Trends of HIV-1 and sexually transmitted diseases among pregnant and postpartum women in urban Malawi

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Objectives: To examine rates of HIV-1 and sexually transmitted disease (STD) among pregnant and postpartum women in urban Malawi, Africa.

Design: Serial cross-sectional surveys and a prospective study.

Methods: Three major surveys were conducted in 1990, 1993 and 1994/1995. Consecutive first-visit antenatal women and women giving birth at the Queen Elizabeth Central Hospital were tested for HIV and STD after counseling and obtaining informed consent. Unlinked, anonymous HIV testing was also conducted on smaller samples of antenatal women in the same hospital to provide annual prevalence data. HIV-seronegative postpartum women from the 1990 and 1993 surveys were enrolled in a prospective study to determine HIV incidence.

Results: HIV seroprevalence rose from 2.0% in 1985 to 32.8% in 1996, a 16-fold increase. The highest age-specific HIV prevalence was in the following age-groups: 20–24 years during 1990, 25–29 years during 1993, and 30–34 years during 1996. Among 1173 women followed for a median of 30.9 months, HIV incidence was 5.98 per 100 person-years in women aged < 20 years and declined steadily in older women. The prevalence of STD significantly declined among both HIV-positive and negative women. This decline in STD prevalence, however, was not accompanied by increased condom use over time.

Conclusions: Among urban childbearing women in Malawi, incidence of HIV is highest among young women while, currently, prevalence is highest among older women. Recent declines in STD prevalence suggest that HIV prevention programs are having an impact either through improved STD diagnosis and treatment or reduced risk behaviors. Sequential cross-sectional STD prevalence measures may be useful in monitoring effectiveness of STD and HIV prevention activities.

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Introduction

Sexually transmitted diseases (STD) are a significant public health problem in many parts of Africa [1]. STD cause substantial morbidity and mortality, and increase the risk of acquiring HIV infection [2,3]. Among pregnant women, STD pose additional problems because of adverse pregnancy outcomes and higher infant morbidity and mortality. STD treatment, partner reduction and consistent condom use are appropriate preventive measures that have been shown to reduce sexual transmission of HIV and STD. For example, better treatment of STD has reduced the incidence of HIV infection by 42% in Tanzania [4], and changes in sexual behaviors (such as increased condom use and reduced sexual relations with commercial sex workers) have been associated with decreasing trends in prevalence of HIV and reported STD among young men in Thailand [5].

Monitoring of STD trends is important because it provides data for designing and evaluating control activities. Sentinel seroprevalence surveys have been frequently used to monitor levels of HIV infection rates in different populations [6–8]. The strong interrelationship between HIV and STD suggests that STD rates over time may be a reliable biologic marker that could be monitored to assess effectiveness of HIV prevention programs [9]. We have previously examined risk factors associated with HIV/STD transmission [10], the impact of HIV on the health of mothers and children [11], and reported that active syphilis and cervicitis were associated with increased child mortality in urban Malawi [12]. This study evaluates trends in incidence of HIV-1 and prevalence of HIV and STD among urban women of child-bearing age in Malawi.

Methods

Study site

Studies on HIV-1 and STD among pregnant women have been in progress since 1989 at Queen Elizabeth Central Hospital (QECH), a tertiary care facility in Blantyre (southern region of Malawi).

Design of studies

Cross-sectional studies

Three major surveys were carried out at QECH in 1990, 1993 and 1994. The 1990 and 1993 surveys were conducted on consecutive first-visit antenatal women. The 1994 survey included all women giving birth at QECH during a 6-month period (June–November). Testing of HIV-1 and STD in these surveys was performed after counseling and obtaining informed consent. Women participating in the 1990 and 1993 surveys were concurrently tested for HIV and STD. In the 1994 study, 6964 women were screened for HIV at delivery (June–November) and for STD in a subset (n = 808) after delivery (May–October 1995).

