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Trends in age at first sex in Uganda: evidence from Demographic and Health Survey data, and longitudinal cohorts in Masaka and Rakai.

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Key Messages

1. Ugandan women born since the 1970s have started sex later than their predecessors.
2. Change in men's age at first sex has not been directional.
3. Changes in age at first sex are unlikely to have contributed to the initial decline in HIV prevalence in Uganda.

Abstract

Objectives

To derive the best possible estimates of trends in age at first sex among successive cohorts of Ugandan men and women based on all the data available from the Demographic and Health Surveys (DHS) and the cohort studies in Masaka and Rakai districts.

Methods

The datasets from the DHS, Masaka cohort and Rakai cohort were analysed separately. Survival analysis methods were used to estimate median ages at first sex for men and women born in the 1950s through 1980s and to compute hazard ratios for first sex comparing later to earlier cohorts.

Results

The DHS and Masaka data show an increase in women's age at first sex in the more recent birth cohorts compared to those born before 1970 but this is less apparent in the Rakai data. Successive male cohorts in Masaka appear to have first increased and subsequently decreased their age at first sex, a trend that is also apparent, but not significant, in the DHS data. Younger men in Rakai have an earlier age at first sex than those born before 1980.

Conclusions

Women in Uganda who were born after 1970 have, on average, had sex at a later age than those born earlier. Men's age at first sex has not changed consistently over the period in question. Differences between Masaka and Rakai may reflect socio-economic differences. Most of the change in age at first sex occurred too late to have contributed to the initial decline in HIV incidence.

Introduction

Although not a strategy that can be maintained throughout a lifetime, avoidance of sexual intercourse is a reliable way to avoid contracting most sexually transmitted infections and of preventing unwanted conceptions. Abstinence has been a key component of many HIV prevention programmes, in Africa and elsewhere¹⁻³. Abstinence usually means encouraging young people to delay their sexual debut with the intention of reducing their exposure to sex and sexual partners before committing to a stable, and hopefully long-lasting partner. For HIV prevention, implicit in this message is that this permanent partner is uninfected, or at least less likely to be infected than other, more casual, partners.

There is considerable interest in measuring levels and trends in the key behaviours tackled by many HIV prevention programmes: abstinence, number of partners, and condom use. Age at first sex (AFS) is a key indicator for measuring behaviour change in HIV prevention programs^{1,4,5}. In many developing countries AFS, and age at first marriage, have occurred at older ages in recent years compared to 40 or 50 years ago^{6,7}. The reasons for these changes are complex, but there are clear links between development and delayed AFS. It is also clear that behaviour change does not occur in isolation, as risk behaviour is unlikely to change unless the social context is supportive of change. The timing of first sex is a product of agency and opportunity. Individuals may have limited autonomy to delay sexual debut if their first experience of sex is through coercive sex or rape⁸⁻¹⁰.

Uganda was the first country to report a generalised epidemic and to show a decline in HIV prevalence among the general population. Sexual behaviour data, including age at first sex have been collected in several DHS surveys over the past 15 years¹¹, and have been collected from 2 population-based cohorts in south western Uganda. There is a considerable literature on changes in sexual behaviour and their influence on the decline in HIV prevalence in Uganda during the 1990's (eg.^{12,13}). This highly charged debate has largely concluded that the multifactorial response, and not one simple behaviour change, was key to the prevalence decline^{14,15}. A secondary but crucial point is that data from the relevant time period are inadequate to settle the debate^{16,17}.

AFS is the only behavioural measure for which historical trends can be reconstructed using more recently reported recall data. These trends can be difficult to identify using data from a series of cross-sectional surveys because observed change could be due to: 1) differences in data quality between surveys; 2) changes in the composition of the population between the time of AFS and the time of the survey, or between surveys. If these differences are related to AFS, for example if those with a younger AFS tend to emigrate or to die prematurely, an artificial trend may be seen.

We determine the trends in age at first sex in Uganda by comparing repeated cross-sectional data on age at first sex from DHS with data collected from two cohorts in rural Uganda. Changes in population structure do not affect the cohort data because information is collected on all individuals during the time they are resident in the area and retained for later analysis. Data therefore includes anyone who subsequently died or moved away as well as immigrants to the area.

The quality of retrospectively reported data on AFS can be compromised by reporting bias due to accidental recall errors or through a desire to conform to health education messages. This can be assessed directly using cohort data and is discussed elsewhere in this issue. Although considerable variability in response is apparent, this does not have a directional effect on the results¹⁸.

Methods

In this paper, we use data from all the DHS conducted to date in Uganda (1988, 1995, 2000/1 and 2006) and data from two longitudinal population-based studies, one in Masaka district and one in Rakai district. The DHS provides robust national estimates for different time points, and the methods by which the data are collected are openly available¹¹. The cohort data provide detailed information for two sets of respondents from two districts of Uganda, both of which have been extensively reported in publications over the past 15 years^{12,19-21}.

DHS

Data were obtained for all the DHS conducted in Uganda. In 1988 only women were interviewed but in subsequent years (1995, 2000/1, 2006) data are available for men and women. The geographical range of the sample was restricted in 1988 compared to the later surveys. Age at first sex, reported in whole years, is one of the first questions asked in the section on marriage and sexual behaviour and has been asked in the same way in all surveys. We have restricted our analysis to people who were born between 1950 and 1991 and had their first sex between 1960 and 2006. We have excluded 973 respondents who were born before 1950. We have used the unedited data from the DHS, and have not corrected age at first sex for other reported ages in the DHS (age at first marriage and age at first birth). We used national, rather than regional, data because the number of respondents from the region that contains Masaka and Rakai districts is inadequate for this analysis.

Masaka study

The Medical Research Council (MRC) general population cohort has been described before^{12,19}. Briefly, the study is located in a rural sub-county in Masaka district in south-western Uganda, where an open cohort has participated in annual, population-based surveys. In 1989, the census included 10,000 people residing in 15 villages, but in 1999/2000 this expanded to 18,000 residents in 25 villages. Survey staff administer a risk factor questionnaire and annually collect a blood sample for HIV testing. Starting in 1997, age at first sex was asked as the first question on sexual behaviour, in the same way in all surveys, and reported in whole years. For this paper analysis was restricted to participants born between 1950 and 1994.

Rakai study

The Rakai Health Sciences Program (RHSP) has, since 1994, conducted annual surveys using an open community cohort of consenting persons aged 15-49, resident in rural communities of Rakai District, south-western Uganda^{20,21}. Surveys are conducted annually using a questionnaire that includes modules on both socio-demographic and behavioural characteristics. The same question on age at first sex was asked, in completed years, at the enrolment visit of a participant during study rounds 4 (1997-98) and 6-10 (1999-2004). This analysis was restricted to participants born between 1950 and 1989 and resident in 43 communities that have been followed since 1994.

Statistical methods

For the two cohort studies, responses that were older than the age of the respondent at the time of the survey were excluded from the analysis. For each participant, the most likely AFS was calculated, as the age reported in 50% or more of the survey responses, or the mean age if no age was reported in 50% of the surveys. Stata 10²² was used for all analyses.

For all three studies we defined birth cohorts based on reported age in the DHS, and reported date of birth in the cohort studies. Ten year birth cohorts, using 1950-1959 as the baseline cohort, were used for the analysis. Later analysis using 5 year birth cohorts was restricted to those born after 1st January 1970, whose first sex occurred when HIV prevalence was already high. The cohort born in 1970-74 were used as the baseline group for comparison.

For all data, we smoothed the distribution by adding a random fraction of a year to each person's reported age at first sex, to account for the time between their birthday and the date of first sex. With this approach it is possible to estimate summary measures for the population in increments of less than one year. Ten replications of each of the datasets were created using different simulations of the random fraction and the Stata command *micombine* was used for the formal comparisons²³.

Age to event analysis (i.e. survival prior to sexual debut) was used to summarise the median age, and inter-quartile range (IQR) of AFS. Curves, plotting the cumulative proportion who have had sex at any given age, are used to display the pattern of sexual debut²⁴. Cox regression models (accounting for the survey design for DHS data²²) were used to look for changes in the median age at first sex by birth cohort. For the DHS data, these analyses were repeated for each survey, and by selected background characteristics.

Results

The number of male and female respondents in each of the DHS, and from the Masaka and Rakai study, by year of birth, is shown in Table 1. For the DHS survey, the median age at first sex in each survey is given for respondents aged 15-49 and 15-24, while for the 2 cohort studies the median AFS is given for the cohorts born in 1950-89 and 1980-89. From the DHS, a consistent increase in the median age at first sex was seen for women, and a similar trend is apparent for young men. However, the composition of the DHS changes over time as each survey captures a different set of birth cohorts.

Table 1: Number of respondents by sex, survey and year of birth, and overall median age at first sex for each survey. For all DHS, and for the Masaka and Rakai studies.

Males

Year of birth	DHS				Median AFS**	Masaka Cohort		Rakai Cohort	
	1995	2001	2006	Total		N	Median AFS	N	Median AFS
1950-59	384	260	205	849	18.1	492	18.5	852	18.1
1960-69	636	494	502	1,632	18.2	843	18.2	2060	17.9
1970-79	767	631	690	2,088	18.0	1389	18.0	4060	17.8
1980-89	25	524	874	1,423	17.9	2781	18.5	2821	17.1
1990-94	0	0	232*	232*	18.1*	933	17.1	0	-
Total	1812	1909	2503	6224	18.0	6438	18.2	9793	17.7

Females.

