%, in 2000/2001, and then rises again to 49% in 2006. These fluctuations could be the result of war, or the lack of partners.

2.2.4 Trends in Sexual Activity

Fig. 20 shows trends in the percentage of women by urban or rural status that has had sexual intercourse in the past four weeks. Percentages are noticeably different by urban and rural status, with rural falling over time and urban falling and then remaining steady.

2.2.5 Trends in Contraceptive Use

Modern contraceptive use is growing steadily in Uganda, but traditional methods are still commonly used (Fig. 21 and 22). Modern contraceptive use more than doubled between 1995 and 2000/2001, after which it leveled off at around 15% of women of reproductive age. Several age groups see a decline or leveling off of modern method use between 2000/2001 and 2006 (ages 15-19, 20-24, 25-29, 35-39, 40-44). Further, modern contraceptive use declines for sexually active urban women between 2000/2001 and 2006 (from 37% to 33%), much like the pattern in Zimbabwe. Condom use among sexually active women (Fig. 24), after seeing a remarkably increase between 1988/1989 and 2000/2001 is now leveling off for urban women at 8.6% and falling to 2.1% for rural women. The condom recall in Uganda occurred in 1994, and thus the effect would have been captured in the 1995 DHS.

2.2.6 Trends in Fertility

Age-specific fertility rates in Uganda are increasing at ages over 30 but falling for ages below this (Fig. 25). Rural TFR has remained constant since 1995, and the urban TFR increases in 2006 (Fig. 26). Cohort fertility (Fig. 26) appears to be doing very little, with declines in total births by cohort for most ages. Finally, birth spacing in Uganda (Fig. 28) follows a somewhat fluctuating pattern, but appears to have leveled off its increase between 2000/2001 and 2006.

2.2.7 Summary for Uganda

While Uganda shows some similar patterns to Zimbabwe, it also shows marked differences. Uganda sees marked declines or stalls in contraceptive use, which helps to explain this country's stall in fertility decline.

2.3 Burkina Faso

2.3.1 Trends in HIV Prevalence

In relation to Zimbabwe and Uganda, Burkina Faso's HIV epidemic has been less severe. The estimated peak of the epidemic occurred in 1998, with a highest estimated prevalence of 2.7% for women. This epidemic, since it was less severe, may therefore show different patterns than those in Zimbabwe and Uganda. In comparison to the TFRs in the other countries, Burkina Faso's TFR fell after prevalence rates discontinued their increase. Fertility in Burkina Faso is also relatively high; at the height of the epidemic, it was 7.1 births per woman.

2.3.2 Trends in Fertility Preferences

The stated ideal number of children in Uganda (Fig. 30) had not changed much over time (Fig. 30).

2.3.3 Trends in Age at First Intercourse, Birth, and Marriage

Ages at first intercourse, first birth, and first marriage have all increased slowly (Fig. 31). Likewise, the percentages of women who have had sexual intercourse, given birth, or been married by age 15 remain constant or decline. The percentage of women married by age also shows a steady decline (Fig. 33).

2.3.4 Trends in Sexual Activity

Sexual activity is higher in the urban areas of Burkina Faso than in the rural, and rates have increased or remained constant between 1992/1993 and 2003 (Fig. 34).

2.3.5 Trends in Contraceptive Use

Modern contraceptive use increases steadily over time for all groups examined and all age groups (Fig. 35, 37). Traditional contraceptive use is widely practiced, but is declining over time (Fig. 36). Additionally, condom use is becoming more prevalent, with rates much higher than those in Zimbabwe and Uganda (Fig. 38).

2.3.6 Trends in Fertility

Reflecting the lack of decline in TFR, the ASFRs also are also declining little. The decline in TFR between 1998/1999 and 2003 appears to have arisen from a decline in birth rates among 35-39 year olds. While the urban TFR is falling, the rural TFR appears constant (Fig. 40). Burkina Faso's cohort fertility levels also do not appear to be falling by much, apart from the older age groups. Finally, birth spacing is also increasing (Fig. 42), and Is increasing the same amount for all parities up to the 5^{th}.

2.3.7 Summary for Burkina Faso

In many ways, Burkina Faso appears to be a country that is not experiencing a great deal of a fertility transition, regardless of the HIV epidemic. While there are trends in the various measures suggesting a movement to lower fertility, most of the changes are not large. The exception is in the use of modern contraceptive methods, which rises steeply.

As described above, the increase in HIV may only posit a threat eliciting changes in fertility behaviors if it is discernible. In the context of high mortality, an HIV rate of 2% may not be causing an out-of-the-ordinary morbidity or mortality level.

3 Discussion

Examination of trends in these three countries show suggestive patterns of fertility stalling in the countries with HIV epidemics that reached prevalence rates over 10%. Trends in Zimbabwe and Uganda suggest that fertility behaviors are changing during the epidemic. Burkina Faso does not experience the same effects as the other two countries; this could indicate that this country's HIV epidemic is not severe enough to causes changes.

While we provide an examination of a number of patterns, this does not provide a complete understanding of the scenario. Certainly, the trends in Zimbabwe and Uganda (and the lack of ones in Burkina Faso) suggest that the HIV epidemic may play a part in fertility patterns. The reduction or lack of increase in contraceptive use, particularly among the urban populations, suggests that women may be attempting to have more children. This theory is supported by the lack of decline in preferred number of children, and the fertility rates themselves. While Uganda appears to have a straightforward decline in contraceptive use in order to allow for the lack of fertility decline, Zimbabwe's patterns are more complex. Zimbabwe may be experiencing a process in which women attempt to avoid HIV while having more children; they may do so by staying married, having less sexual intercourse, and beginning

their fertility later. Their contraceptive use may be to space births more intentionally, rather than avoid them.

4 Conclusions

This article has provided an investigation of the mechanisms by which HIV can lead to changes in fertility. Through the exploration of three different countries with three different epidemics, we have attempted to describe the trends in patterns of behavior surrounding fertility in relationship to HIV. From this analysis we can posit several theories and suggestions for future analysis.

First, more detailed HIV data on the level of the subgroup would be necessary to explore trends according to age, urban/rural status, and region. If the community threat status is operating, then more specific rates are necessary to more clearly mimic what individuals witness in their daily lives.

Second, if women with HIV are less likely to be able to conceive or carry children to term, then this suggests fertility rates would decline. Witnessing that these rates are not declining by much, this suggests that uninfected women are having more children than they would have had. A study of the distribution of the number of children is therefore necessary.

Third, women may be deliberately having more children in order to make sure that a specific number live to adulthood, or may be replacing children who die. This article has not explored this possibility.

Fourth, while many rates will not change according to the population age structure, this may have important ramifications for fertility behaviors and population growth trends related to the epidemic. For example, age-specific fertility rates will not depend on the proportion of the population at that age, but relative ages may have bearings on partner availability and choice.

Finally, these conclusions are all preliminary and require far more rigorous analysis. The threat of HIV may work differently in different subpopulations, and only in the context of high prevalence rates. Analyses simultaneously controlling for the various fertility determinants would enable understanding of the relative importance of the various factors at different stages of the epidemic.

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Table 1: Dates and Sample Sizes of DHS Data Used

Zimbabwe	**1988/1989**	**1994**	**1999**	**2005/2006**
Number of observations	4,201	6,128	5,907	8,907
Uganda	**1988/1989**	**1995**	**2000/2001**	**2006**
Number of observations	4,730	7,070	7,246	8,531
Burkina Faso	**1992/1993**	**1998/1999**	**2003**	
Number of observations	6,354	6,445	12,477	

Fig.1: Zimbabwe: Estimated HIV prevalence rates for all people aged 15-49, women aged 15-49, and all people aged 15-24, 1982-2006, with TFRs at dates of DHS surveys

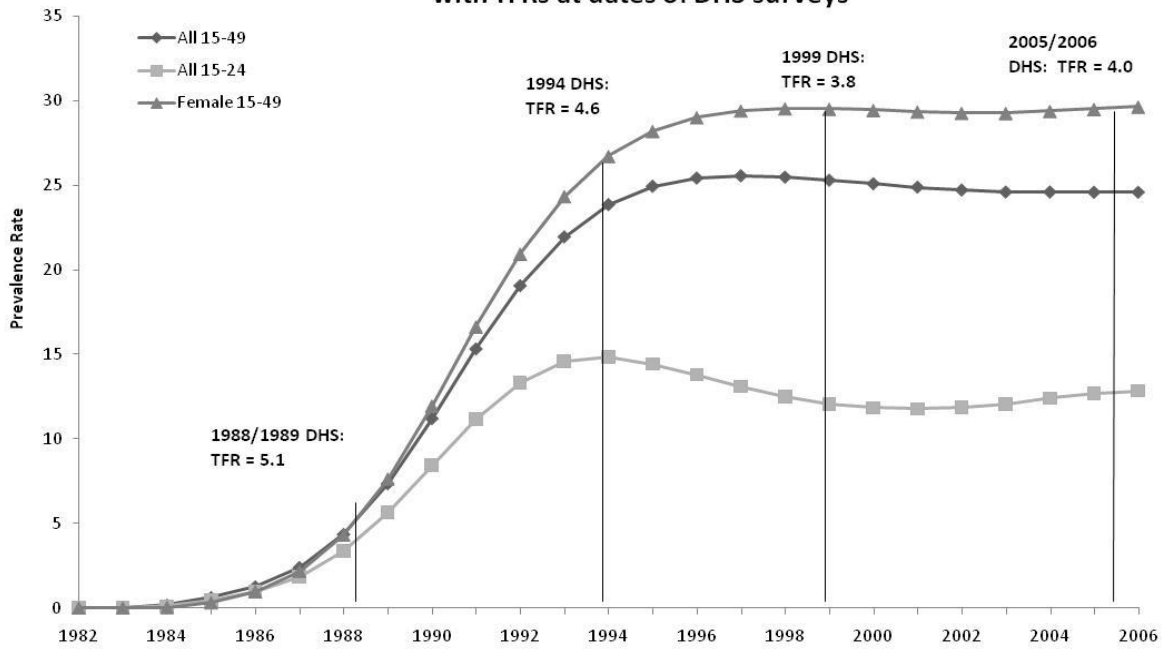

Fig. 2: Ideal Number of Children, by Age Group, Zimbabwe

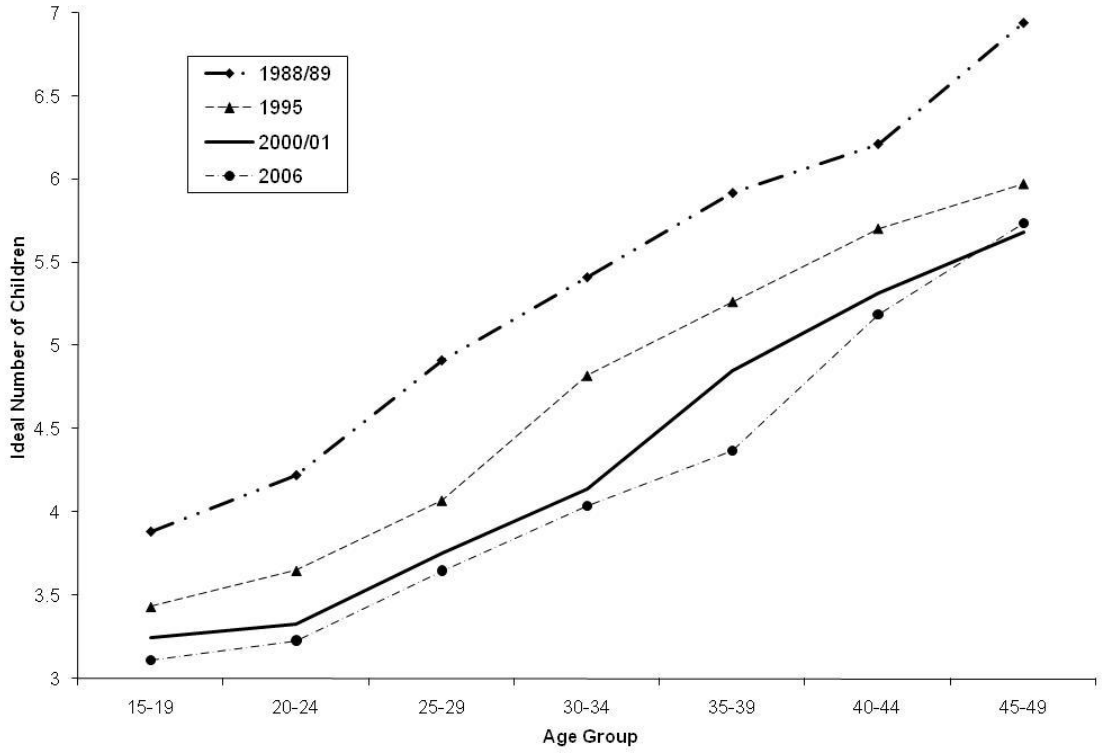

Fig. 3: Trends in age at first intercourse, age at first marriage, and age at first birth, Zimbabwe 1988-2006

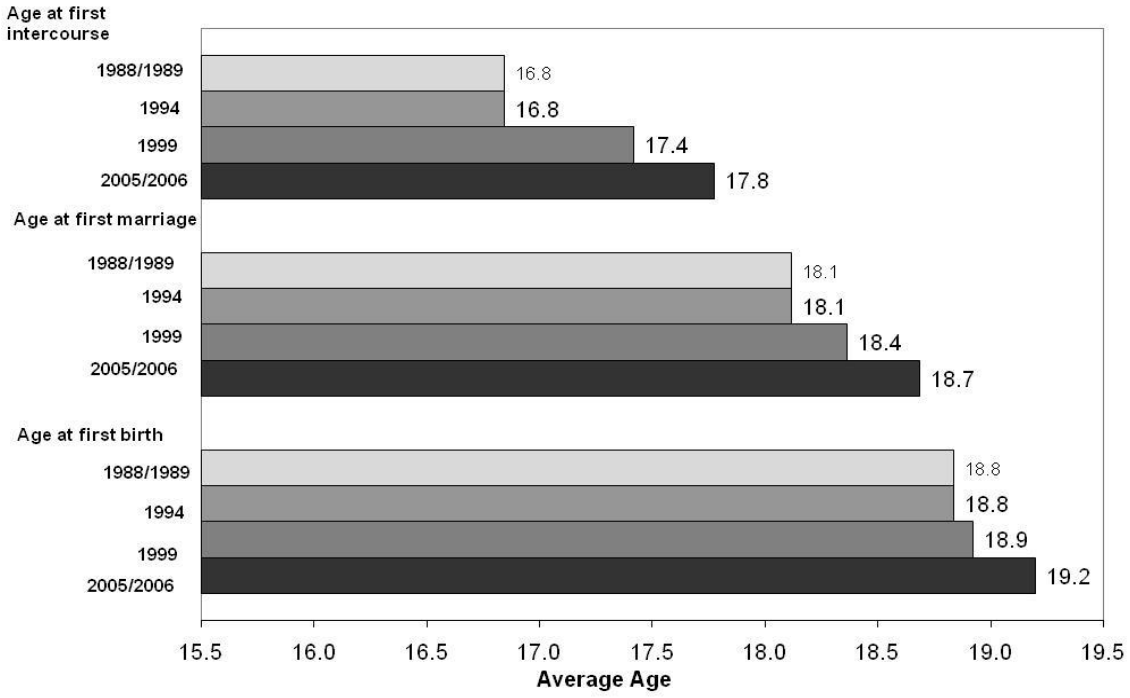

Fig. 4: Trends in percentage of women who have had sex by age 15, who have given birth by age 15, and who are married by age 15, Zimbabwe 1988-2006