Several surveys on smaller samples of women were also conducted annually in the same hospital from 1985 to 1996 (with the exception of 1986, 1989 and 1995). Consecutive first-visit antenatal women were included in these samples. Anonymous, unlinked testing of HIV was performed to determine annual HIV seroprevalence among pregnant women.

Follow-up study

HIV-seronegative women from the 1990 and 1993 surveys were enrolled in a prospective study after delivery to determine the incidence of HIV and to study biologic and behavioral risk factors associated with HIV transmission. These women were followed every 3 months and HIV-tested at 6-month intervals. An elaborate description of the follow-up procedures of the studies conducted at the QECH has been reported elsewhere [10–12].

Laboratory testing for HIV and STD

HIV was determined by two enzyme-linked immunosorbent assays (ELISA). Western blot testing for confirmation of ELISA results was performed on all ELISA-positive women in the 1990 survey and in situations where ELISA results were borderline in the 1993 and 1994 surveys. In the 1996 serosurvey, only two ELISA were performed [Genetic Systems LAV EIA (Redmond, Washington, USA) for screening and Wellcozyme HIV Recombinant EIA (Murex Diagnostics, Dartford, Kent, UK) for confirmation]. This HIV testing strategy is consistent with approaches suggested by investigators from the World Health Organization, and others, when the prevalence of HIV is greater than 10% in the study population [13–16]. In the prospective study, the serostatus of all HIV-seroconverting women was confirmed by Western blot (Bio-Rad, Richmond, California, USA). Syphilis was tested using rapid plasma reagin for screening and *Treponema pallidum* hemagglutinin assay or fluorescent treponemal antibody for confirmation. Vaginal wet mounts were examined microscopically to detect trichomonads, and cervical swabs were cultured on modified Thayer–Martin medium for detection of *Neisseria gonorrhoeae*. Genital warts and ulcers were diagnosed by physical examination. Treatment for bacterial and protozoal STD and condoms were provided free at the clinic.

Data collection

Sociodemographic information and history of reported condom use (lifetime use) were collected on women included in the 1990, 1993 and 1994/1995 surveys. This information was obtained at the time of pre-test counseling for HIV screening, before the woman knew her HIV status (with the exception of the 1994/1995 survey, where information on condom use was obtained at enrollment after delivery).

Statistical analysis

Analyses included estimation of rates and 95% confidence intervals (CI), and Mantel–Haenszel χ^2 tests for trends. HIV incidence was estimated as the number of seroconversions among HIV-seronegative women who had been followed and was expressed per 100 person-years (PY) of follow-up. The duration of risk for HIV infection was defined as the time from enrollment in the study to the last negative HIV test for women who remained seronegative, or the midpoint between the last negative test and the first positive test, for women who seroconverted. Calculation of the 95% CI for rates of seroconversion according to PY was based on the Poisson distribution.

Results

The serial seroprevalence of HIV-1 among pregnant women surveyed at QECH for the years 1985–1996 is shown in Fig. 1. There was a linear increase in HIV prevalence amongst antenatal women ranging from 2.0% in 1985 to 25.9% in 1991, followed by a slower increase to 32.8% in 1996. The rate of increase between 1991 and 1996 was slower and not statistically significant (trend test $P = 0.13$). The age-specific HIV-1 seroprevalence in 1990, 1993 and 1996 (triennial surveys) is shown in Fig. 2. Although a trend of increase over time was seen in each age-group, excluding those aged below 20 years and over 35 years, these increases were not significant between cohorts of women surveyed in 1993 and 1996. The 1990 rates were significantly lower (excluding those aged < 20 and ≥ 35 years). Fig. 2 also shows that the highest HIV-1 prevalence was in those aged 20–24 years in 1990, 25–29 years in 1993, and 30–34 years in 1996.