Year of birth	DHS				Median AFS**	Masaka Cohort		Rakai Cohort		
	1988	1995	2001	2006		Total	N	Median AFS	N	Median AFS
1950-59	1,158	1,171	777	360	3,466	15.9	581	16.6	1039	15.9
1960-69	1,948	2,273	1,604	1,553	7,378	16.1	1030	16.8	2196	16.0
1970-79	947	3,199	2,805	2,497	9,448	16.4	1768	17.0	5606	16.6
1980-89	0	131	2,060	3,366	5,557	17.1	3235	17.5	4853	16.5
1990-94	0	0	0	755*	755*	-	829	16.9	0	
Total	4053	6774	7246	8531	26604	16.4	7443	17.1	13694	16.4

*1990-1991 only. ** Based on data from all surveys.

Survival curves by 10 year birth cohorts are shown in Figure 1. Figure 1a combines the data from all 4 of the DHS and the curves suggest that there has been a change towards a later age at first sex for women. The pattern of the change appears to be different for men and women: the female cohorts born in 1980's appear to be delaying first sex from the outset, whereas there has been little change in the proportion of men who have had sex at the younger ages. The survival curves for females in the Masaka study (Fig 1b) and the Rakai study (Fig 1c) show a similar pattern to those from the DHS, with the female cohorts of the 70's, 80's and 90's showing a delay in age at first sex. AFS in Masaka females is slightly older than that reported in the DHS study and in the Rakai cohort (Table 1 and Fig 1), and delay in AFS among the 80's birth cohort appears smaller in the Rakai cohort compared to DHS data and the Masaka cohort. For the males, there seems to be some delay in AFS in the 70's and 80's birth cohorts in Masaka, but an earlier AFS in the 80's birth cohort in Rakai (Fig 1).

Table 2 translates these survival curves into relative hazards for the 10-year birth cohorts taking a baseline of those born in 1950-1959. For females there is strong evidence from the DHS and the Masaka study that females in the 80's and 90's cohorts are starting sex later, with significantly lower relative hazards for those born in the 70's, 80's and 90's compared to the baseline cohort of the 1950's. For the females in Rakai a significantly lower hazard is seen for the cohort born in the 70's but there is no significant difference in hazard for starting sex between those born in the 80's and those born in the 50's. For males, both the DHS and the Masaka study show a trend towards delayed AFS in the later birth cohorts, but the only significant effects are seen in Masaka, with higher relative hazard in those born in the 70's and lower hazard in those born in the 90's. Conversely the trend in Rakai was towards a earlier sexual debut, with significantly higher relative hazard in the cohort of the 80's compared to those born in the 50's.

Table 2: Crude hazard ratios from Cox regression models showing the effect of 10 year birth cohorts on survival time to first sex, for DHS (pooled), the Masaka study and the Rakai study.

Year of birth	DHS		Masaka		Rakai	
	Crude HR	p-value	Crude HR	p-value	Crude HR	p-value
MEN						
1950-59	1		1		1	
1960-69	1.08 (0.98-1.19)	0.130	1.19 (1.06-1.33)	0.004	1.03 (0.95-1.11)	0.5
1970-79	1.08 (0.99-1.18)	0.096	1.29 (1.15-1.44)	<0.001	1.05 (0.98-1.13)	0.16
1980-89	0.93 (0.83-1.05)	0.253	0.98 (0.87-1.11)	0.79	1.61 (1.49-1.74)	<0.001
1990-94	0.86 (0.61-1.21)	0.383	0.32 (0.19-0.64)	<0.001	-	-
N	6113		5655		11211	
WOMEN						
1950-59	1		1		1	
1960-69	0.94 (0.9-0.99)	0.017	0.92 (0.83-1.02)	0.11	0.96 (0.89-1.03)	0.3
1970-79	0.87 (0.83-0.92)	<0.001	0.83 (0.75-0.91)	<0.001	0.81 (0.76-0.87)	<0.001
1980-89	0.67 (0.63-0.71)	<0.001	0.62 (0.57-0.69)	<0.001	1.03 (0.96-1.11)	0.36
1990-94	0.37 (0.3-0.44)	<0.001	0.23 (0.15-0.35)	<0.001	-	-
N	26531		6880		14808	

In restricting the analysis to those born after 1st January 1970, the survival curves for 5 year birth cohorts are shown in Figure 2, and the relative hazards in Table 3. In the DHS and Masaka studies, men and women in the later cohorts (those born in 1980-1984 and 1985-1989) have delayed AFS (Figure 2). Rakai data shows the opposite with the later cohorts showing earlier age at first sex. This pattern is clearly seen in the hazard ratios for age at first sex in Table 3, which shows increased hazard in the later cohorts in Rakai, but reduced hazards in the DHS and Masaka studies.

Table 3. Crude hazard ratios from Cox regression models showing the effect of 5 birth cohorts on survival time to first sex, for DHS (pooled), the Masaka study and the Rakai study. Restricted to those born on or after 1st January 1970

Year of birth	DHS		Masaka		Rakai	
MEN	Crude HR	p-value	Crude HR	p-value	Crude HR	p-value
1970-74	1		1		1	
1975-79	0.99 (0.89-1.1)	0.81	1.02 (0.91-1.15)	0.7	1.10 (1.03-1.17)	0.002
1980-84	0.88 (0.77-1.0)	0.059	0.94 (0.83-1.06)	0.29	1.59 (1.49-1.71)	<0.001
1985-89	0.82 (0.70-0.96)	0.011	0.51 (0.44-0.59)	<0.001	1.58 (1.42-1.76)	<0.001
1990-94	0.8 (0.57-1.12)	0.187	0.21 (0.12-0.34)	<0.001	-	-
N	3662		4398		8013	
WOMEN	Crude HR	p-value	Crude HR	p-value	Crude HR	p-value
1970-74	1		1		1	
1975-79	0.97 (0.92-1.03)	0.301	0.93 (0.84-1.02)	0.13	0.94 (0.89-0.99)	0.016
1980-84	0.82 (0.77-0.86)	<0.001	0.84 (0.76-0.93)	0.001	1.20 (1.13-1.26)	<0.001
1985-89	0.67 (0.62-0.73)	<0.001	0.54 (0.48-0.61)	<0.001	1.37 (1.27-1.49)	<0.001
1990-94	0.44 (0.37-0.54)	<0.001	0.27 (0.18-0.41)	<0.001	-	-
N	15734		5328		11707	

Using data from the DHS, restricted to those born after 1st January 1970, comparisons can be made between those with different characteristics (Table 4). Age at first sex was delayed in later, female, birth cohorts, with a similar, highly significant, pattern in all regions (Table 4b). The delay in AFS was not seen in those females with secondary education, and was much smaller in females in the richest quintile. For males a smaller overall effect had been seen (Table 3). The delay in AFS in men born in the 1980s was seen as significant in urban areas, and in those with no education (Table 4a).

Table 4. Hazard ratios from Cox regression models showing the effect of 5 birth cohorts on survival time to first sex, for DHS (pooled), stratified for area of residence, region, and wealth. Restricted to those born on or after 1st January 1970

Table 4a. Males – all birth cohorts compared to those born 1970-1974

	Median AFS 1970-74 cohort	Hazard Ratios by Birth cohort				
		1970-74 (baseline)	1975-79	1980-84	1985-89	1990-91
All subjects (N)		1002	1041	831	558	230
All subjects (HR)	17.74	1	0.99	0.88	0.82*	0.8
AREA (URBAN/RURAL)						
Urban	17.1	1	0.78*	0.76*	0.69*	0.48
Rural	17.9	1	1.04	0.91	0.85	0.88
REGION						
Central [†]	17.5	1	0.95	0.99	0.96	0.64
Eastern	17.0	1	0.97	0.82	0.63*	0.43*
Northern	18.2	1	1.22	0.95	1.14	1.62*
Western	18.0	1	0.90	0.72*	0.67*	0.8
EDUCATION						
None	17.6	1	0.87	0.88	0.39	N/A
Primary	17.6	1	1.02	0.85	0.85	0.68
Secondary & above	18.1	1	0.97	0.97	0.84	1.71
WEALTH RANKING						
Poorest	17.3	1	1.0	0.86	0.73	1.3
Poor	18.4	1	1.36*	1.19	0.96	0.75
Middle	17.7	1	0.82	0.93	0.84	0.71
Rich	15.7	1	0.82	0.79	0.73	0.93
Richest	16.2	1	0.93	0.87	1.0	0.75
YEAR OF SURVEY						
1995	17.5	1	0.92	0.51	-	-
2001	18.1	1	1.02	0.95	0.6	-
2006	17.6	1	0.97	0.9	0.83*	0.85

* p<0.05

** p<0.01

*** p<0.001

[†] Central region contains Masaka and Rakai districts

Table 4b. Females – all birth cohorts compared to those born in 1970-1974

	Birth cohort					
	Median AFS 1970-74 cohort	1970-74 (baseline)	1975-79	1980-84	1985-89	1990-91
All subjects (N)		4,893	4,532	3,454	2,101	754
All subjects (HR)	16.4	1	0.97	0.82 ***	0.67 ***	0.44 ***
AREA (URBAN/RURAL)						
Urban	16.6	1	0.94	0.79***	0.67***	0.61**
Rural	16.3	1	0.99	0.84***	0.69***	0.42***
REGION						
Central [†]	16.1	1	0.97	0.81***	0.61***	0.44***
Eastern	15.8	1	0.96	0.83***	0.68***	0.47***
Northern	16.5	1	0.97	0.82**	0.71***	0.34***
Western	17.0	1	0.96	0.82**	0.71***	0.49**
EDUCATION						
None	15.9	1	0.99	0.98	0.77	0.41
Primary	16.2	1	1.04	0.81***	0.7***	0.42***
Secondary & above	17.9	1	0.92	0.94	0.87	0.91
WEALTH RANKING						
Poorest	16.0	1	1.05	0.94	0.82	0.35
Poor	16.3	1	0.99	0.91	0.78**	0.36***
Middle	15.1	1	1.09	0.83**	0.6***	0.45**
Rich	15.0	1	0.9	0.7***	0.57***	0.43***
Richest	17.1	1	1	0.88	0.76**	0.75
YEAR OF SURVEY						
1995	16.3	1	0.98	0.67		
2001	16.6	1	1.04	0.89*	0.56***	-
2006	16.2	1	0.93	0.8***	0.65***	0.42***

* p<0.05

** p<0.01

*** p<0.001

[†] Central region contains Masaka and Rakai districts

Discussion

Results from the DHS and from the Masaka study show a clear trend towards a delay in starting sex among females in Uganda, with those born in the 1980's reporting AFS about 1 year later than those born in the 1950's. A smaller delay is seen among females in Rakai, for those born in the 1970's and the 1980's compared to those born in the 1950's. The change in AFS among males is less clear: in the DHS data no significant difference seen between any of the male birth cohorts, and little evidence of a delay in AFS in either Masaka or Rakai. In the latest birth cohorts, born in the 1990's, the data from both DHS and Masaka indicate the possibility that AFS has been delayed even further in both females and males. However this was based on small numbers and needs further follow up to confirm the findings. These findings agree with other analyses of changes in sexual behaviour in young people in sub-Saharan Africa^{6,7} and in Uganda^{13,14}.