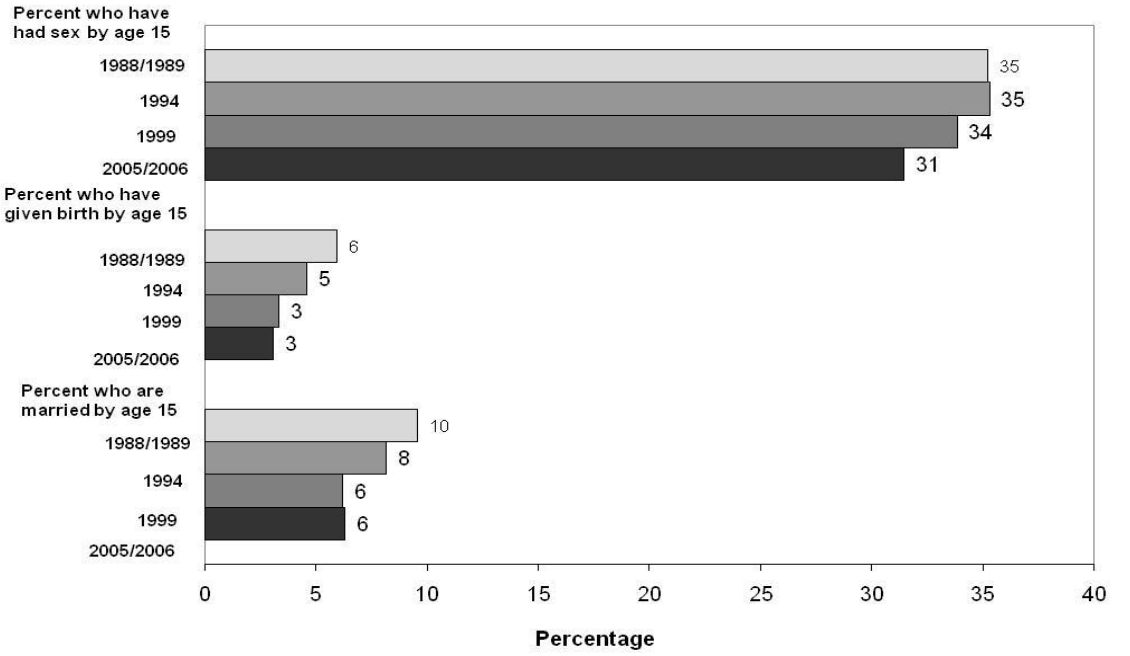

Fig. 5: Trends in Percentage of Women Who are Currently Married, by Age Group, Zimbabwe 1988-2006

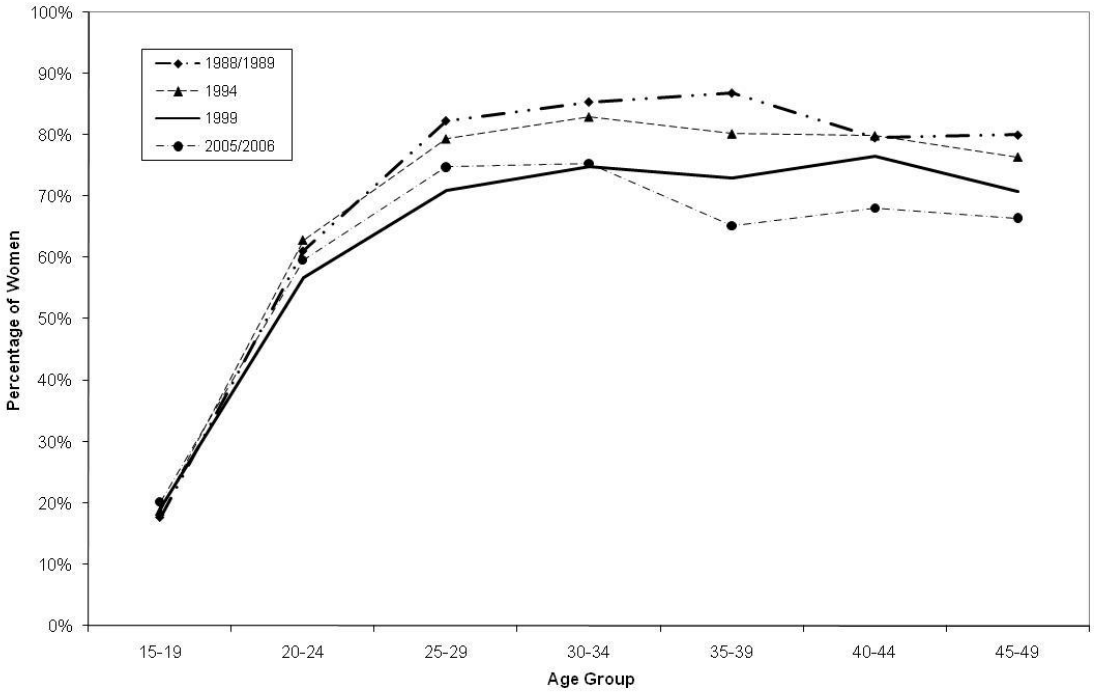

Fig. 6: Trends in sexual activity among urban versus rural women, Zimbabwe 1988-2006

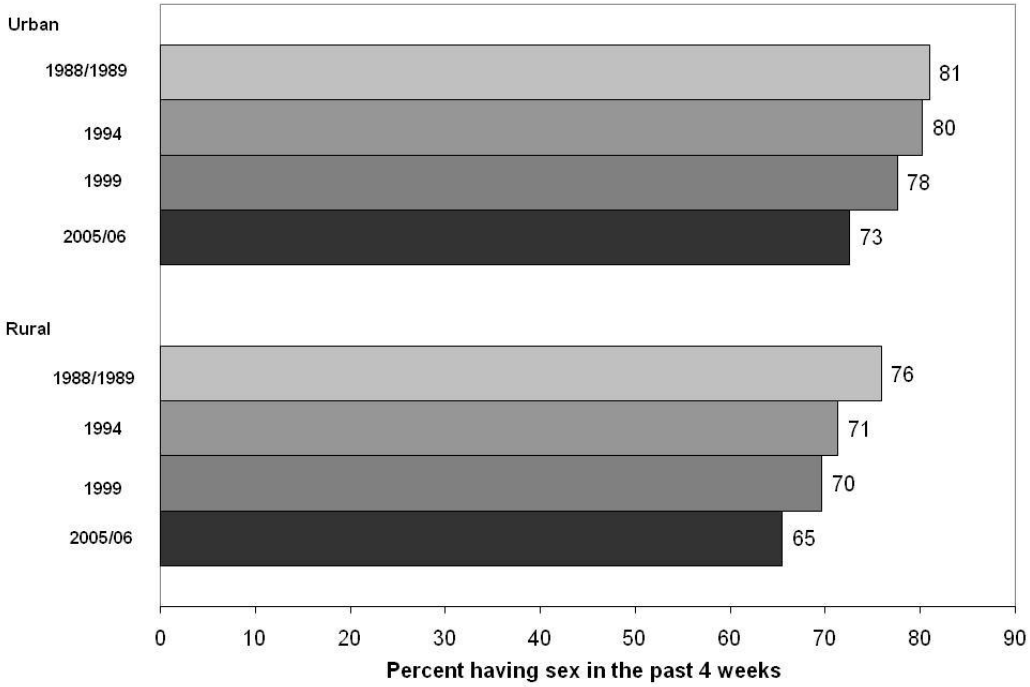

Fig. 7: Trends in modern contraceptive use among all women, sexually active women, and married sexually active women, Zimbabwe 1988-2006

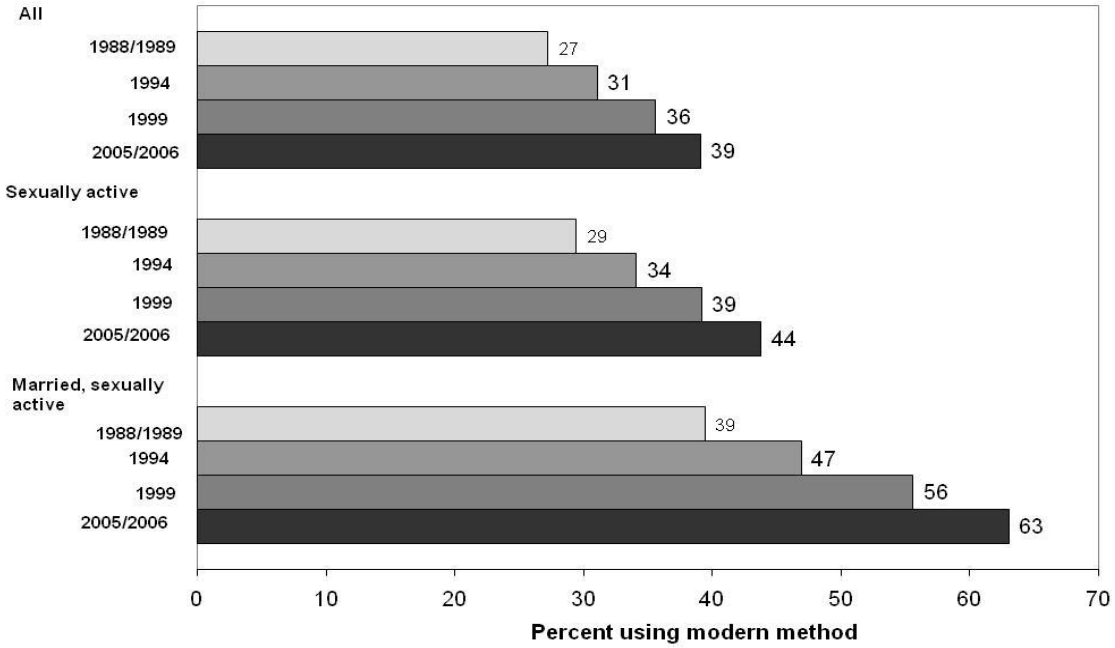

Fig.8: Trends in current use of contraception among women by age, Zimbabwe 1988-2006

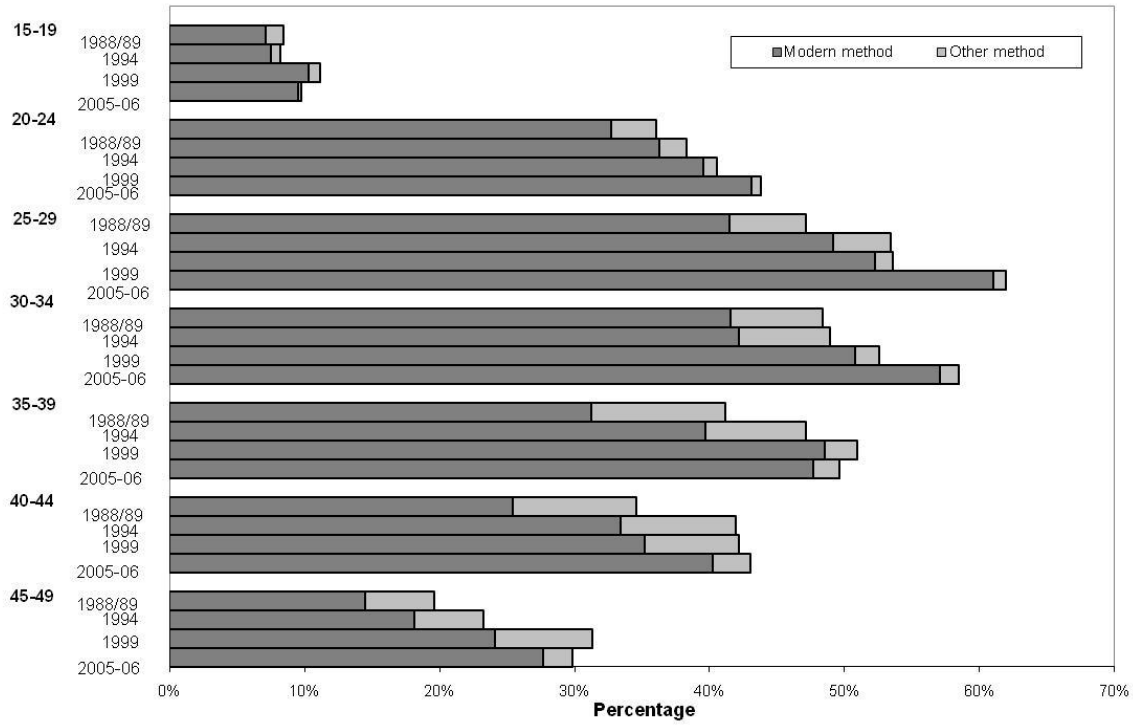

Fig. 9: Trends in the use of modern contraceptive method among sexually active urban versus rural women, Zimbabwe 1988-2006