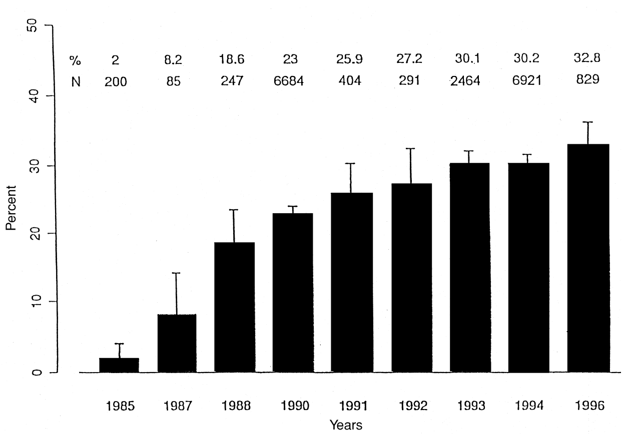

Fig. 1. Serial seroprevalence of HIV-1 among pregnant women, Queen Elizabeth Central Hospital, Malawi. Vertical bars represent 95% confidence intervals.

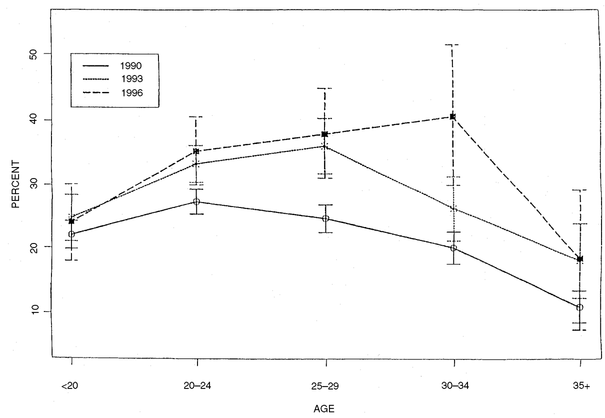

Fig. 2. HIV age-specific seroprevalence among pregnant women. Vertical bars represent 95% confidence intervals.

Selected demographic characteristics of women surveyed in 1990, 1993 and 1994/1995 are shown in Table 1. The selection of these factors was based on availability of comparable data in all three surveys. There was a significant association between all of these characteristics and HIV infection of the woman in each of the cohorts (with the exception of maternal age in 1993). Women who were young, with fewer pregnancies, and more education, were most likely to be HIV-infected. Statistically significant trends in prevalence across categories of age, education and parity were also

Table 1. Selected characteristics of women surveyed in 1990, 1993 and 1994/1995 stratified by HIV status.

Characteristic	HIV-positive [n (%)] 1990	1993	1994/1995*	$P^{\dagger}$
Maternal age (years)				
< 20	1377 (22.0)	543 (24.7)	1691 (24.1)	NS
20–24	2111 (27.3)	979 (33.3)	2460 (37.0)	< 0.001
25–29	1587 (24.6)	488 (36.7)	1173 (36.2)	< 0.001
30–34	890 (20.0)	283 (26.1)	896 (26.1)	< 0.004
≥ 35	719 (11.1)	171 (18.1)	701 (16.4)	< 0.005
$P^{\ddagger}$	< 0.001	NS	< 0.001	
Maternal education				
Illiterate	1250 (13.4)	388 (21.9)	1341 (22.3)	< 0.001
1–8 years	4649 (23.3)	1726 (30.3)	4367 (29.2)	< 0.001
≥ 9 years	785 (35.2)	364 (36.8)	1224 (42.3)	< 0.001
$P^{\ddagger}$	< 0.001	< 0.001	< 0.001	
Husband's education				
Illiterate	904 (17.5)	240 (27.9)	254 (18.5)	NS
1–8 years	3047 (18.1)	1151 (25.5)	3148 (25.6)	< 0.001
≥ 9 years	2429 (30.8)	919 (35.7)	3042 (35.8)	< 0.001
$P^{\ddagger}$	< 0.001	< 0.001	< 0.001	
Number of pregnancies				
Primigravida	1560 (25.6)	663 (28.7)	2449 (29.5)	< 0.009
1–2	2177 (26.4)	963 (33.4)	2083 (37.1)	< 0.001
3–4	1505 (22.9)	497 (30.8)	1125 (31.6)	< 0.001
≥ 5	1447 (14.4)	355 (21.7)	1276 (19.1)	< 0.001
$P^{\ddagger}$	< 0.001	0.04	< 0.001	

*1996 cohort not included because HIV testing was anonymous and information on education and parity was not available. $^{\dagger}\chi^2$ test for trend between cohorts of women surveyed in 1990, 1993 and 1994/1995. $^{\ddagger}\chi^2$ test for trend in each cohort. NS, Not significant.