By looking at the whole of the survival function, rather than just the median age at first sex, it is clear that the pattern of change has been different for men and women and that the youngest women in the more recent cohorts are delaying sex but their male counterparts are not. In all graphs the females have sexual debut over a shorter period of time than the males, with many birth cohorts showing some males are still virgin at the age of 25 years. This may show the choice that males have about sexual debut, which may be denied to females, either through social pressure, or through coercive sex.

The DHS findings show that the changes in the last 20 years have been greatest in those in the middle income quintiles, and those with lower education (primary school or lower). This may be partly because more wealthy/highly educated young females have always been able to delay sexual debut, and it is only recently that the less wealthy, and less educated have been able to access the same choices. The median AFS for women born in the 1970s who had secondary education and were in the richest quintile was 18.2 compared to 16.3 for all other women.

The timing of the observed changes in AFS relative to the decline in HIV prevalence in the early to mid 1990s (see Figure 3) suggest that these changes have been a response to the danger of HIV infection not a cause. To illustrate this, the survival functions can be plotted over calendar time. Based on DHS data, in 1980 22% of 14-16 year old women had had sex, in 1990 this had declined slightly, to 20%, but had halved by 2000.

Changes in age at first sex may have helped to further reduce incidence but cannot have been a cause of the initial decline. Young women need the knowledge and ability to delay first sex. Regardless of the

contribution to HIV prevention, if women in Uganda are increasingly able to delay first sex this would be a major achievement for the health messages that have been used over the last 20 years.

The changes in reported AFS in the Rakai study are different from those seen in the DHS and the Masaka study. There is some evidence that delaying AFS started earlier in Rakai, with females born in the 1970's, who started sex in the late 1980's and early 1990's, showing later AFS compared to those born in the 1950's. This could have occurred because HIV prevalence was higher at an earlier date, and the preventive action by young women was initiated in an earlier birth cohort. However, the effect in the latest birth cohort of men in Rakai shows earlier AFS, and does not fit with the explanation that changes in the sexual debut of young people are a response to the HIV infection seen in the community. The result of the changes in the most recent cohorts is a more similar experience for young men and women, around a quarter of whom have started sex around the age of 15 in Rakai. Sex between partners of different ages can be a risk for HIV infection.^{25,26} The availability of more sexually active young men may reduce age mixing in this community if young women increasingly choose partners close to their own age. This may be beneficial for HIV prevention, though any effect may be transient and dependent on other characteristics of the partnership networks²⁷. The difference seen between the Rakai and Masaka cohorts could be due to the inclusion of trading centres in the Rakai study, which are not seen in Masaka, as these may provide some employment to younger, single women and men, and keep them in the study area. Single men aged between 15 and 24 comprised 25% of the Masaka cohort and 29% of the Rakai cohort in 2006; Single women of the same age made up 21% of the Masaka cohort and just 18% of the Rakai cohort at the same time. The overall proportions of young single people and the sex ratios were therefore different between the cohorts.

There are several limitations to these analyses. We have combined data from repeated cross-sectional, DHS and two cohort studies. There may be selection biases in the DHS, but these should not be present in the cohort studies²⁴. Different questionnaires were used for each data source. In the Rakai study, AFS was only asked at the enrolment into the cohort at round 4 and during rounds 6-10 so we have more information on some respondents. However, this is entirely at random as recruitment to the cohort is not related to first sex.

Others have shown that the quality of reporting of AFS can be variable and inconsistent, but this can be in either direction and should have no effect on the overall estimates¹⁸. All data may be affected by social desirability bias, as there have been extensive media campaigns in Uganda promoting safe sex, and abstinence, but this should be similar across all sources. Although there have been health messages promoting abstinence and safe sex in Uganda, we did not see any difference in the responses of the same birth cohort over the four rounds of DHS, which may indicate a limited bias due to social desirability. This effect may be more pronounced in the two cohort studies where the same people are seen every year, and any messages would be reinforced over time but there is no evidence for this in the Masaka data¹⁸.

A limitation of the cohort studies is the migration of young people from rural areas after completion of school. In Masaka most young people, and especially girls, do not remain at home, but either get married, or migrate

to larger towns, or trading posts to search for work. This may skew the proportion of sexually active young women that remain in the cohort and may artificially raise the age at first sex if those who leave are never recruited into the cohort and have a younger AFS than cohort members.

All three studies cover a large population, and so the effects we see have tight confidence limits, and should give an accurate picture of any real changes in reported AFS in Uganda.

The three studies indicate that large changes in AFS have been seen in females over the last 20 years. These changes may be influenced by the HIV epidemic seen in Uganda, but are unlikely to be the factor which explains the decline in HIV prevalence seen in Uganda in the 1990's. It is more likely that this is a positive side effect of the empowerment of women, especially young women, so that they can make their own choices about when and with whom they initiate sex.

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Competing Interests

There are no competing interests.

Contributions

ES planned the analyses and analysed the DHS data. JT oversaw the analyses. JT, IK and DM analysed the Masaka data. TL and JBB analysed the Rakai data. All authors reviewed the results and wrote the paper.

Figure 1: Survival curves (cumulative proportion that has had sex by age) for men and women by 10 year birth cohorts.

Figure 1a. From the four DHS (data pooled across all 4 surveys) for each sex

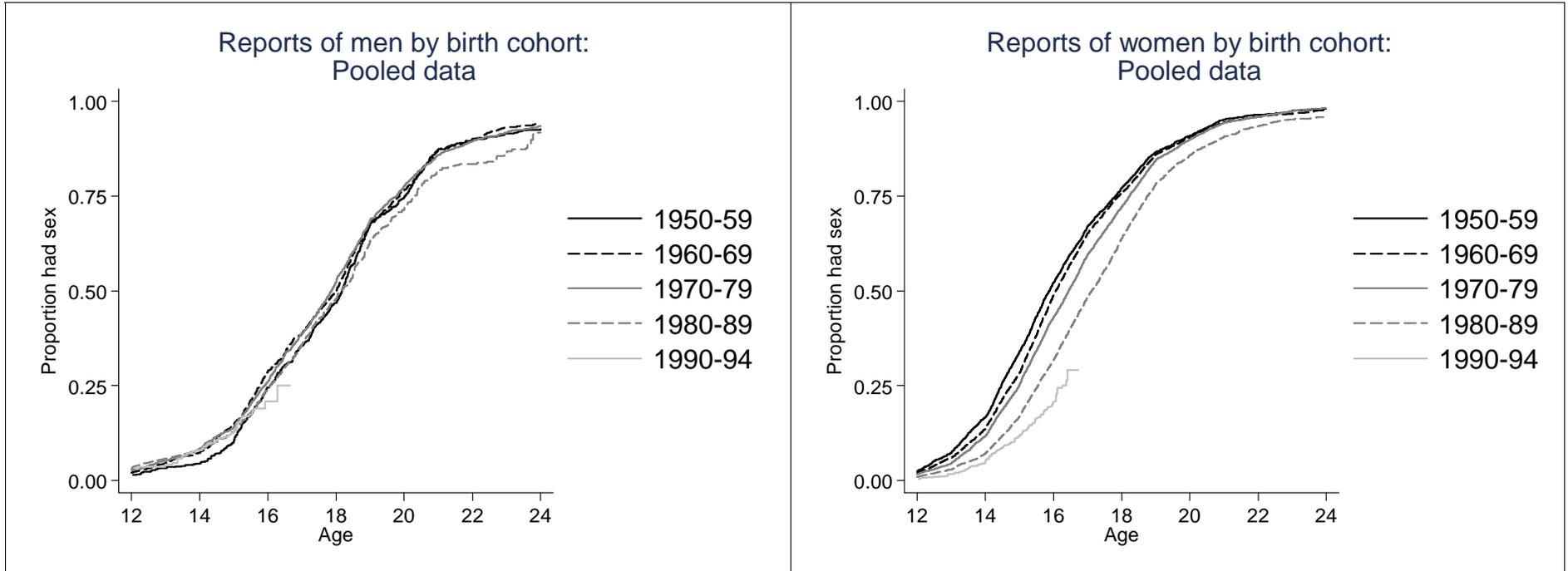


Figure 1b. Masaka cohort (most likely age at first sex, across all rounds).