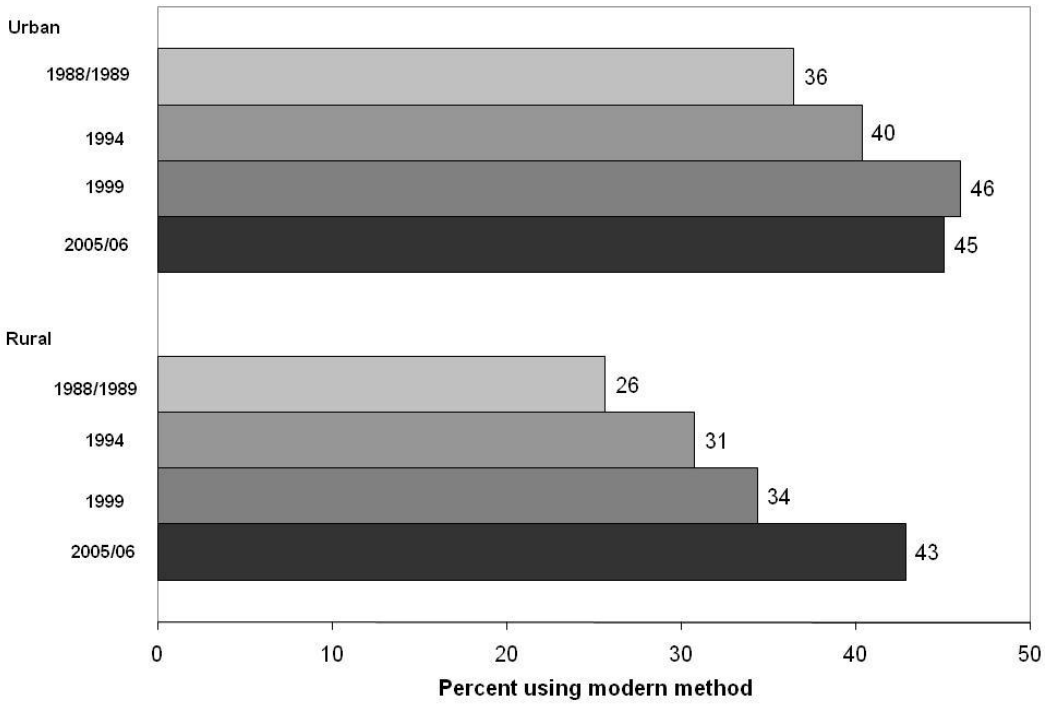

Fig. 10: Trends in condom use among urban versus rural sexually active women, Zimbabwe 1988-2006

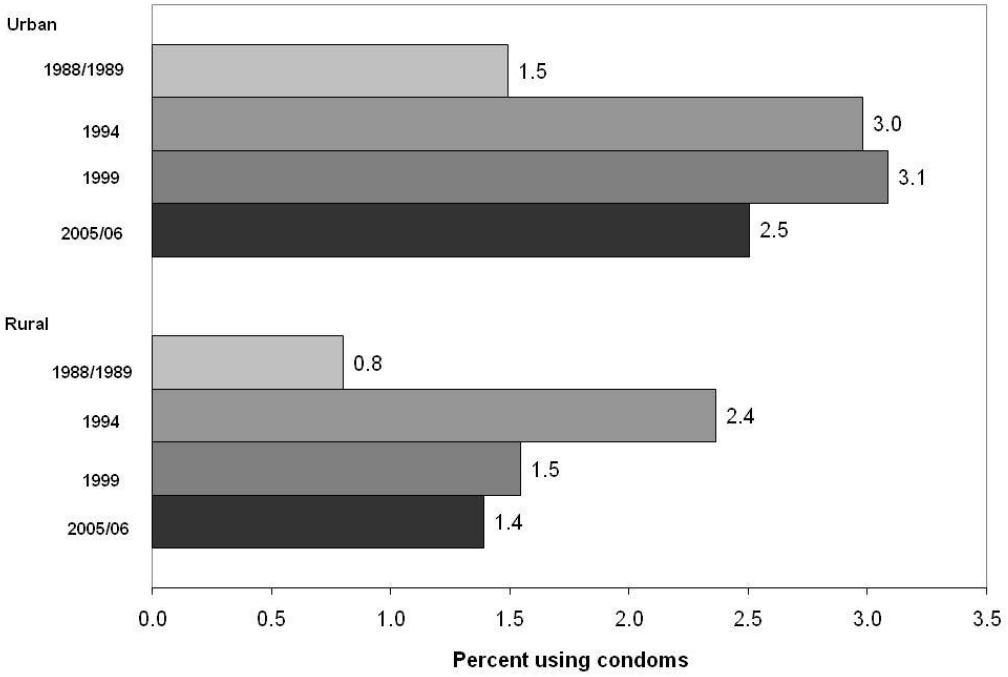

Fig. 11: Trends in Five-Year Age-Specific Fertility Rates, Zimbabwe 1988-2006

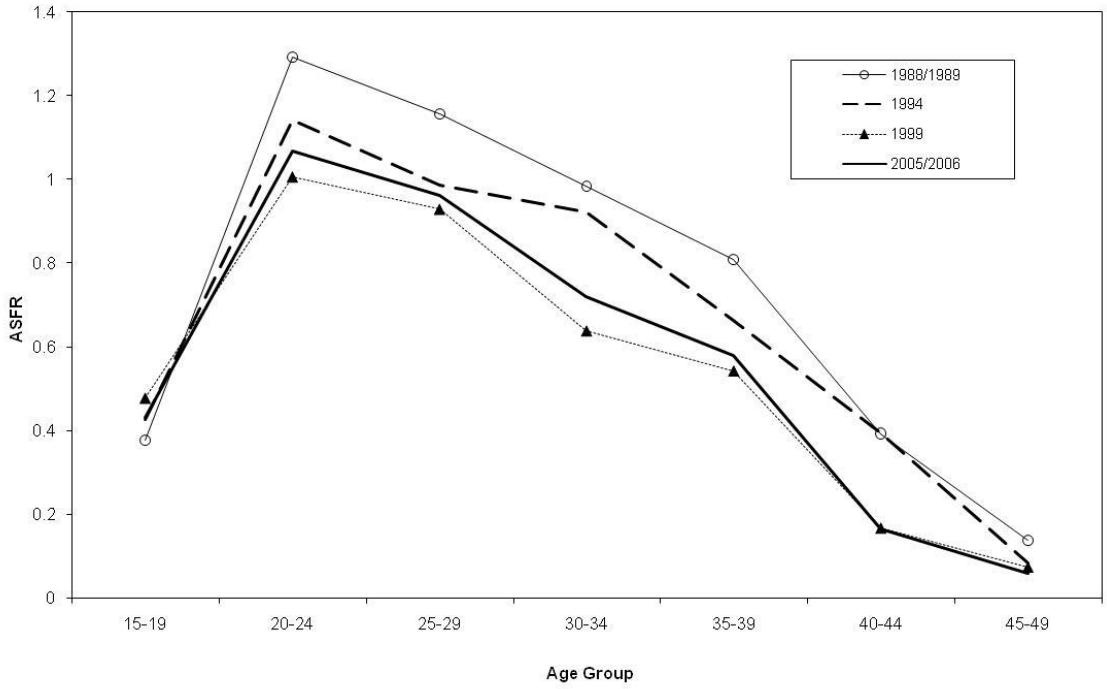

Fig. 12: Trends in period total fertility rate for urban versus rural women, Zimbabwe 1988-2006

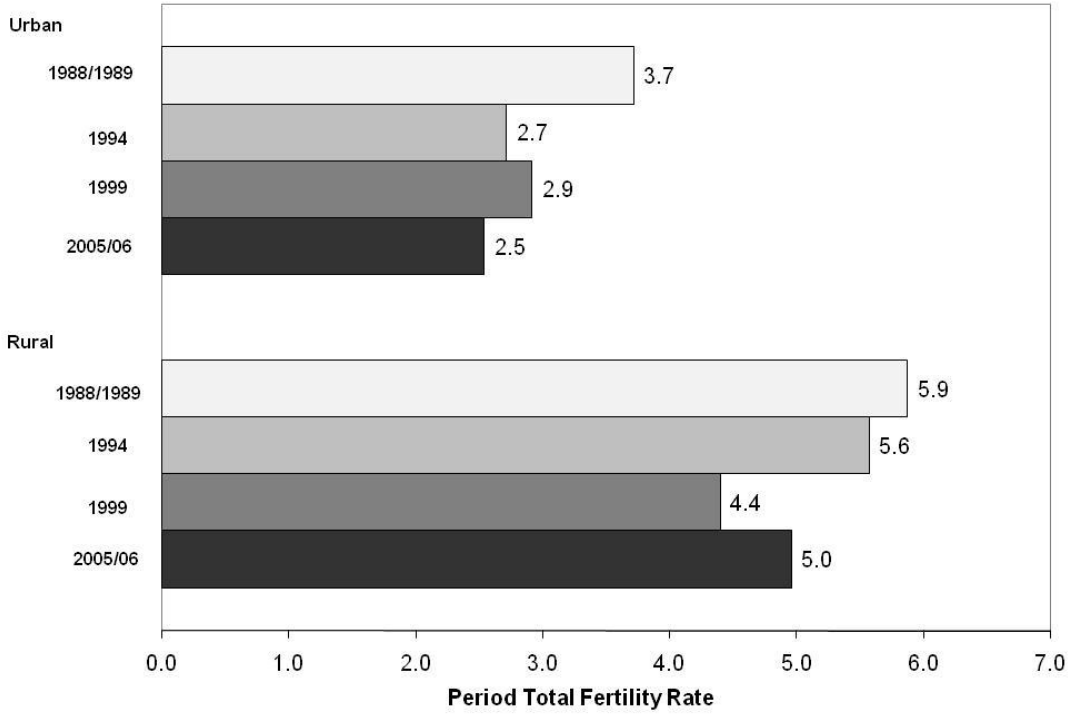

Fig. 13: Cumulative number of births by mother's age and birth cohort, Zimbabwe

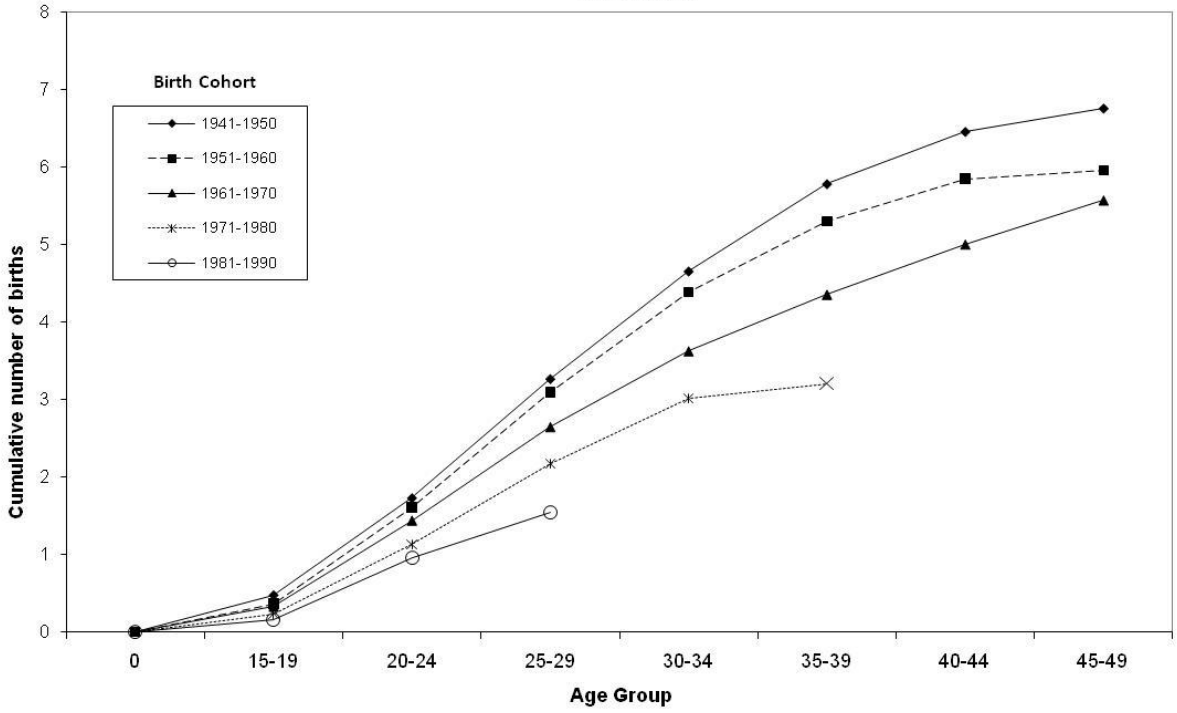

Fig. 14: Trends in number of months between births, by parity, Zimbabwe 1988-2006

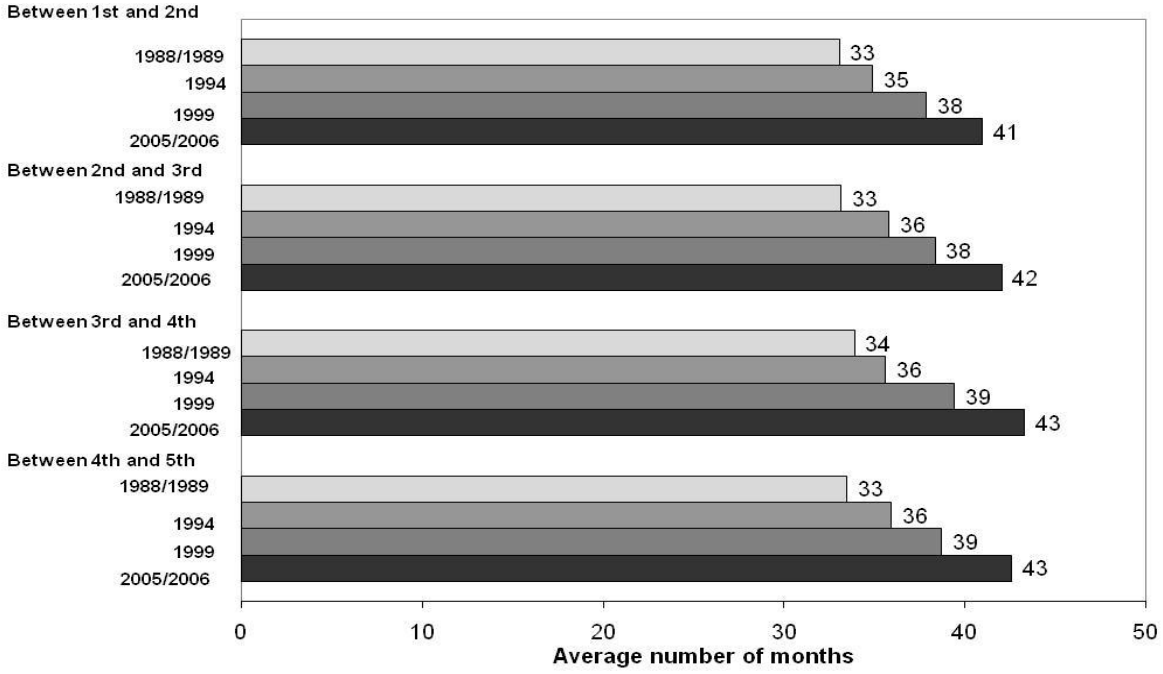

Fig. 15: Uganda: Estimated HIV prevalence rates for all aged 15-49, women aged 15-49, and all aged 15-24, 1982-2006, with TFRs at dates of DHS surveys