Table 2. Age-specific seroconversion rates among postpartum women in Blantyre, Malawi.

Age at entry (years)	New HIV infections	Person-years	Incidence rate* (95% CI)
< 20	30	502	5.98 (3.91–8.05)
20–24	32	699	4.58 (3.03–6.13)
25–29	21	496	4.23 (2.46–6.00)
30–34	12	343	3.50 (1.55–5.41)
≥ 35	2	262	0.76 (0.01–1.81)
Overall	97	2302	4.21 (3.17–5.25)

*Percentage of person-years.

observed between cohorts (as indicated by *P* values in the last column of Table 1, with the exception of maternal age < 20 years and illiterate male partners of the women surveyed). Much of the increases occurred between 1990 and 1993, with little or no change between 1993 and 1994/1995 (the time intervals, however, were not exactly comparable).

In the follow-up study, 1173 HIV-seronegative women were evaluated for 2302 PY (median duration, 30.9 months per person; range, 0.03–73.4 months). During this period, 97 women seroconverted at an incidence of 4.21 per 100 PY (95% CI, 3.17–5.25). The age-specific seroconversion rates are shown in Table 2. HIV incidence was highest among young women below 20 years of age (incidence rate, 5.98 per 100 PY; 95% CI, 3.91–8.05) and progressively decreased with increase in age. The annual seroconversion rate was highest during the first year of follow-up and steadily declined in the subsequent years. For example, the rates of seroconversions during the years 1990, 1991, 1992, 1993, and 1994–1995 were 21.26, 12.77, 8.15, 3.33 and 1.11 per 100 PY, respectively.

The prevalence of STD (syphilis, trichomoniasis, gonorrhea, and genital warts and ulcers) among women surveyed in 1990, 1993, 1995 and 1996 is shown in Table 3. There was a significant trend of decline over time for all STD. Although this decline occurred among both HIV-positive and negative women, it had been more consistent for all STD among HIV-positive women. For example, the decrease in prevalence of genital warts and ulcers among HIV-seronegative women was not statistically significant.

Overall, there was an increase in reported lifetime use of condoms from 5.6% (95% CI, 5.1–6.2) in 1990 to 17.5% (95% CI, 15.9–19.1) in 1993, but this declined to 4.9% (95% CI, 3.4–6.4) in 1995. HIV-positive women reported higher use of condoms (7.1% of 1502 women in 1990, 22.2% of 616 women in 1993, and 5% of 701 women in 1995) than HIV-negative women (5.2% of 5101 women in 1990, 15.6% of 1487 women in 1993, and 4.1% of 97 women in 1995).

Discussion

This study shows that HIV prevalence is high in urban pregnant women in Blantyre, Malawi. Similar to the situation in many African urban cities [17], there has been an increasing trend over time. However, the most recent figures (e.g., 1993–1996) suggest either slowing rate of increase or a trend towards leveling off (albeit at a high level). This is consistent with reports from other sub-Saharan countries [18] and is in agreement with modeling work, which suggested a rapid increase in HIV prevalence followed by stabilization within about 10 years of the onset of the epidemic [19]. It is unlikely that the observed HIV prevalence is due to changes in serologic methods for testing. We performed Western blot tests on all ELISA-seropositive specimens in the

Table 3. Trends of sexually transmitted diseases among women surveyed at Queen Elizabeth Central Hospital, Blantyre, Malawi.