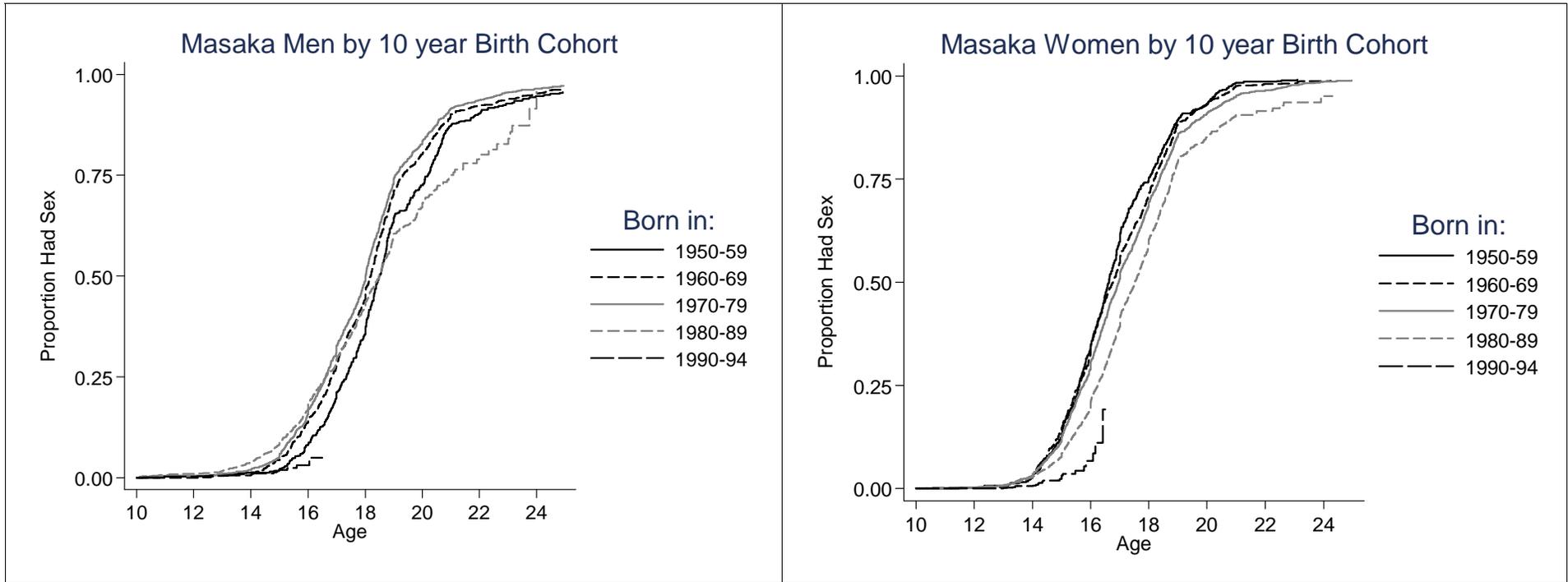


Figure 1c Rakai

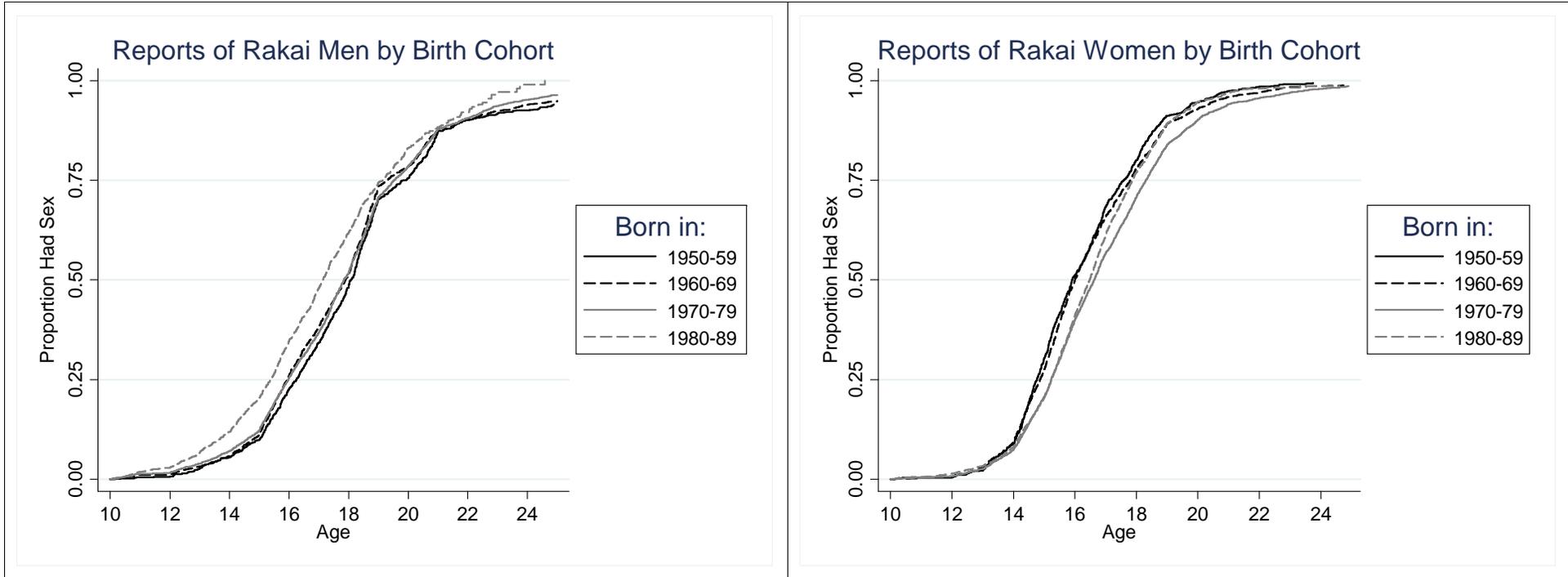


Figure 2b Masaka cohort

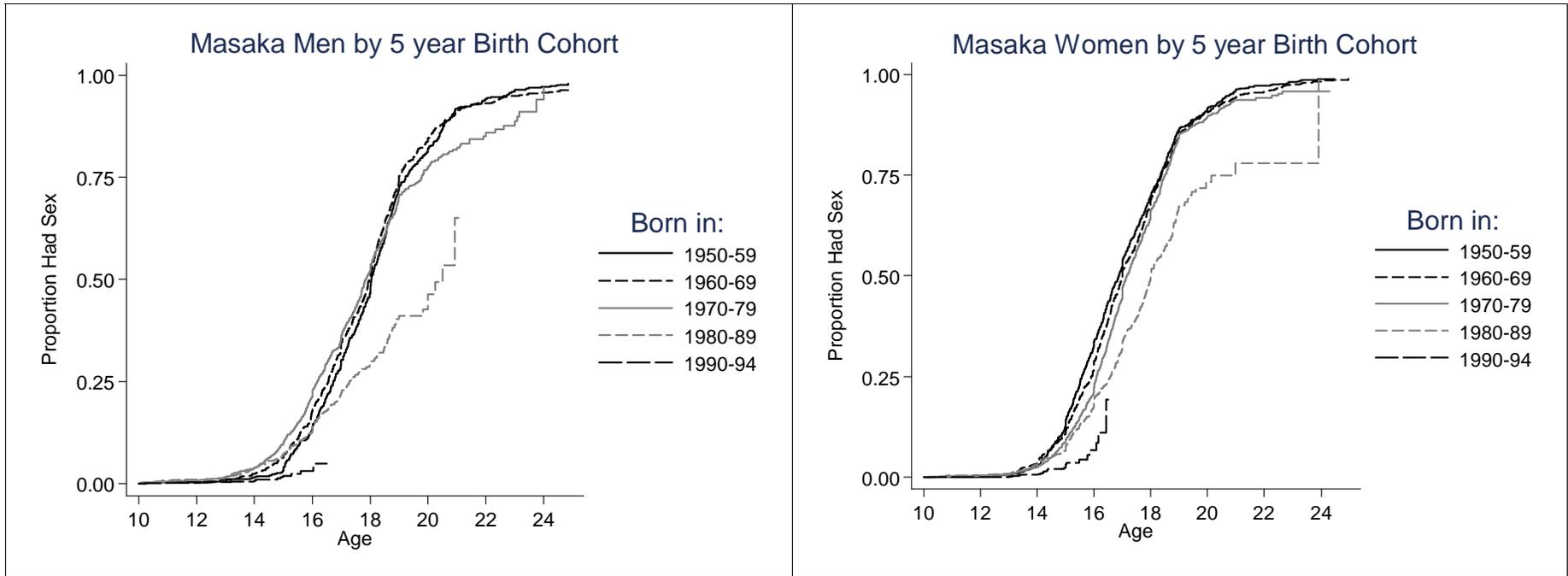


Figure 2c Rakai.