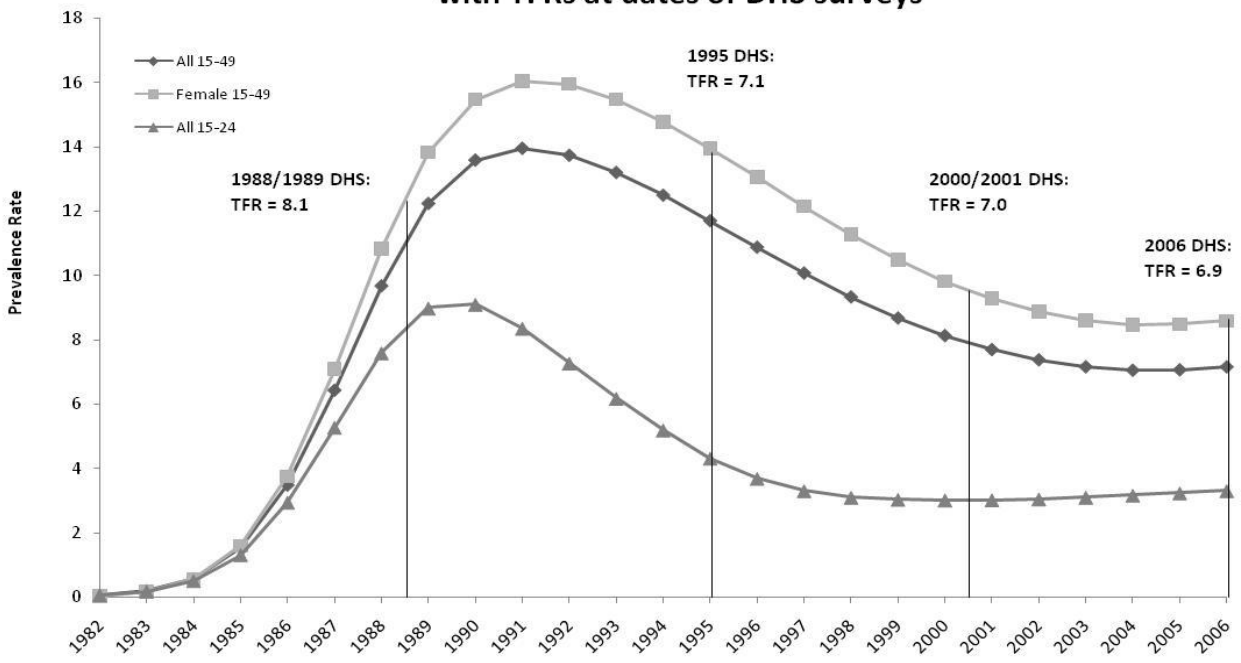

Fig. 16: Trends in Stated Ideal Number of Children, by Age Group, Uganda 1988-2006

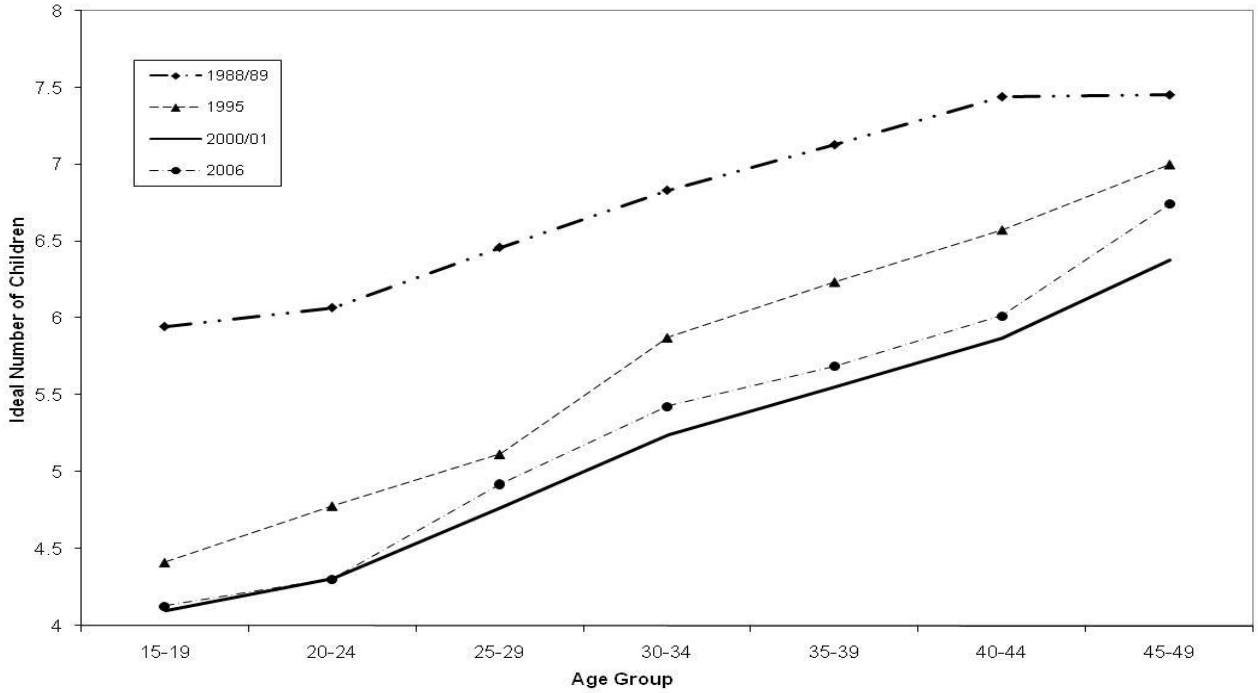

Fig. 17: Trends in age at first intercourse, age at first marriage, and age at first birth, Uganda 1988-2006

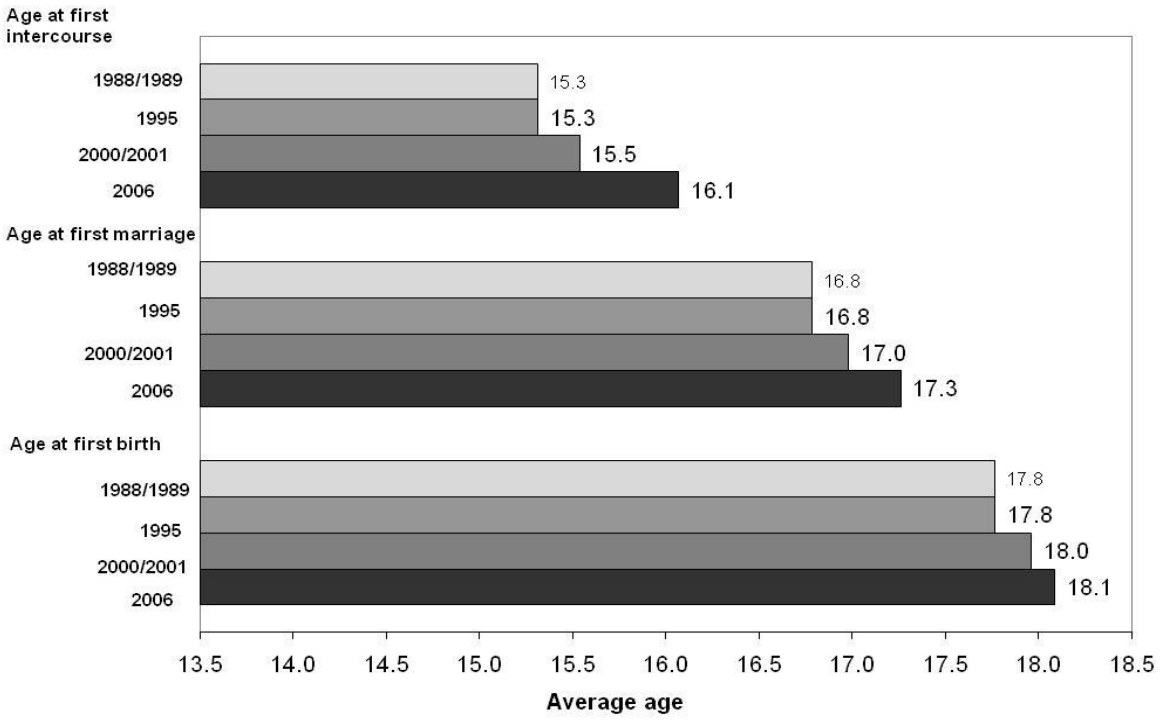

Fig. 18: Trends in percentage of women who have had sex by age 15, given birth by age 15, and who are married by age 15, Uganda 1988-2006

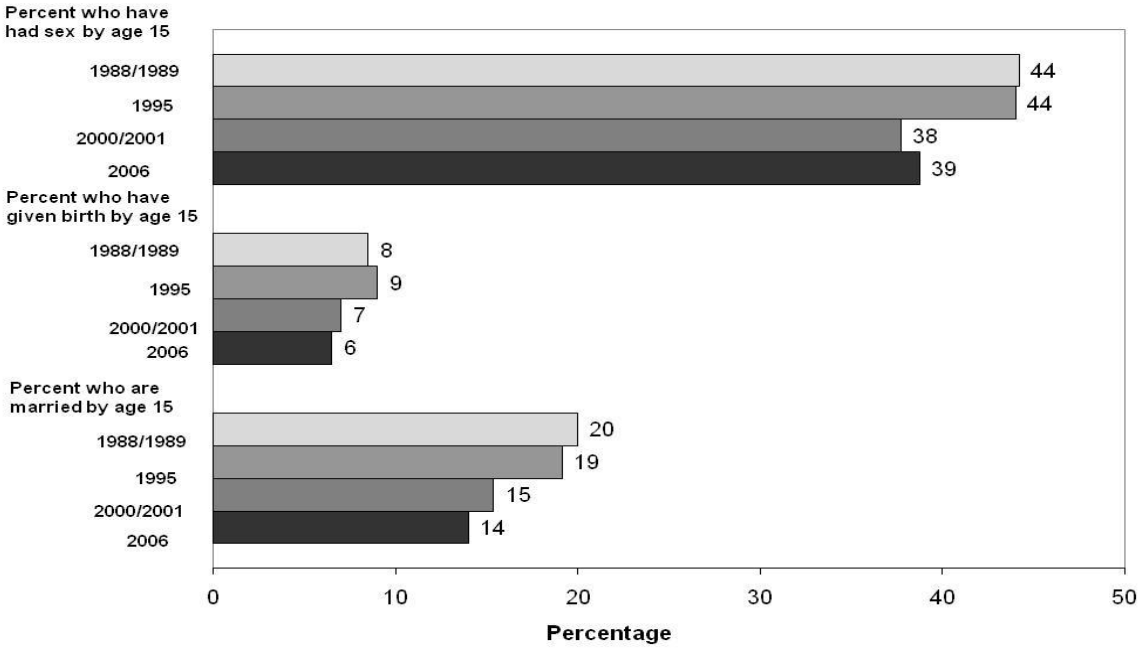

Fig. 19: Trends in Percentage of Women Who are Currently Married, by Age Group, Uganda 1988-2006

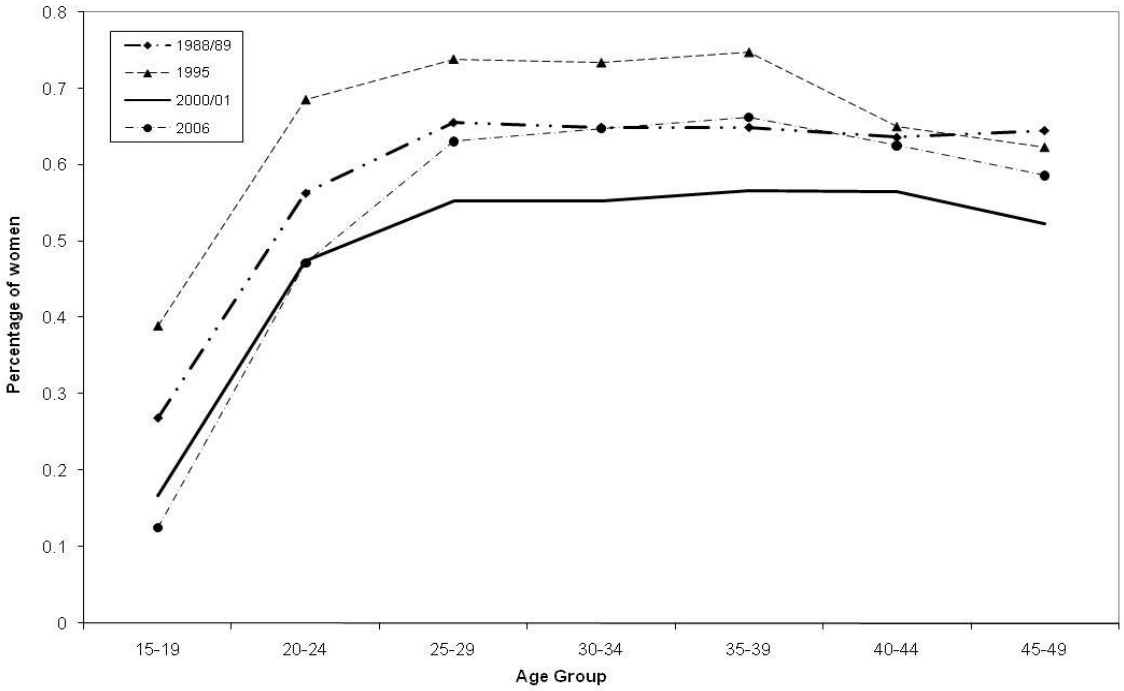

Fig. 20: Trends in sexual activity among urban versus rural women, Uganda 1988-2006