	1990	1993	1995	1996*	$P^{\dagger}$
No. women	6603	2161	808	829	
HIV-positive	1502	694	701		
HIV-negative	5101	1467	107		
Sexually transmitted diseases‡					
Syphilis	13.4 (12.6–14.2)	12.2 (10.8–13.6)	12.1 (9.9–14.4)	11.1 (9.0–13.2)	0.027
HIV-positive	18.4	16.0	13.0		0.001
HIV-negative	12.0	10.4	6.7		0.027
Trichomoniasis	32.5 (31.4–33.6)	28.6 (26.7–30.1)	23.8 (20.9–26.7)	–	< 0.001
HIV-positive	46.9	37.4	24.7		< 0.001
HIV-negative	28.2	24.4	17.1		< 0.001
Gonorrhea	4.9 (4.4–5.4)	2.5 (1.8–3.2)	2.5 (1.4–3.6)	–	< 0.001
HIV-positive	10.8	3.7	2.4		< 0.001
HIV-negative	3.2	1.9	2.9		0.022
Genital warts	4.8 (4.3–5.3)	3.1 (2.4–3.8)	2.5 (1.4–3.6)	–	< 0.001
HIV-positive	8.3	6.3	2.7		< 0.001
HIV-negative	2.2	1.7	1.0		0.172
Genital ulcers	6.8 (6.2–7.4)	6.7 (5.6–7.8)	3.4 (2.1–4.7)	–	0.004
HIV-positive	11.0	9.1	3.6		< 0.001
HIV-negative	5.5	5.7	2.1		0.689

*Sample tested only for syphilis and HIV (anonymous HIV testing; results of HIV and syphilis not linked). †χ^2 test for trend. ‡Values are percentages (95% confidence intervals).

earlier surveys when HIV seroprevalence was not known, and have followed conventional testing strategies in subsequent surveys [13–16].

Analysis of the age-specific prevalence is more revealing than the overall seroprevalence rates. HIV prevalence in the younger age-groups (< 20 and 20–24 years) for women surveyed in 1996 was not significantly higher than among women of these ages surveyed in 1993 (among women < 20 years, HIV prevalence in 1996 was slightly lower than in 1993). The 1996 prevalence (32.8%) was high mainly due to higher HIV prevalence amongst older women (30–34 years) than in earlier years. The highest age-specific HIV prevalence shifted over the years from younger to older age-groups (20–24 years in 1990, 25–29 years in 1993, and 30–34 years in 1996), suggesting an aging cohort of women who became infected at a younger age.

The overall incidence of HIV (4.21 per 100 PY) was high among women of childbearing age included in this study. The incidence of HIV was highest among women aged under 20 years (5.98 per 100 PY) compared with the incidence among older women. Since young women are the most at risk of seroconversion, it is important that intervention programs to control heterosexual transmission of HIV are specifically developed to target this group (e.g., educational activities including condom promotion). In this study, the HIV incidence was also high among women aged 20–34 years (4.58 per 100 PY among women aged 20–24 years declining to 3.50 per 100 PY among women aged 30–34 years; Table 2). Therefore, HIV/STD control activities should continue throughout the entire reproductive life.

The observation that seroconversion was highest during the first year of enrollment with a declining trend in subsequent years suggests that women are at highest risk during the postpartum period. It is likely that male partners are exposed to infected non-regular partners during late pregnancy and early postpartum when sexual abstinence is common [20]. The regular female partners of these men are therefore at greatest risk when sexual activity is resumed postpartum. This finding emphasizes the need for HIV intervention measures that women could use after delivery other than condoms. A vaginal microbicide with virucidal, bactericidal and spermicidal properties would be highly desirable. It is also important to note that in studies designed to evaluate the efficacy of HIV prevention measures in similar populations of postpartum women, most events (seroconversions) occur early during the follow-up period.