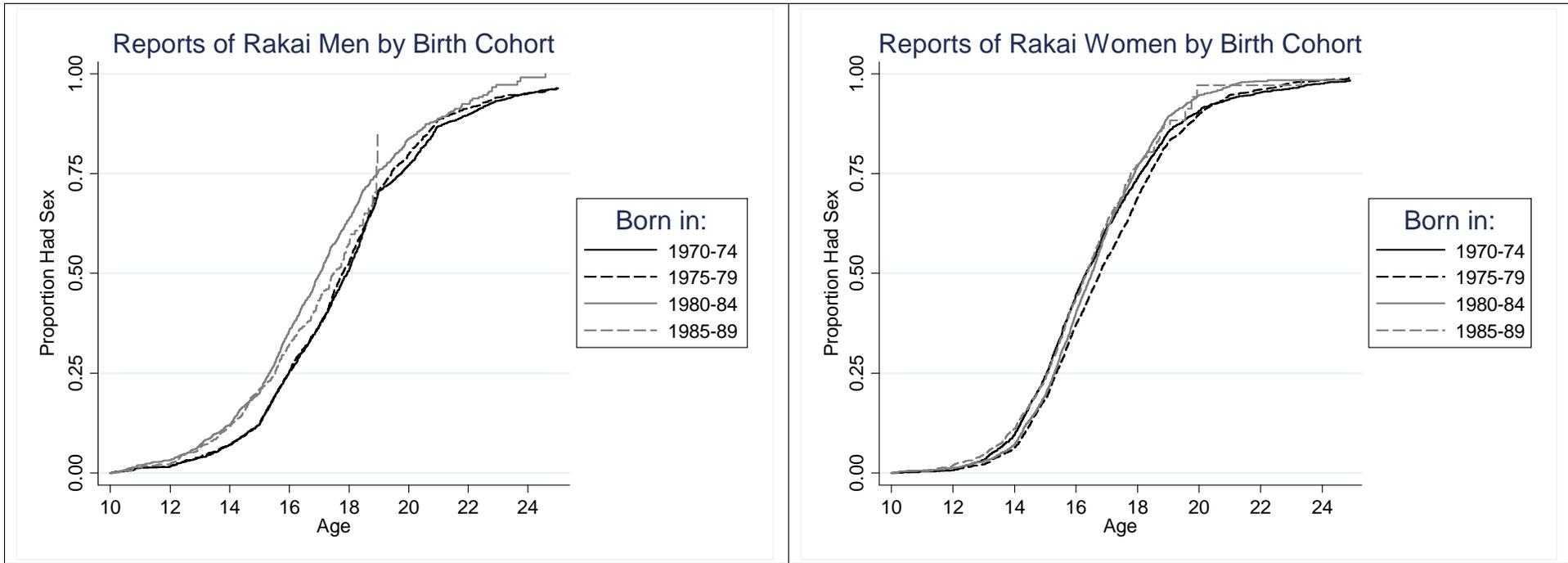
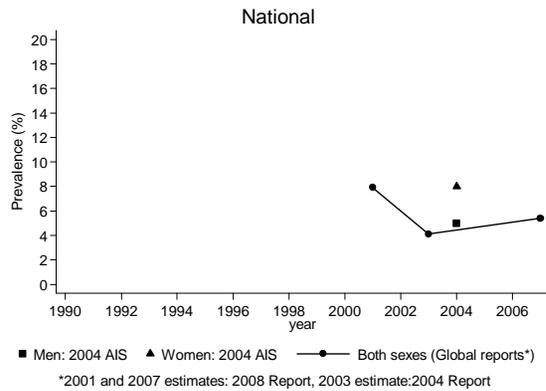
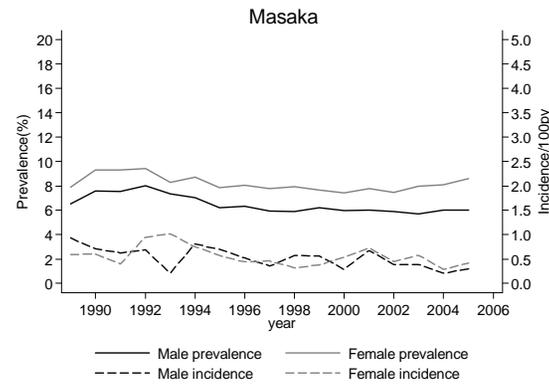


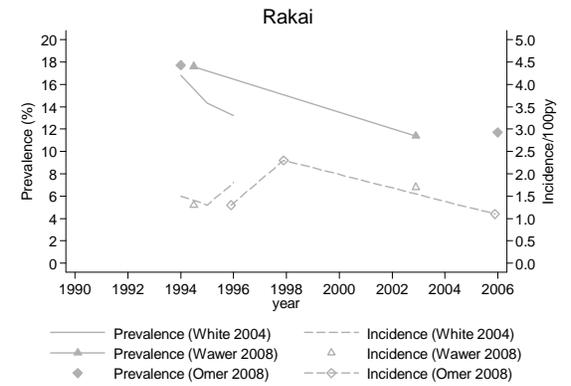
Figure 3: Trends in HIV prevalence and incidence in the two cohorts and HIV prevalence estimates for the whole of Uganda.



AIS²⁸
 2004 Global Report²⁹
 2008 Global Report³⁰



All data: Shafer 2007³¹



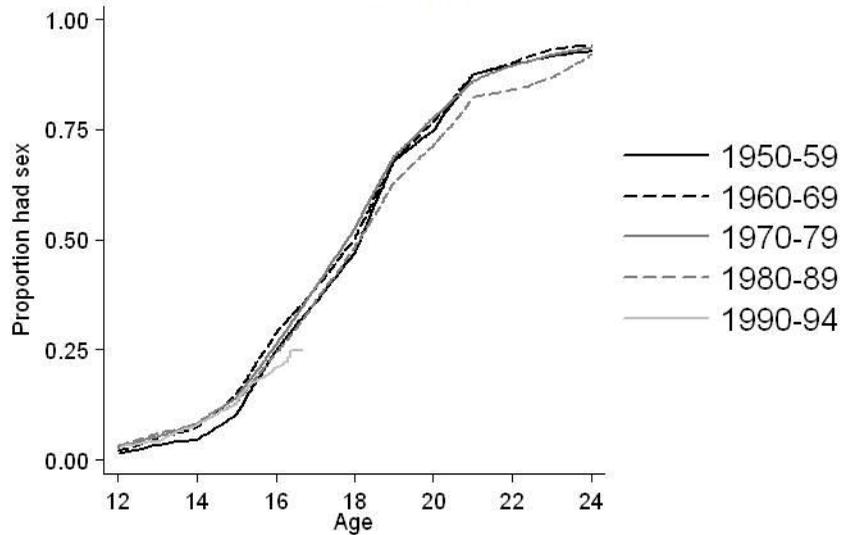
White 2004³²
 Wawer 2008
 Omer 2008³³

References

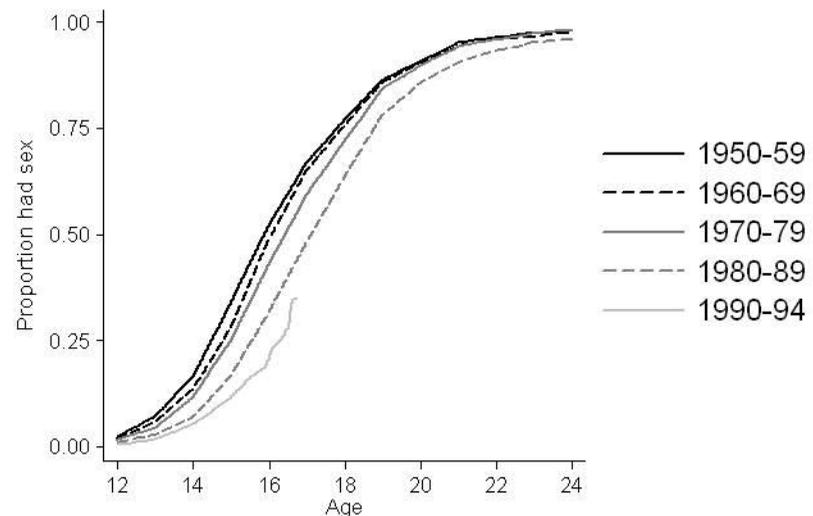
1. UNAIDS. *National AIDS Programmes: A Guide to Monitoring and Evaluation*. 1 ed. Geneva: UNAIDS, 2000.
2. UNAIDS. *United Nations General Assembly Special Session on HIV/AIDS. Monitoring the Declaration of Commitment on HIV/AIDS. Guidelines on Construction of Core Indicators*. Geneva: Joint United Nations Programme on HIV/AIDS (UNAIDS), 2002.
3. UNAIDS. Follow-up to the 2001 United Nations General Assembly Special Session on HIV/AIDS: Progress Report on the Global Response to the HIV/AIDS Epidemic, 2003: UNAIDS, 2003.
4. Measure DHS. AIDS Indicator database: List of Indicators, 2008.
5. WHO. *National AIDS programmes: a guide to indicators for monitoring and evaluation national HIV/AIDS prevention programmes for young people*. Geneva: WHO, 2004.
6. Mensch B, Grant M, Blanc A. The Changing Context of Sexual Initiation in sub-Saharan Africa. *Population and Development Review* 2006;32(4):699-727.
7. Wellings K, Collumbien M, Slaymaker E, Singh S, Hodges Z, Patel D, et al. Sexual behaviour in context: a global perspective. *The Lancet* 2006;368(9548):1706-1728.
8. Marston C, King E. Factors that shape young people's sexual behaviour: a systematic review. *Lancet* 2006;368:1581-86.
9. Dickson N, Paul C, Herbison P, Silva P. First sexual intercourse: age, coercion and later regrets reported by a birth cohort. *BMJ* 1998;316(7124):29-33.
10. Koenig MA, Lutalo T, Zhao F, Nalugoda F, Kiwanuka N, Wabwire-Mangen F, et al. Coercive sex in rural Uganda: Prevalence and associated risk factors. *Social Science & Medicine* 2004;58(4):787-798.
11. MEASURE DHS. Demographic and Health Surveys, 2008.
12. Kamali A, Carpenter LM, Whitworth JAG, Pool R, Ruberantwari A, Ojwiya A. Seven-year trends in HIV-1 infection rates, and changes in sexual behaviour, among adults in rural Uganda. *Aids* 2000;14(4):427-434.
13. Kirungi WL, Musinguzi J, Madraa E, Mulumba N, Callejja T, Ghys P, et al. Trends in antenatal HIV prevalence in urban Uganda associated with uptake of preventive sexual behaviour. *Sexually Transmitted Infections* 2006;82 supplement 1:I36-I41.
14. Bessinger R, Akwara P, Halperin D. Sexual Behavior, HIV, and Fertility Trends: A Comparative Analysis of Six Countries Phase I of the ABC Study. Chapel Hill, North Carolina, USA: MEASURE Evaluation, 2003.
15. Green E, Halperin D, Nantulya V, Hogle J. Uganda's HIV Prevention Success: The Role of Sexual Behavior Change and the National Response. *AIDS and Behavior* 2006;10(4):335-346.
16. Singh S, Darroch JE, Bankole A. A, B and C in Uganda: the roles of abstinence, monogamy and condom use in HIV decline. *Reprod Health Matters* 2004;12(23):129-31.
17. Parkhurst J. The Ugandan success story? Evidence and claims of HIV-1 prevention *The Lancet* 2002;360(9326):78-80.
18. Wringe A. A comparative assessment of the quality of age at event reporting in three HIV cohort studies in sub-Saharan Africa. *STI* 2008.
19. Mulder D, Nunn A, Wagner H, Kamali A, Kengeya-Kayondo J. HIV-1 incidence and HIV-1-associated mortality in a rural Ugandan population cohort. *AIDS* 1994;8(1):87-92.
20. Wawer M, Gray R, Sewankambo N, Serwadda D, Paxton L, Berkley S, et al. A randomized, community trial of intensive sexually transmitted disease control for AIDS prevention, Rakai, Uganda. *AIDS* 1998;12(10):1211-25.
21. Wawer M, Sewankambo N, Serwadda D, Quinn T, Paxton L, Kiwanuka N, et al. Control of sexually transmitted diseases for AIDS prevention in Uganda: a randomised community trial. Rakai Project Study Group. *The Lancet* 1999;353(9152):525-35.