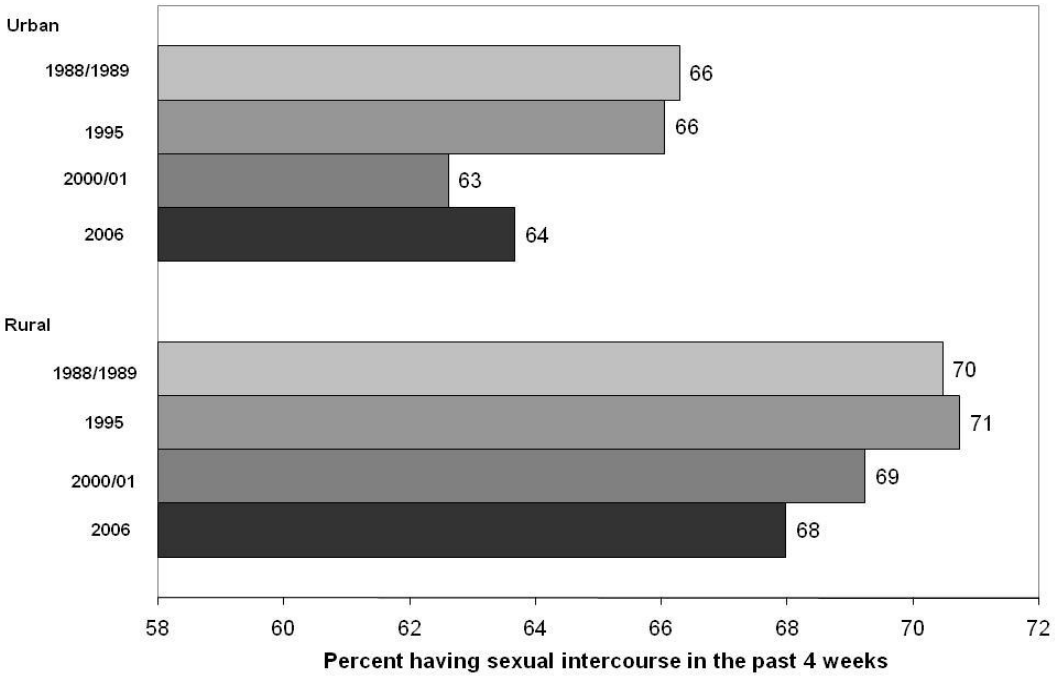

Fig. 21: Trends in modern contraceptive use among all women, sexually active women, and current married, sexually active women, Uganda 1988-2006

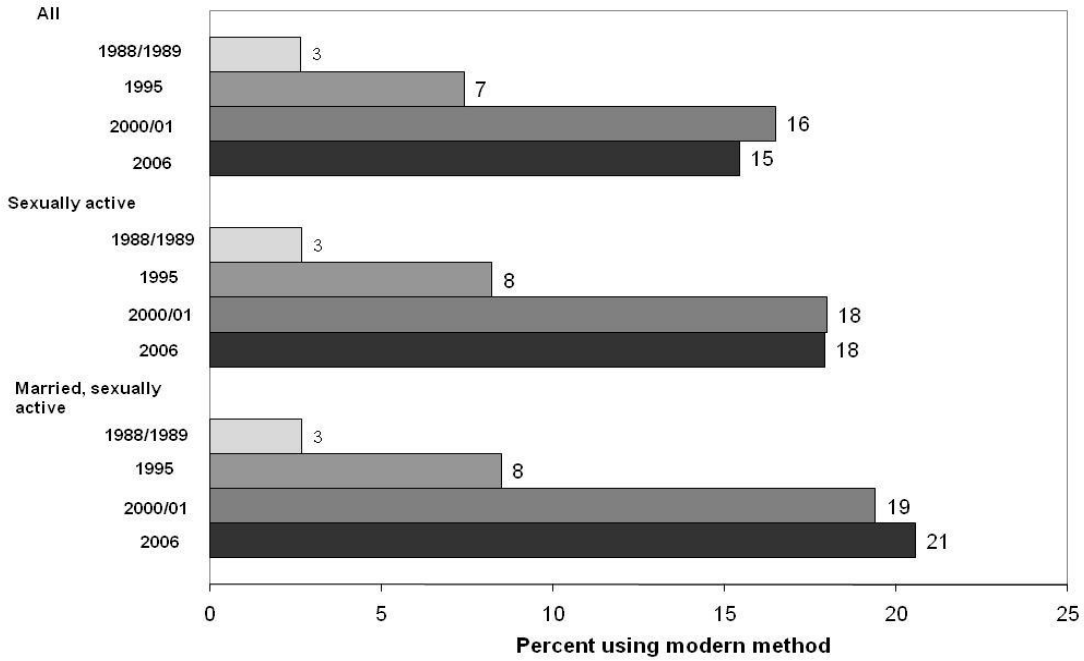

Fig.22: Trends in current use of contraception among women by age, Uganda 1988-2006

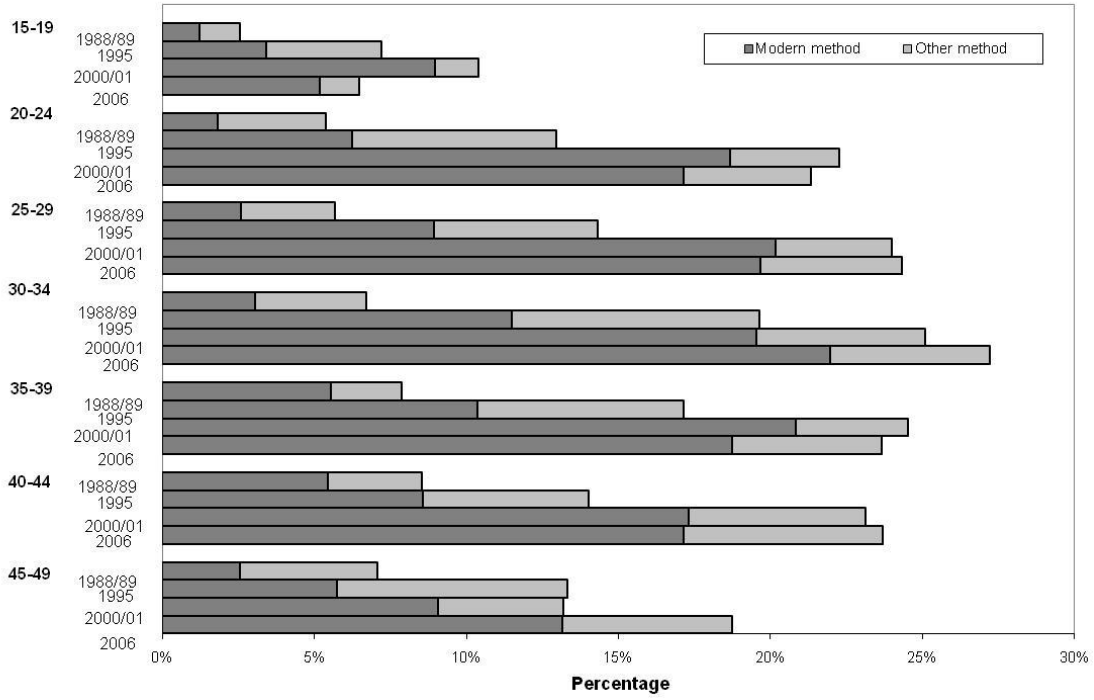

Fig. 23: Trends in use of modern contraceptive method among sexually active urban versus rural women, Uganda 1988-2006

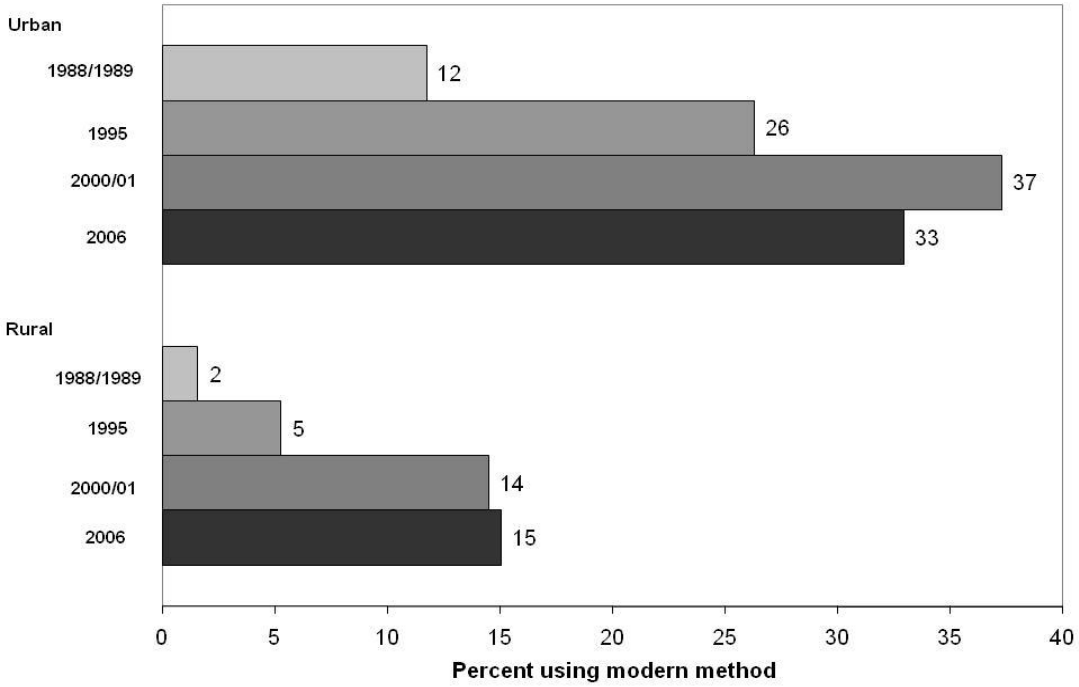

Fig. 24: Trends in condom use among urban versus rural sexually active women, Uganda 1988-2006

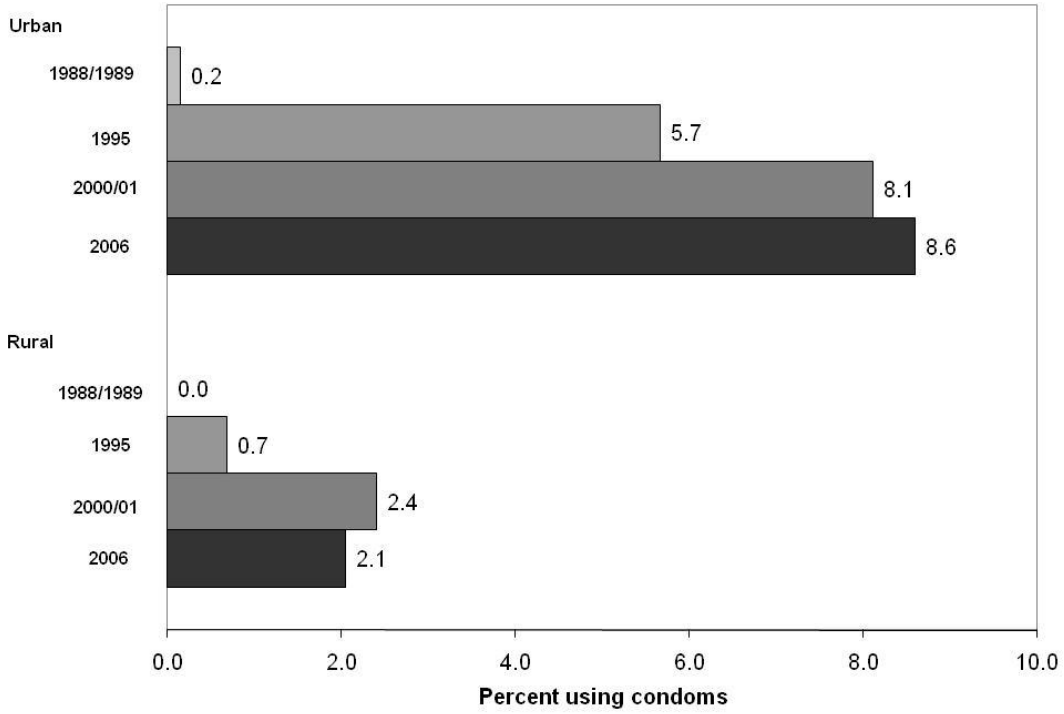

Fig. 25: Trends in 5-Year Age-Specific Fertility Rates, Uganda 1988-2006

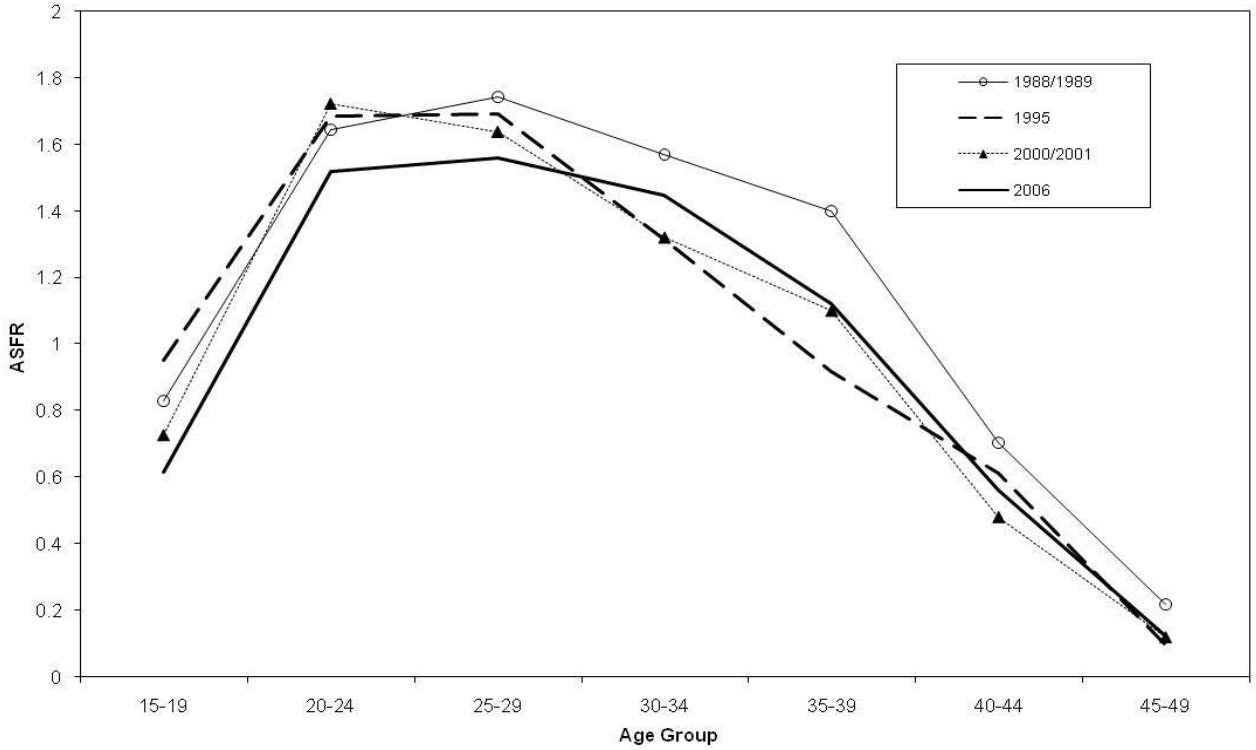

Fig. 26: Trends in the period total fertility rate for urban versus rural women, Uganda 1988-2006