The high HIV incidence among young women could explain the increasing prevalence over time. Several studies have shown that when prevalence is stable or declining, the incidence of HIV could be high or increasing [21,22]. Although antenatal HIV serial seroprevalence data have been helpful for surveillance purposes, underestimation of seroprevalence or seroincidence is likely. For example, in a population-based study in Uganda, HIV-positive women were found to have reduced fertility due to lower rates of conception [23]. Biologic factors limiting fertility or sociodemographic variables that influence antenatal attendance of seropositive women could bias serial seroprevalence estimates.

A declining trend of STD prevalence has been observed in the last 5 years. STD prevalence was higher in HIV-positive women (Table 3), but the decline in prevalence occurred among both HIV-positive and negative women with the exception of genital warts and ulcers. Since higher rates of genital warts and ulcers amongst HIV-infected women are usually attributed to immunosuppression, it is difficult to interpret the declining trend we observed in our data for these conditions. These conspicuous genital lesions could not have been misclassified by the clinic staff. It is probable that these declines are due to a secular beneficial effect of other factors (e.g., improvements in treatment of concomitant bacterial infections such as syphilis or chancroid) or decreased sexual behavior due to a decline in health status. There was no significant decrease in rates of warts and ulcers among HIV-seronegative women. In this group of women, warts and ulcers are mainly due to chronic viral infections (e.g., human papillomaviruses and herpesviruses), and are not expected to be cured by conventional STD bacterial therapy.

A potential limitation when comparing our STD data is the time when testing was performed, since sexual practices during pregnancy and postpartum might not be the same (e.g., abstinence in the first few months postpartum) [20]. In the 1990 and 1993 cohorts, women were tested for STD during pregnancy, whereas in the 1994 study women were tested for STD 5 months or more after delivery in 1995 (after women had resumed sexual activity). These differences in design are unlikely to have influenced our results. A decline in all STD and a continuing decline for syphilis in 1996 suggest that the decrease in STD rates amongst the 1995 women is not the result of a bias.

An important finding is that the decline in STD has occurred without substantial increases in reported condom use. The decline in condom use in the 1995 cohort of women is of concern and does not parallel increasing condom distribution in the southern region of Malawi in recent years (Population Service International, personal communication, 1996). We could not verify whether this decline is due to changes in degree of reporting of condom use among women in different cohorts (e.g., a decline in over-reporting of ever use of condoms in the 1994/1995 cohort compared with the 1993 cohort of women). We showed in an earlier analysis of the 1990 and 1993 cohorts that HIV-seropositive women over-report condom use and that reported condom use is inconsistent amongst these women [24]. An in-depth investigation is urgently needed to verify rates and patterns (i.e., use of condoms with regular and non-regular partners) of condom use in this community. Currently, it not clear whether the large amounts of condoms distributed in the region during the study period were not used or whether women were under-reporting condom use.

A recent study from a neighboring country in East Africa found similar trends of condom use. Among male workers from a textile factory in Tanzania, significant changes in sexual behavior demonstrated by decrease in number of sexual partners was noted without substantial increases in condom use [25]. Interestingly, condom use with casual partners in Tanzania increased and declined over a period of 2 years of follow-up, a trend similar to that observed among women in Malawi. These findings underscore the value of applying multiple interventions to prevent heterosexual transmission of HIV/STD.

The large decline in STD prevalence in this population suggests that the HIV prevention program is having an impact either through improved STD treatment or reduced risk behaviors. The National AIDS Control Programme of Malawi and other governmental and non-governmental organizations have been active in spreading health education messages and adopting a country-wide syndromic management of STD [26]. Within Africa, reports from Uganda indicate that mass education, reduction of sex partners, control of STD and condom use have contributed to declining prevalence of HIV among young adults in the rural areas [27]. Recent findings in Thailand are another example that behavioral change can reduce the prevalence of both HIV and STD [5]. Sequential cross-sectional STD prevalence measures may be useful in monitoring the impact of STD and HIV prevention programs. In this population, since there was no simultaneous increase in condom use, the observed trends possibly reflect improvements in diagnosis and treatment of STD.

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