22. Stata [program]. 10 version. College Station, TX, USA, 2007.
23. Royston P. Multiple imputation of missing values: further update of ice, with an emphasis on interval censoring. *The Stata Journal* 2007;7(4):445-464.
24. Zaba B, Pisani E, Slaymaker E, Boerma JT. Age at first sex: understanding recent trends in African demographic surveys. *STI* 2004;80(Supplement II):ii28-ii35.
25. Gregson S, Nyamukapa CA, Garnett GP, Mason PR, Zhuwau T, Carael M, et al. Sexual mixing patterns and sex-differentials in teenage exposure to HIV infection in rural Zimbabwe. *Lancet* 2002;359(9321):1896-1903.
26. Kelly RJ, Gray RH, Sewankambo NK, Serwadda D, Wabwire-Mangen F, Lutalo T, et al. Age differences in sexual partners and risk of HIV-1 infection in rural Uganda. *J Acquir Immune Defic Syndr* 2003;32(4):446-51.
27. Hallett TB, Gregson S, Lewis JJC, Lopman BA, Garnett GP. Behaviour change in generalised HIV epidemics: impact of reducing cross-generational sex and delaying age at sexual debut. *STI* 2007;83(i50-i54).
28. Ministry of Health U, ORC Macro. Uganda HIV/AIDS sero-behavioural survey 2004-5. Calverton, Maryland USA: Ministry of Health and ORC Macro, 2006.
29. UNAIDS. Report on the Global AIDS Epidemic, 2004.
30. UNAIDS. Report on the Global AIDS Epidemic, 2008.
31. Shafer LA, Biraro S, Nakyingi-Miirwa J, Kamali A, Ssematimba D, Ouma J, et al. HIV prevalence and incidence are no longer falling in southwest Uganda: evidence from a rural population cohort 1989–2005. *AIDS* 2008;22(13):1641-1649.
32. White RG, Orroth KK, Korenromp EL, Bakker R, Wambura M, Sewankambo N, et al. Can Population Differences Explain the Contrasting Results of the Mwanza, Rakai, and Masaka HIV/Sexually Transmitted Disease Intervention Trials? *JAIDS* 2004;37(4):1500-1513.
33. 12-year trends in HIV prevalence, incidence, mortality and risk behaviours in a community based cohort in Rakai, Uganda: evidence of decreased HIV incidence, increased sexual risk behaviors offset by condom use. XVII International AIDS Conference; 2008 3rd-8th August; Mexico City.

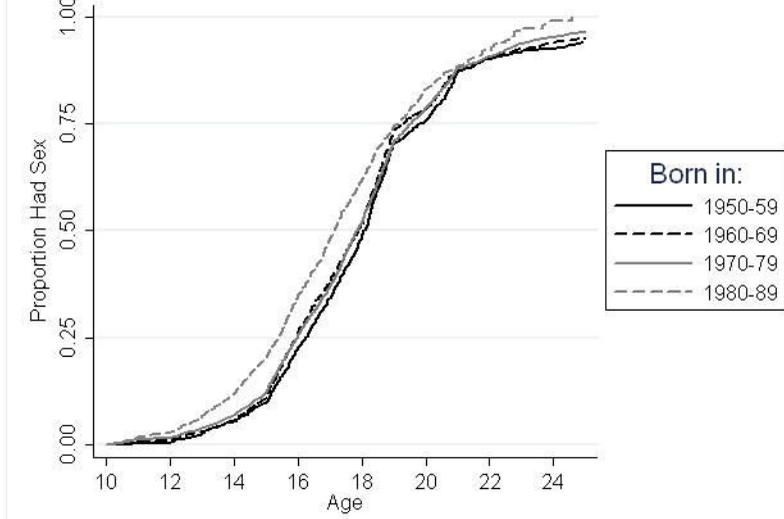
Reports of men by birth cohort:
Pooled data



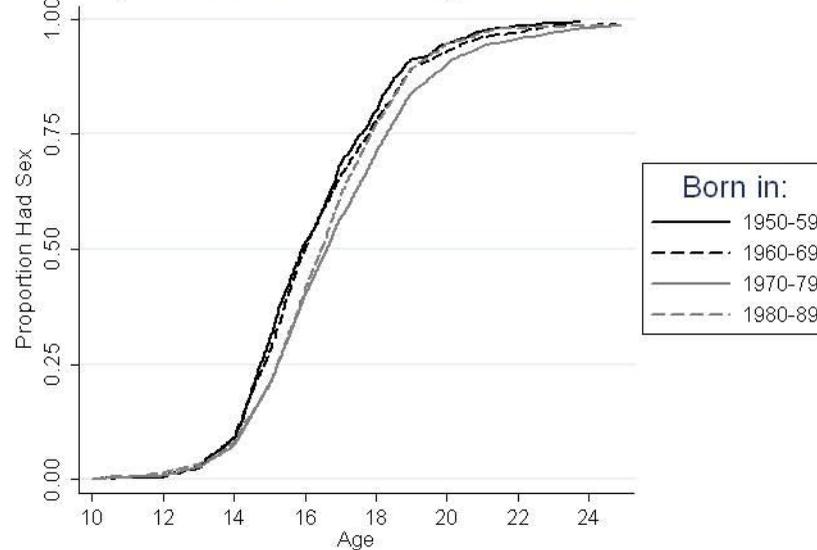
Reports of women by birth cohort:
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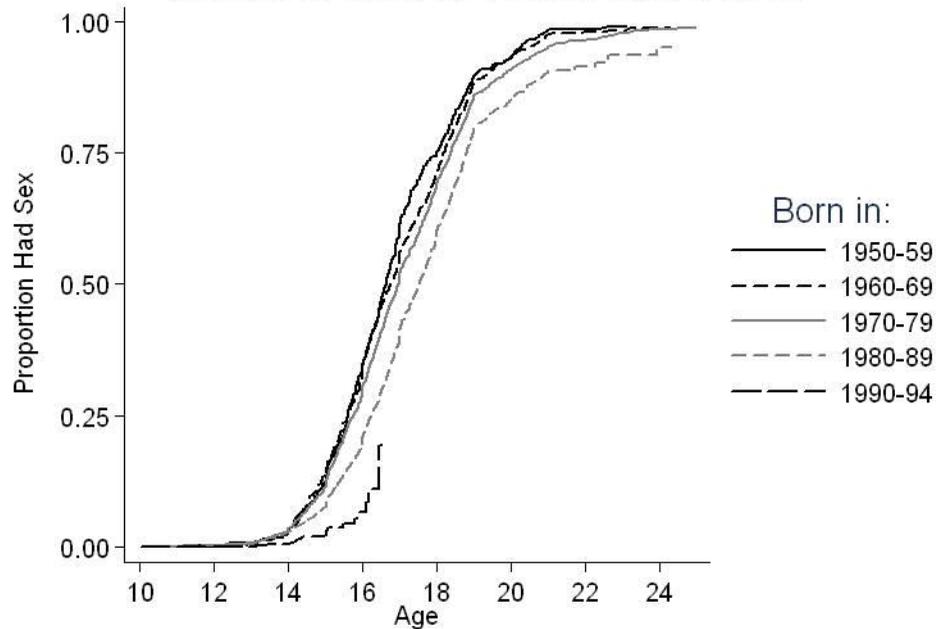
Reports of Rakai Men by Birth Cohort