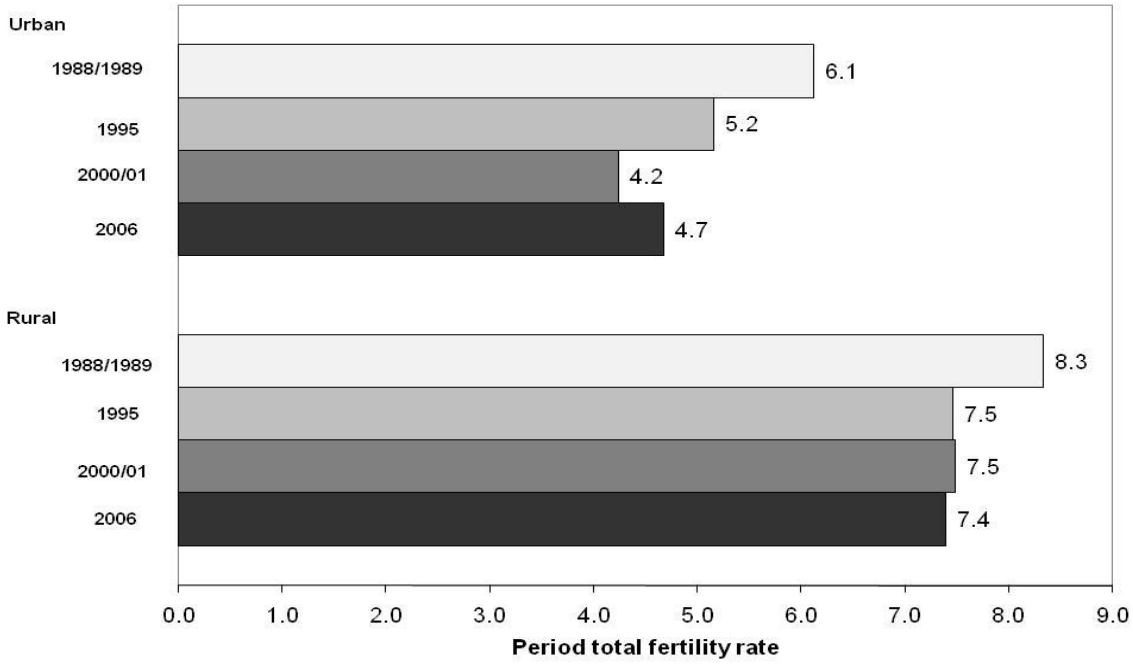

Fig. 27: Cumulative number of births by mother's age and birth cohort, Uganda

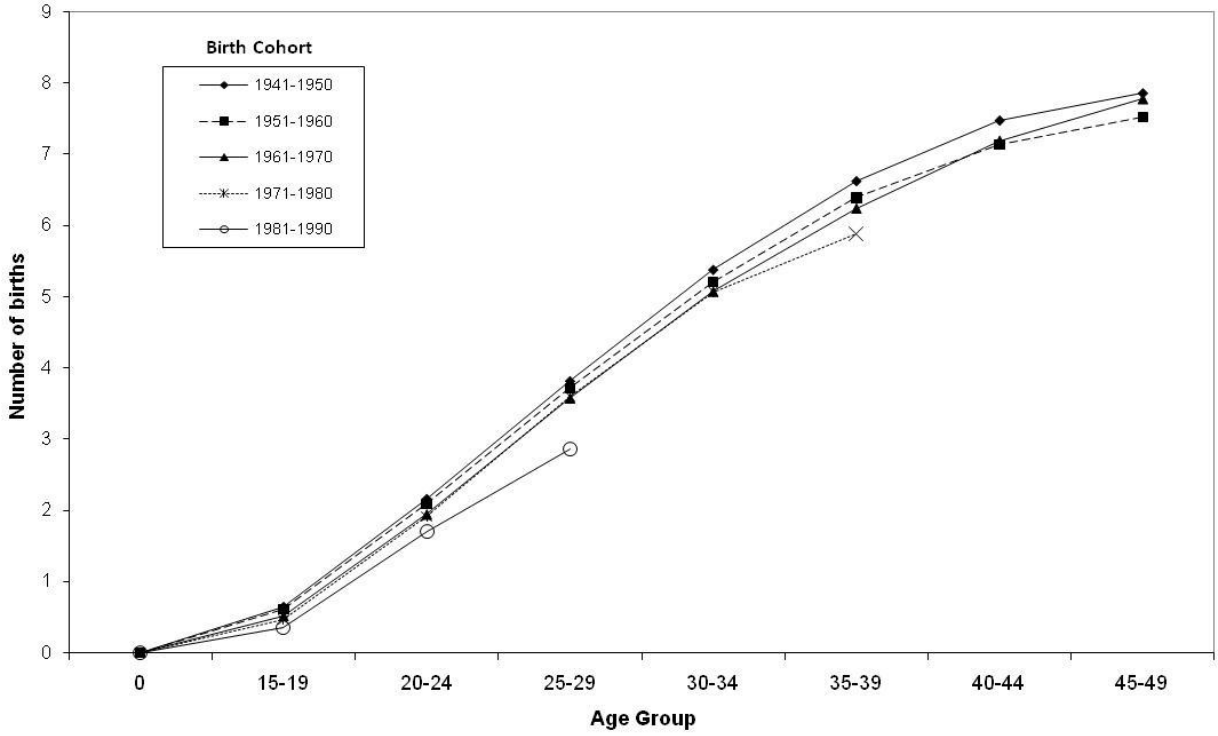

Fig. 28: Trends in number of months between births, by parity, Uganda 1988-2006

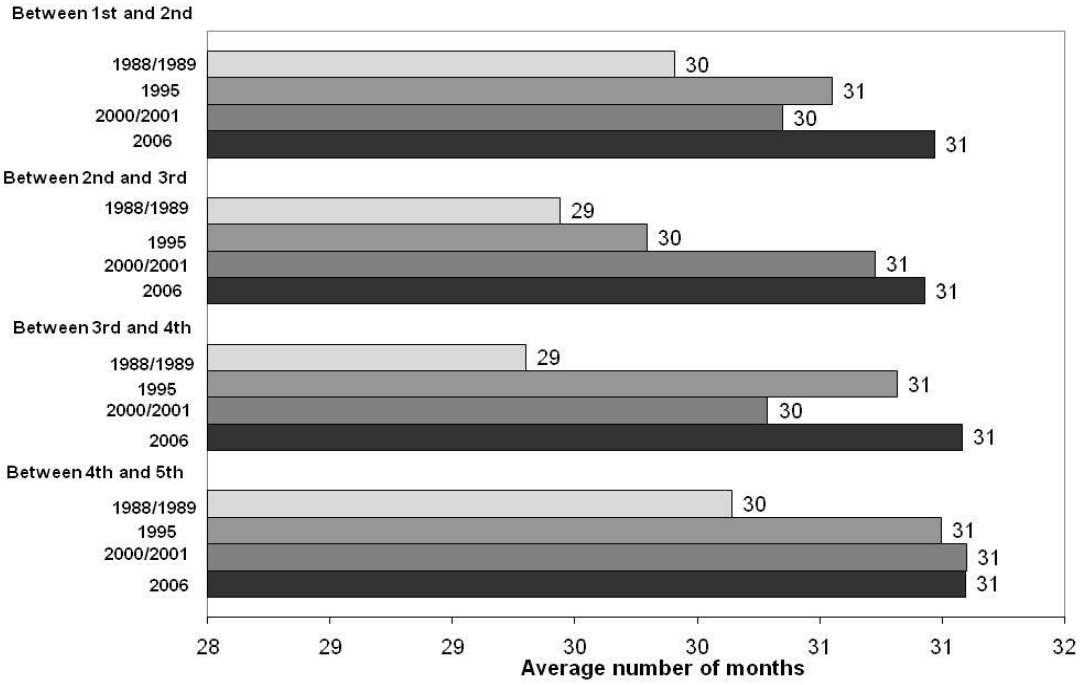

Fig. 29: Burkina Faso: Estimated HIV prevalence rates, for all aged 15-49, women aged 15-49, and all aged 15-24, 1982-2006, with TFRs at dates of DHS surveys

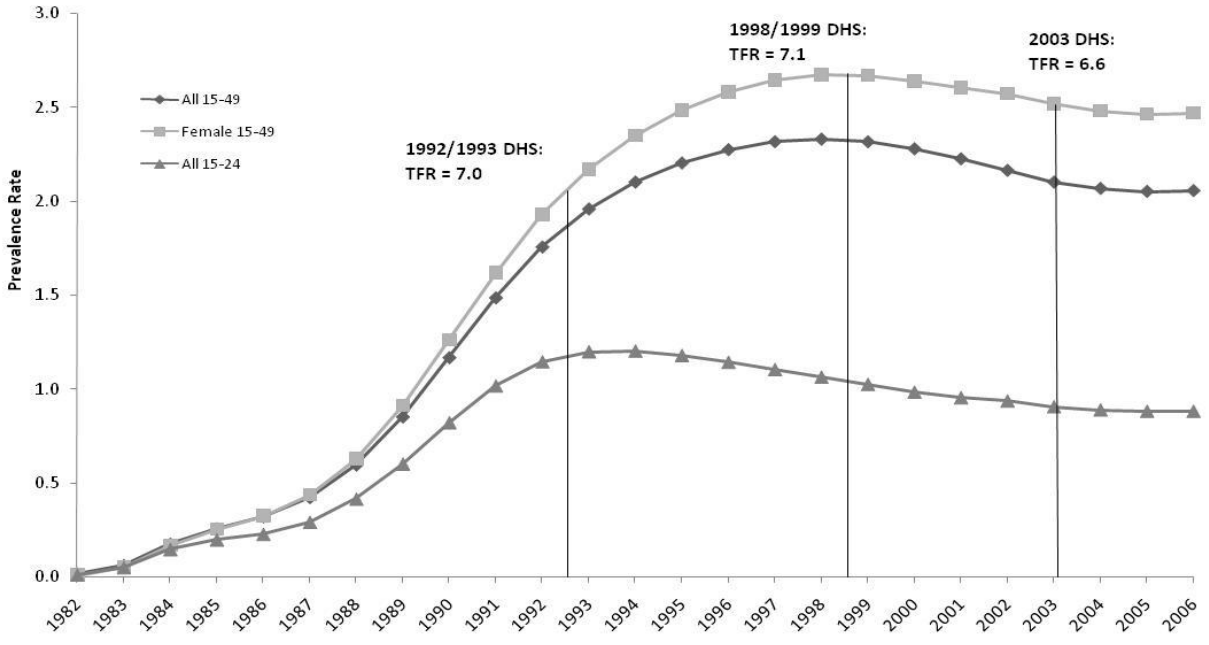

Fig. 30: Trends in Stated Ideal Number of Children, by Age Group, Burkina Faso 1992-2003

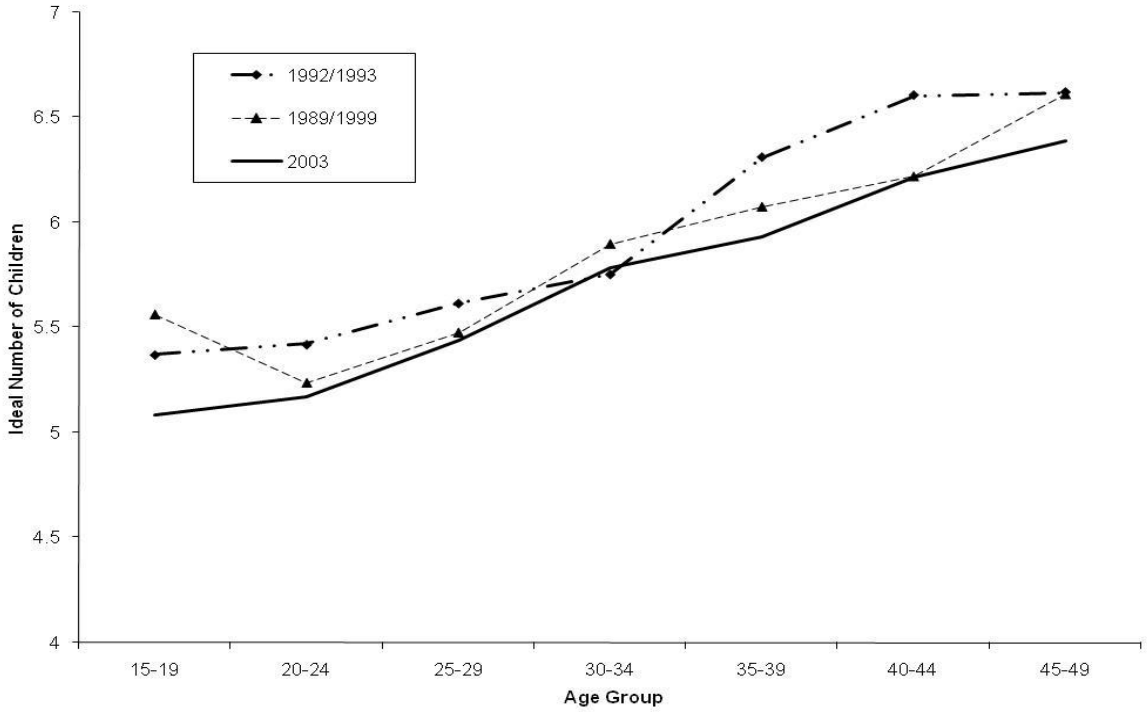

Fig. 31: Trends in age at first intercourse, age at first marriage, and age at first birth, Burkina Faso 1992-2003

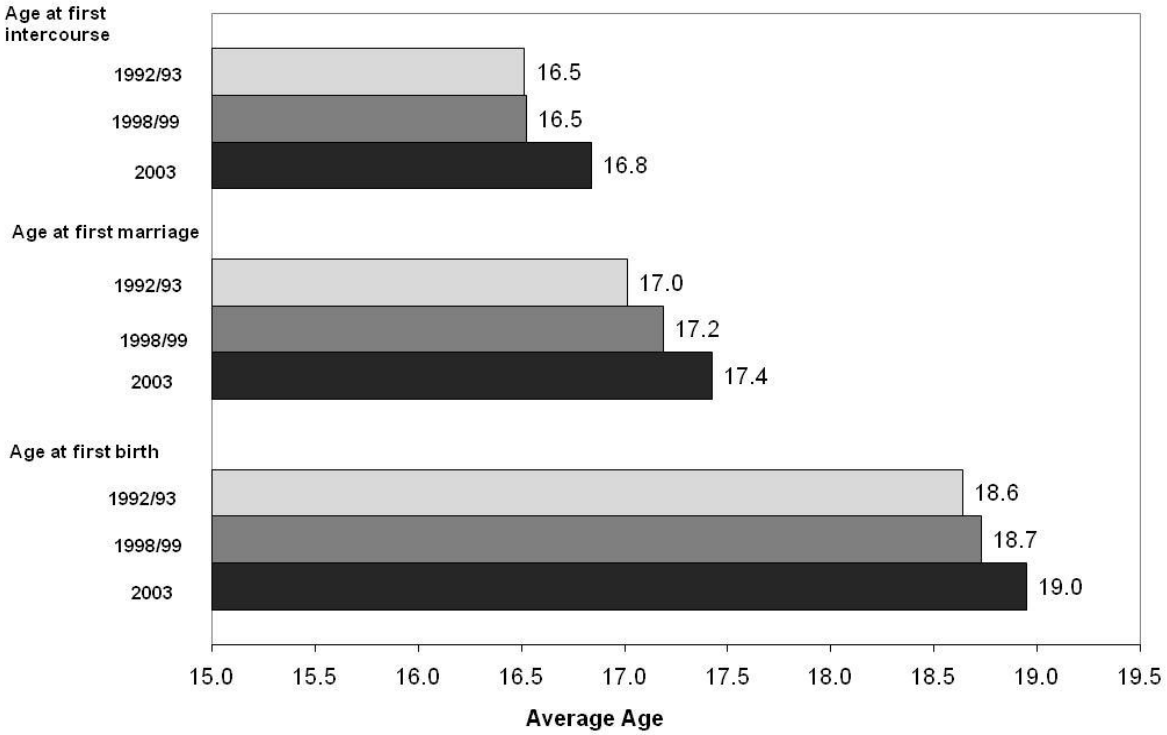

Fig. 32: Trends in percentage of women who have had sex by age 15, given birth by age 15, and who are married by age 15, Burkina Faso 1992-2003

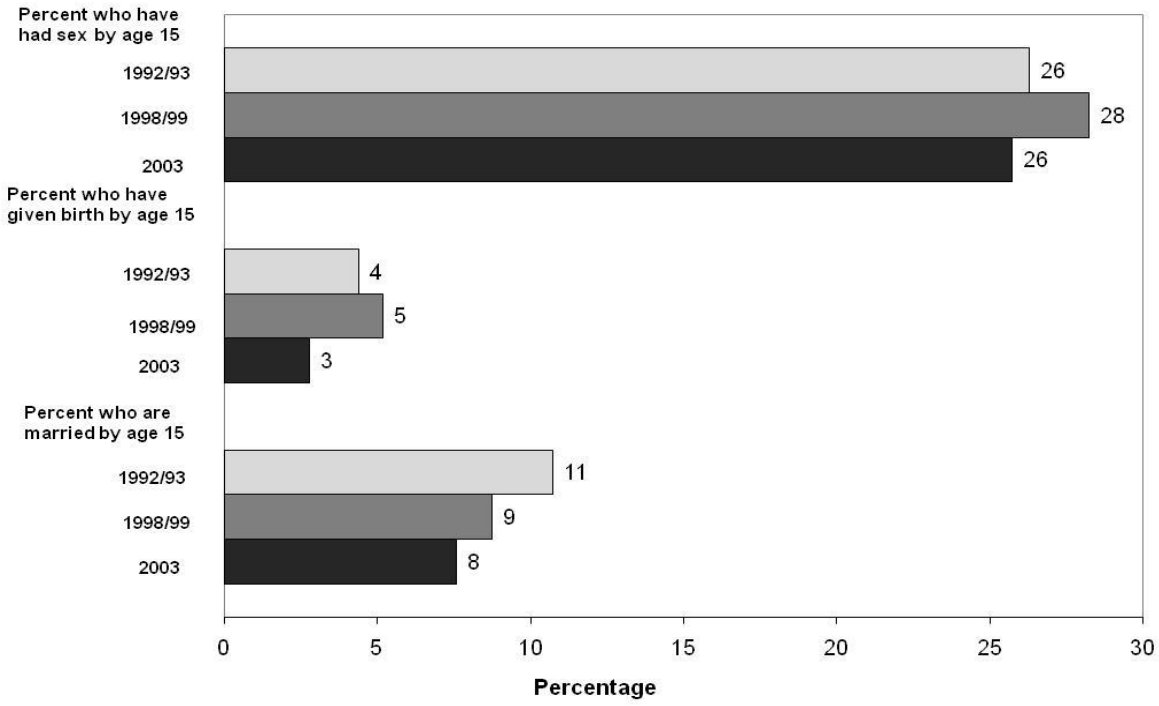

Fig. 33: Trends in Percentage of Women Who are Currently Married, by Age Group, Burkina Faso 1992-2003

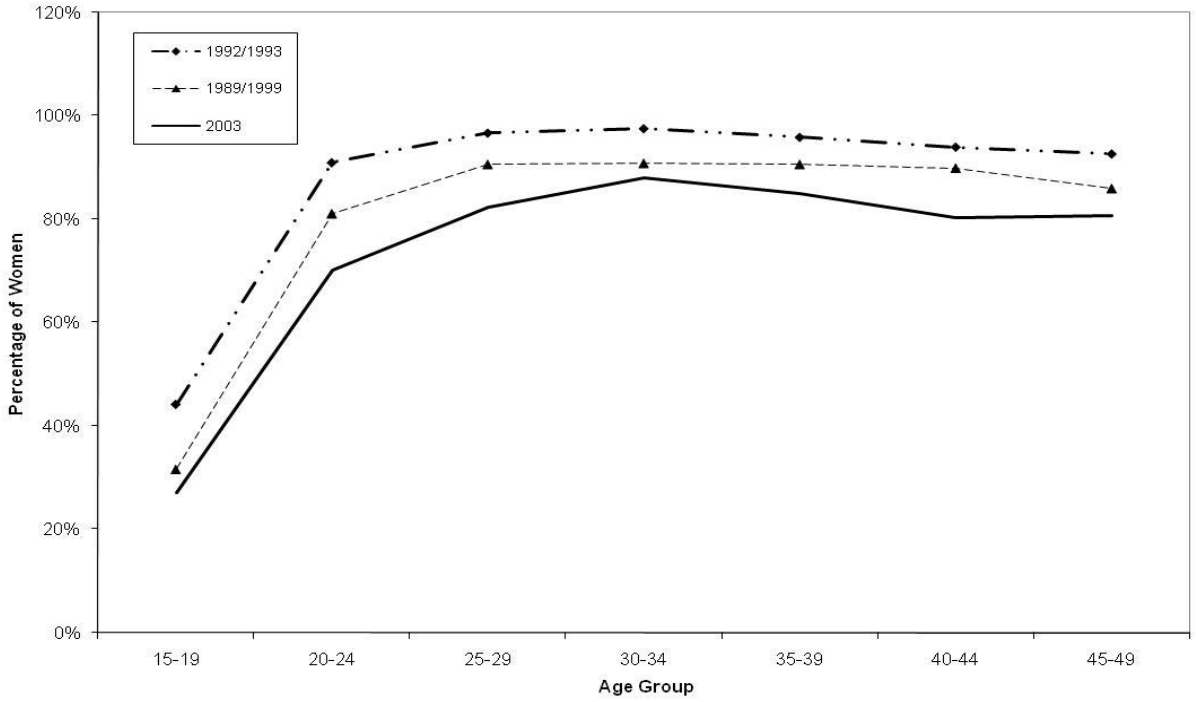

Fig. 34: Trends in sexual activity amount urban versus rural women, Burkina Faso 1988-2006

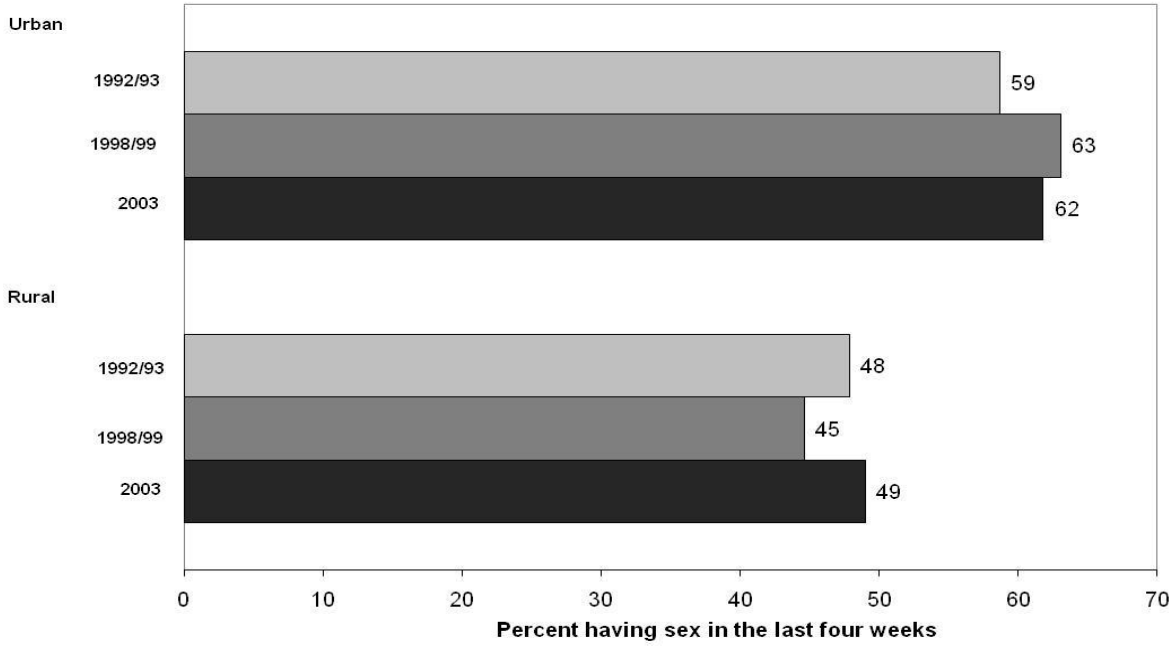

Fig. 35: Trends in the use of modern contraceptive method among all women, sexual active women, and married, sexually active women, Burkina Faso 1992-2003

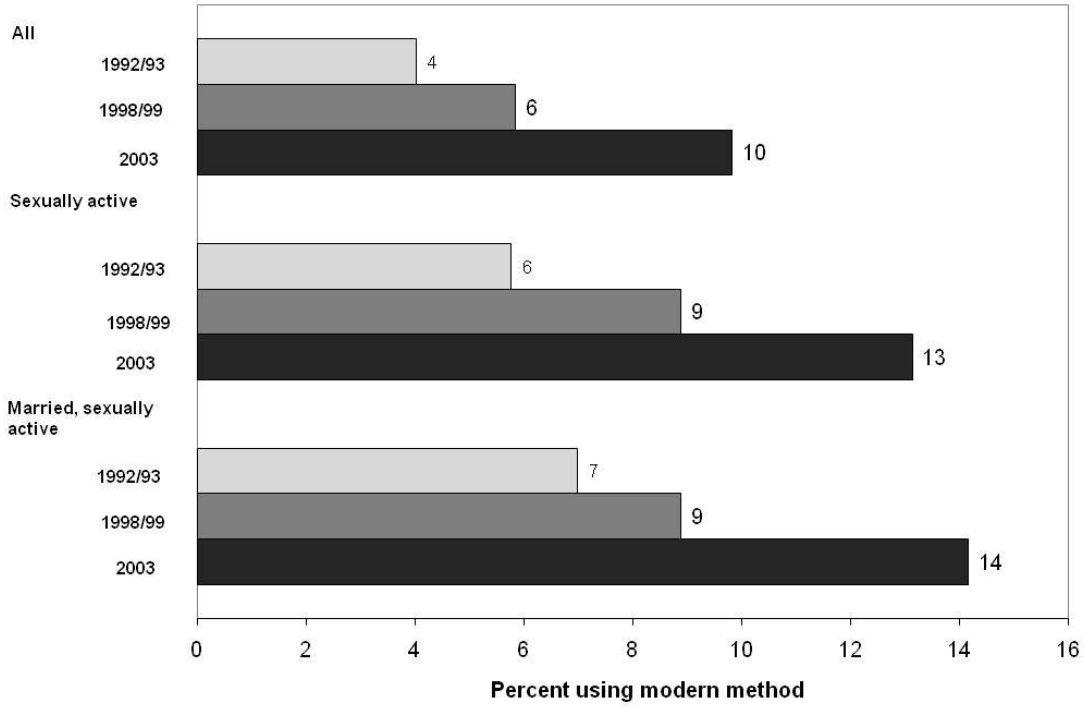

Fig.36: Trends in current use of contraception among women by age, Burkina Faso 1992-2003

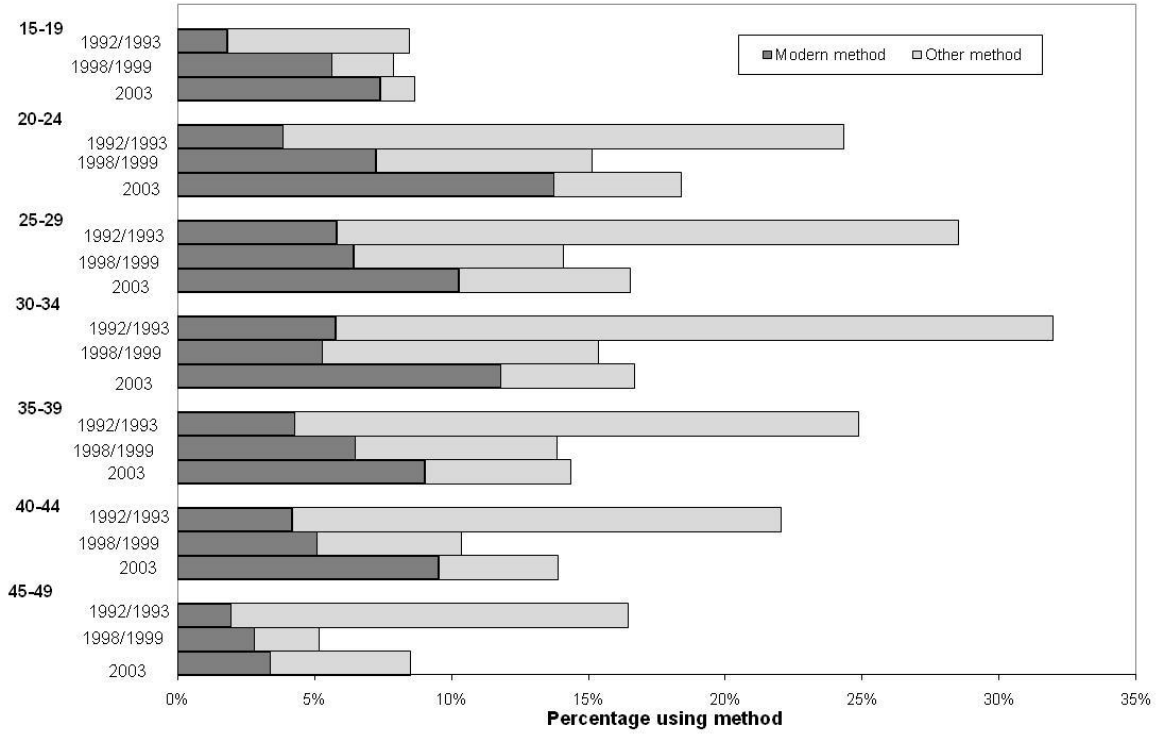

Fig. 37: Trends in the use of modern contraceptive method among sexually active urban versus rural women, Burkina Faso 1992-2003