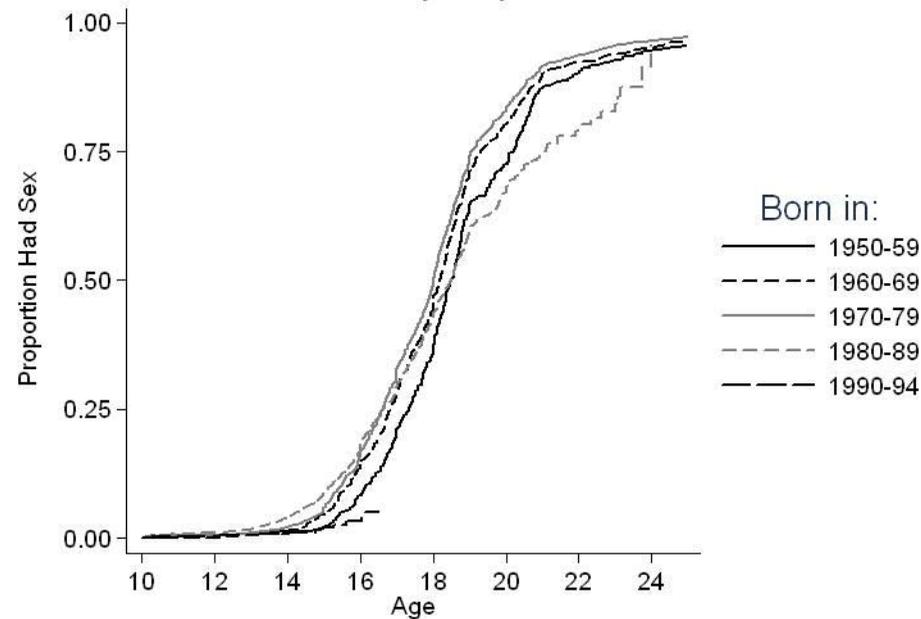
Reports of Rakai Women by Birth Cohort



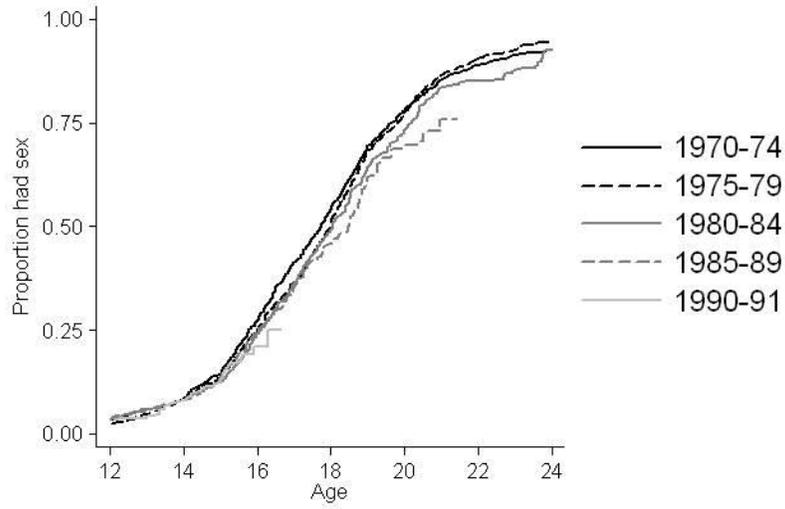
Masaka Women by 10 year Birth Cohort



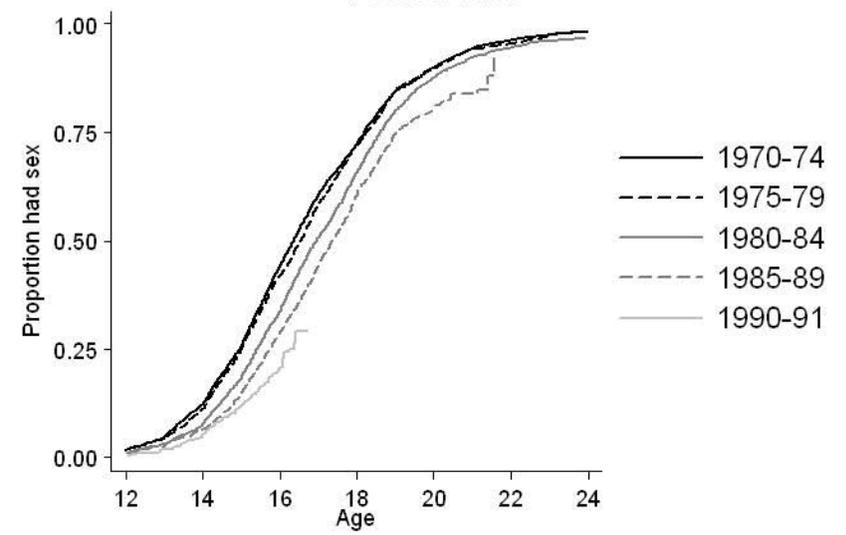
Masaka Men by 10 year Birth Cohort



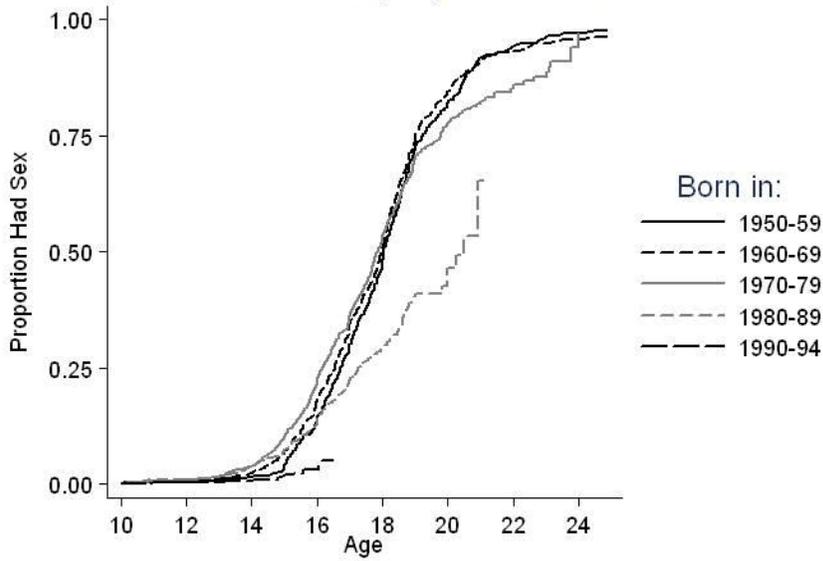
Reports of men by birth cohort:
Pooled data



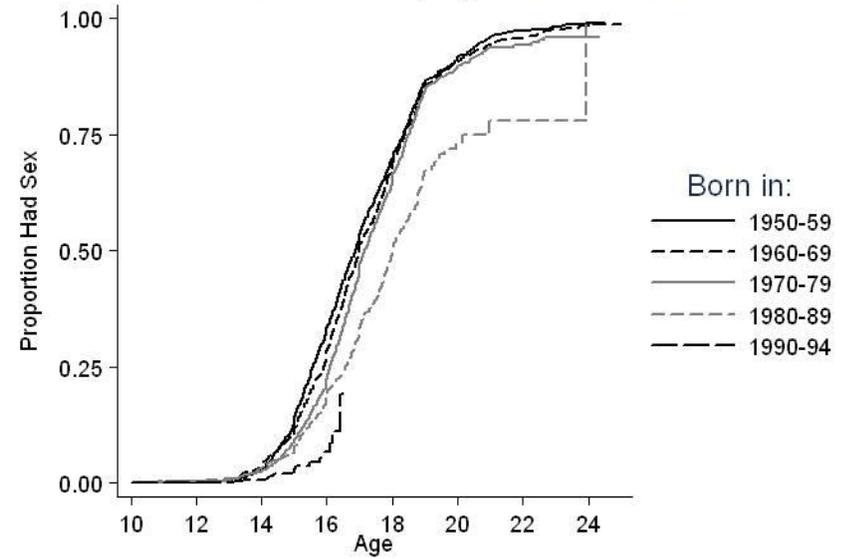
Reports of women by birth cohort:
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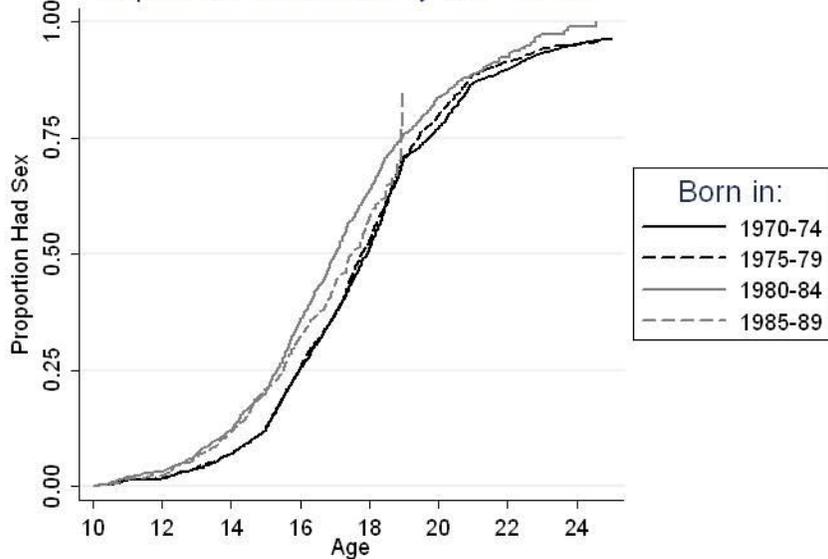
Masaka Men by 5 year Birth Cohort