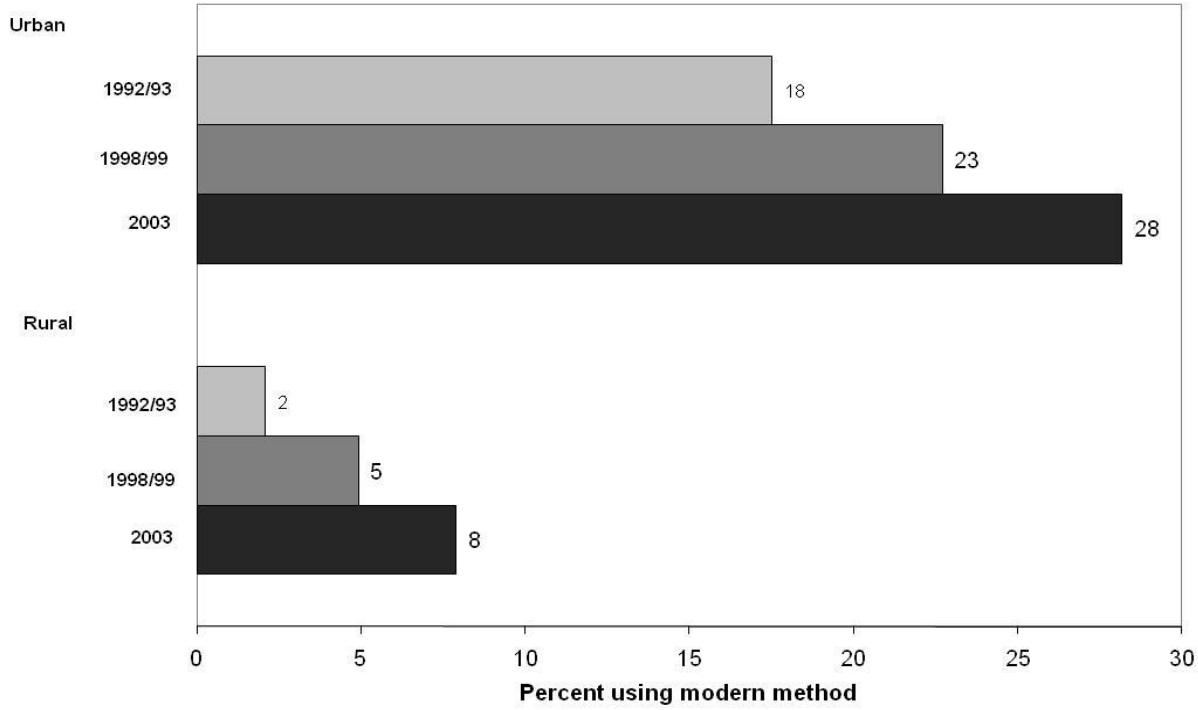

Fig. 38: Trends in the use of condoms by sexually active urban versus rural women, Burkina Faso 1992-2003

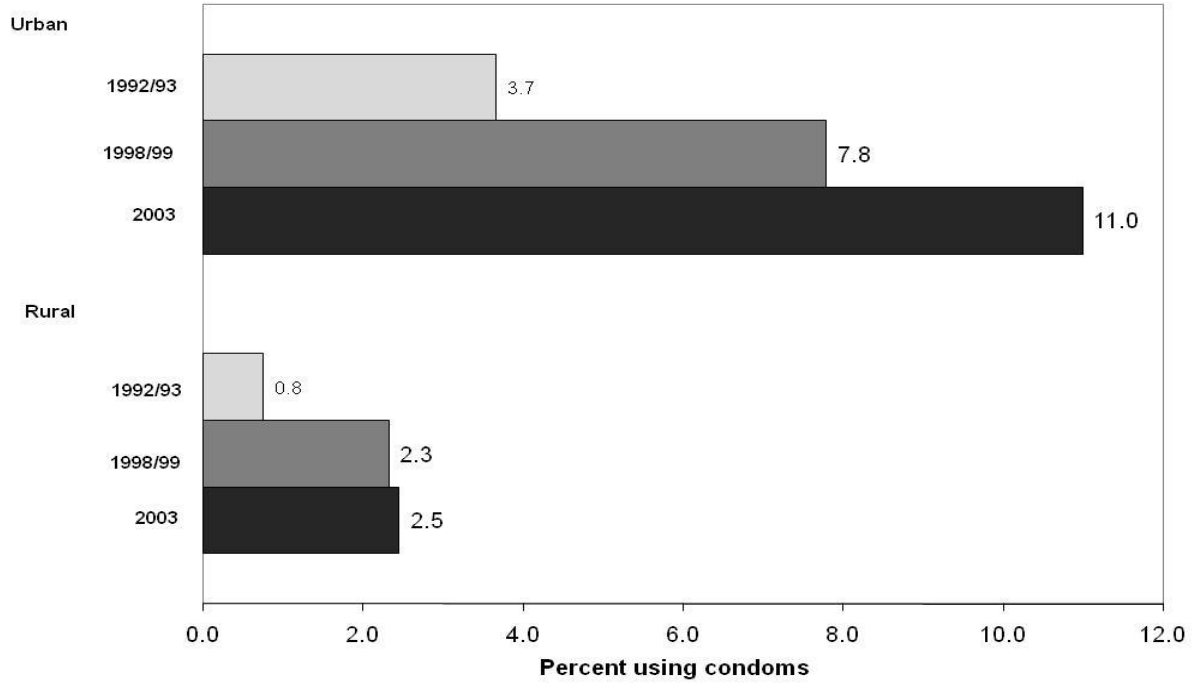

Fig. 39: Trends in 5-Year Age-Specific Fertility Rates, Burkina Faso 1992-2003

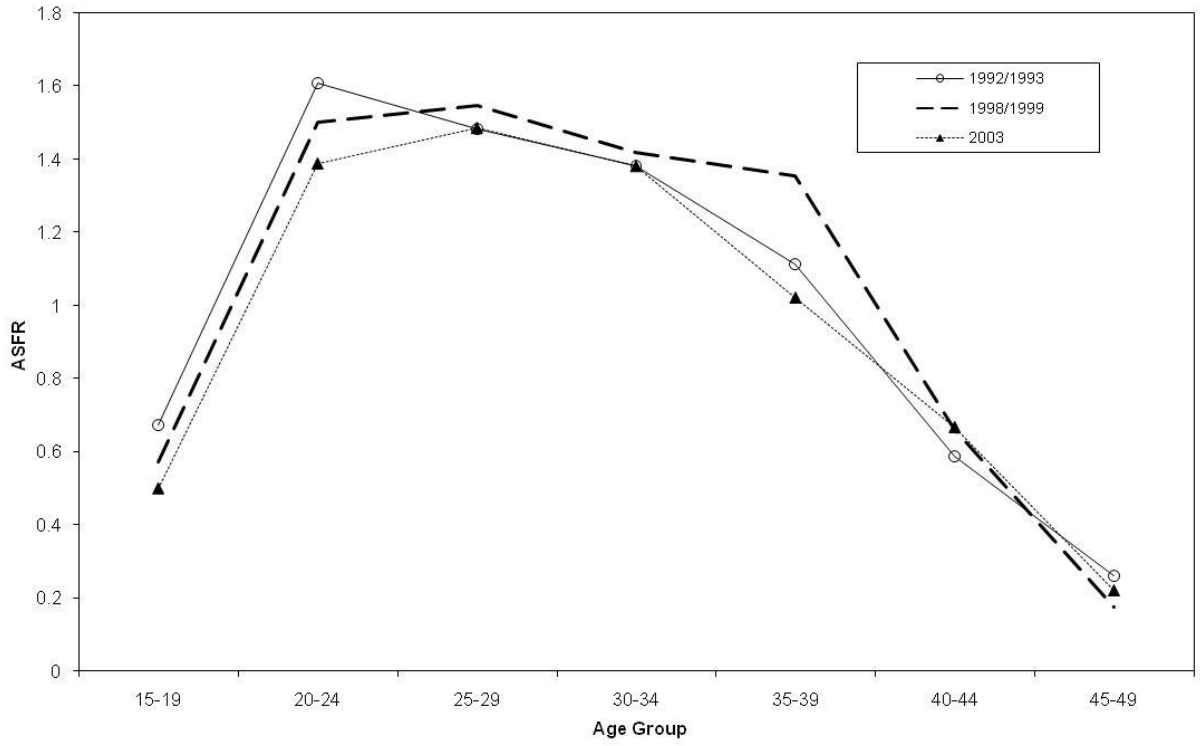

Fig. 40: Trends in period total fertility rate for urban versus rural women, Burkina Faso 1992-2003

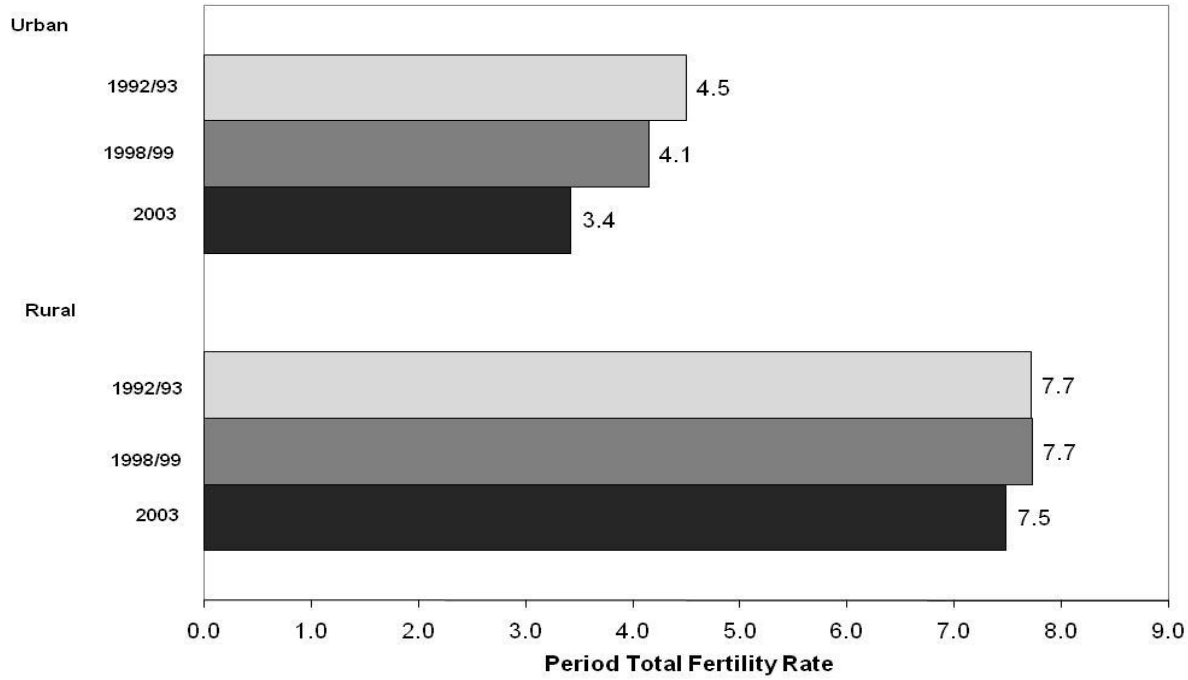

Fig. 41: Cumulative number of births by mother's age and birth cohort, Burkina Faso

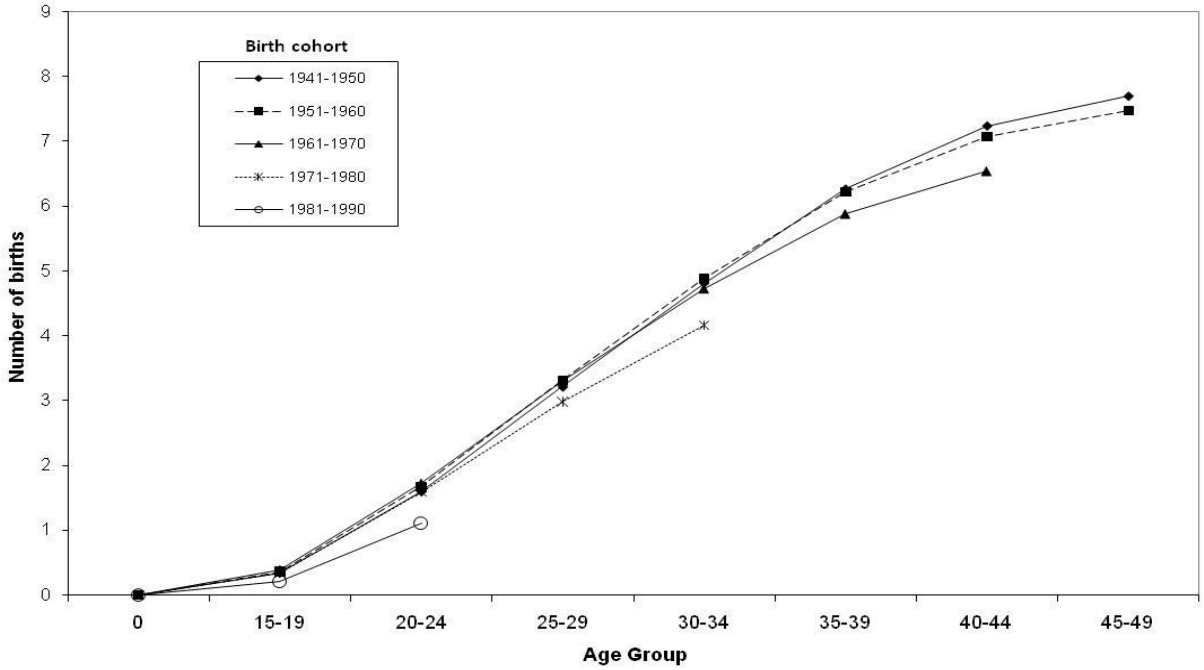

Fig. 42: Trends in number of months between births, by parity, Burkina Faso 1992-2003