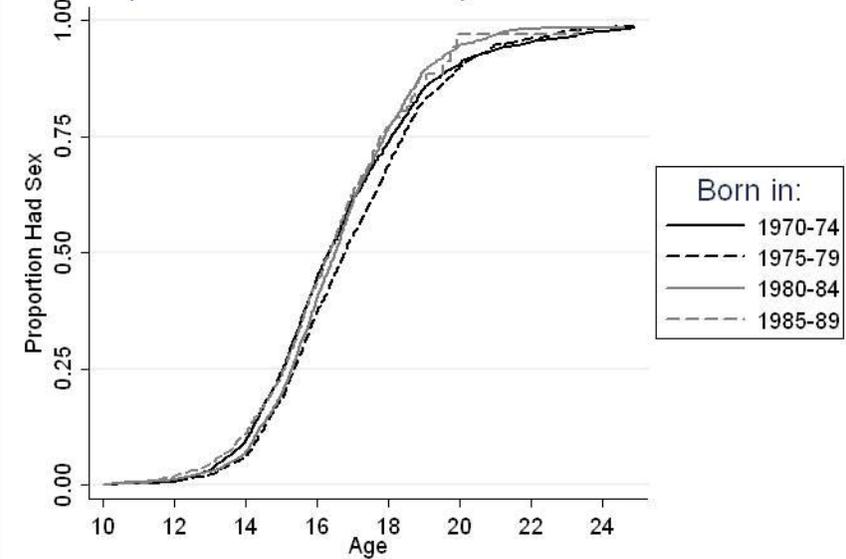
Masaka Women by 5 year Birth Cohort



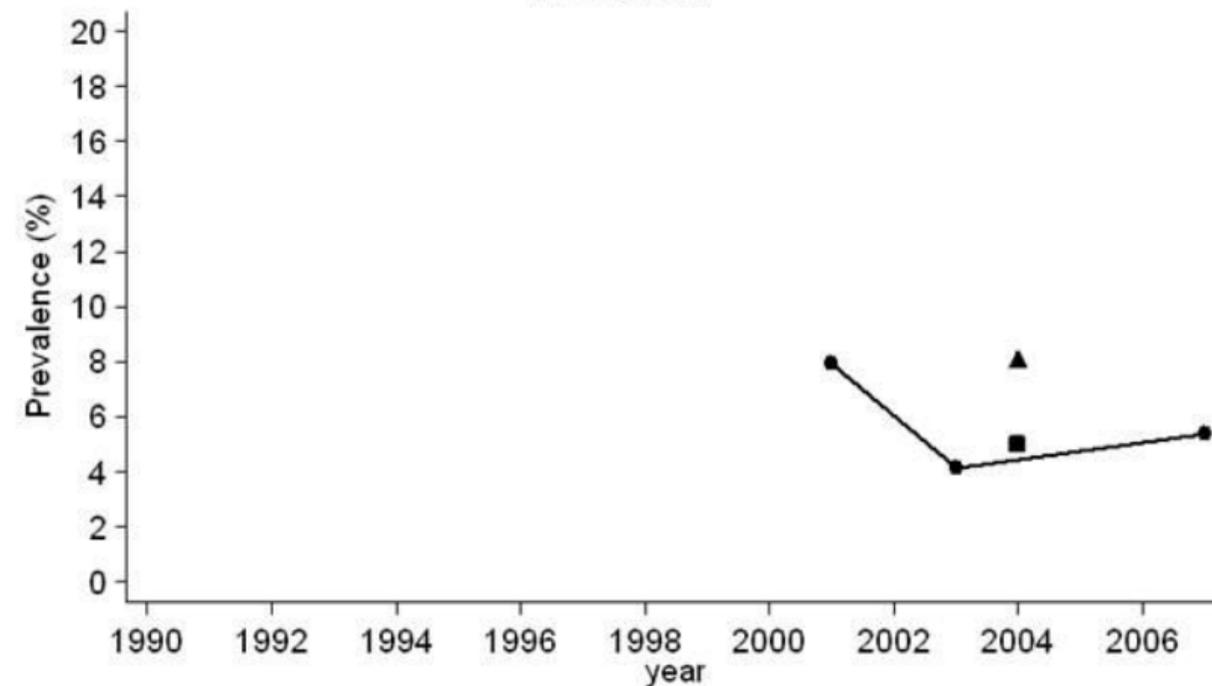
Reports of Rakai Men by Birth Cohort



Reports of Rakai Women by Birth Cohort



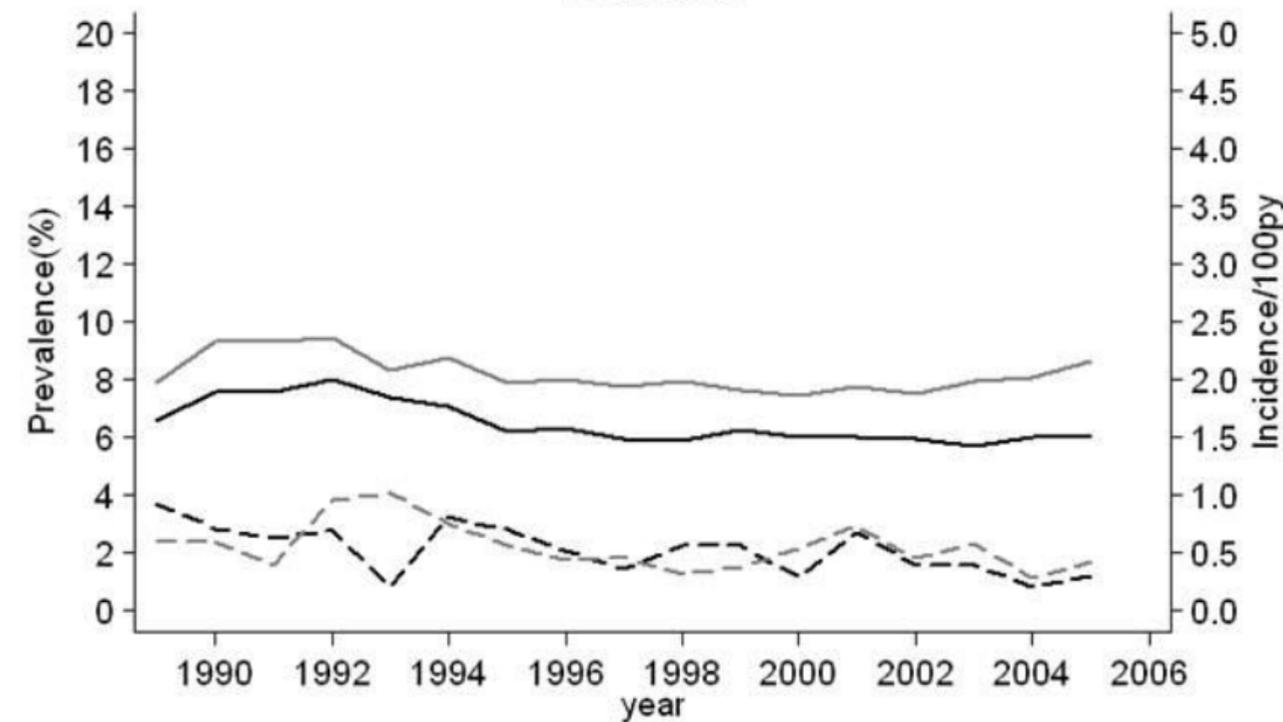
National



■ Men: 2004 AIS ▲ Women: 2004 AIS ● Both sexes (Global reports*)

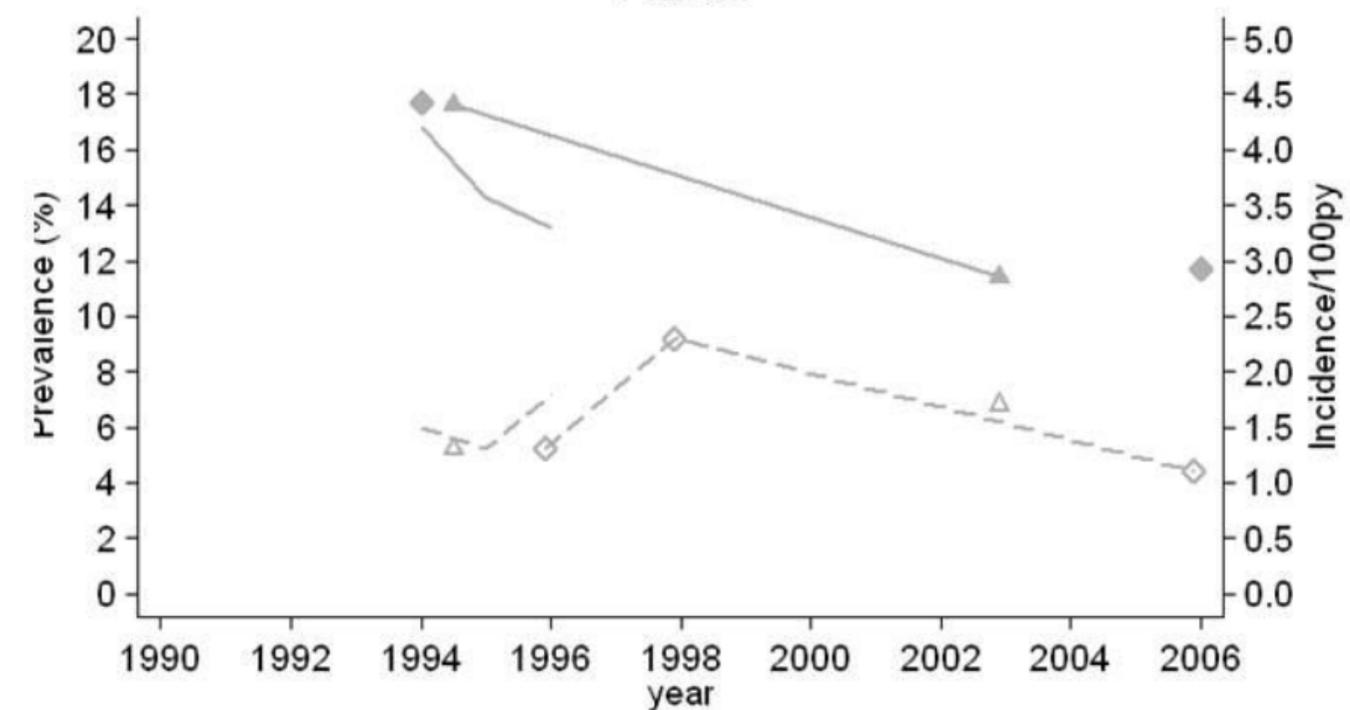
*2001 and 2007 estimates: 2008 Report, 2003 estimate:2004 Report

Masaka



— Male prevalence — Female prevalence
 - - - Male incidence - - - Female incidence

Rakai



— Prevalence (White 2004) - - - Incidence (White 2004)
 —▲ Prevalence (Wawer 2008) ▲ Incidence (Wawer 2008)
 ◆ Prevalence (Omer 2008) ◆ Incidence (Omer 2008)