

## Critical Review

# HIV Epidemics in Africa: What Explains the Variations in HIV Prevalence?

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### Summary

There are large differences in the prevalence of HIV infection between different regions in sub-Saharan Africa, ranging from less than 10% in pregnant women in most of West Africa, to over 25% in pregnant women in large cities in Eastern and Southern Africa. These differences in HIV prevalence are in many instances due to differences in rate of spread of the virus. The multicenter study on factors determining the differential spread of HIV in four African cities tried to identify factors that could explain differences in spread of HIV between different regions in sub-Saharan Africa. The study was conducted in four cities, including two cities with a relatively low HIV prevalence (Cotonou in Bénin and Yaoundé in Cameroon) and two cities with a high HIV prevalence (Kisumu in Kenya and Ndola in Zambia). The difference in HIV prevalence between the four cities could not be explained by differences in sexual behavior. Any differences in sexual behavior were outweighed by differences in factors that influence HIV transmission, i.e. male circumcision and HSV-2 infection. These findings have important implications for the design of interventions.

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Africa is the continent in the world worst affected by the HIV/AIDS epidemic. At the end of the year 2000, UNAIDS and WHO estimated that there were 25 million Africans living with HIV infection, which represents 70% of the global number of people living with HIV. Over 90% of adults in Africa acquired their infection through heterosexual contact.

There are, however, large variations in HIV prevalence between different regions in sub-Saharan Africa. Eastern and Southern Africa are more severely affected than West and Central Africa. In large cities in Eastern and Southern Africa, the prevalence of HIV infection often exceeds 20%, and even is as

high as 40% in Harare in Zimbabwe and Gaborone in Botswana. In contrast, in large cities in West and Central Africa, with the notable exception of large cities in Ivory Coast, the prevalence of HIV infection does not exceed 10%.

There are two possible explanations for these differences in prevalence. The first possible explanation is that the epidemics in Eastern and Southern Africa started earlier than the HIV epidemics in West and Central Africa. A second possible explanation is that there are differences in the rate and extent of the spread of HIV in the population.

When one looks at trends in HIV prevalence among pregnant women, who are representative of the general population, it appears that there are differences in the rate of spread of HIV in different regions of sub-Saharan Africa. For instance, in Kinshasa (Democratic Republic of Congo) and Yaoundé (Cameroon), the prevalence of HIV infection has increased slowly or remained relatively stable over the past 15 years, whereas the epidemics in Gaborone (Botswana) and Gauteng Province (South Africa) were truly explosive. In Gauteng Province the HIV prevalence shot up from nearly 0% to about 20% in less than 10 years.

Another argument against differences in timing as a possible explanation for the differences in HIV prevalence is the fact that there is some evidence that the HIV epidemics in Central Africa are the oldest in Africa. The largest variety of HIV strains is found in Cameroon, Gabon, the Democratic Republic of Congo, suggesting a long-standing presence of the virus in the human populations there. In addition, a few years ago, evidence was found for the zoonotic transmission of HIV from primates to humans, and this was in Cameroon.

We undertook a study to try and identify factors that could explain the differences in rate of spread of HIV between different regions in sub-Saharan Africa. The study was conducted in two cities with relatively low HIV prevalence, Cotonou in Bénin and Yaoundé in Cameroon, and two cities with a high prevalence of HIV infection, Kisumu in Kenya and Ndola in Zambia. We postulated that in the cities with high HIV prevalence, compared to the cities with low HIV prevalence, risky sexual behavior would be more common and/or the prevalence of factors that enhance

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the transmission of HIV would be higher. In addition, we did a study of the distribution of HIV-1 subtypes in the four cities.

In each of the four cities, we aimed for a study population of 1,000 men and 1,000 women aged 15 to 49 years, randomly selected from the general population. Selected study participants were visited in their homes and asked for their informed consent. If they agreed, they were interviewed about their sociodemographic characteristics and sexual behavior. After the interview, study participants were asked for a blood sample that was tested for HIV, syphilis, and HSV-2, and a urine sample that was tested for gonorrhea and chlamydial infection by DNA amplification methods. Women were also asked to insert a swab in the vagina that was immediately inoculated into a culture medium for *T. vaginalis*.

In each of the four cities, we also conducted a study among sex workers. We first did a census of self-acknowledged sex workers, then on the basis of the census data, took a representative sample of 300 sex workers in each city. After giving their informed consent, sex workers were interviewed, then invited to come to a clinic where they underwent a full genital examination and samples were taken. The lab procedures were the same as for the general population.

Of the samples that tested positive for HIV, we selected 100 from the general population from each city and 50 from the sex workers for subtyping. Subtyping was done with the heteroduplex mobility assay of the *env* fragment followed by sequencing if needed.

In Cotonou, 3.3% of men were HIV infected and 3.4% of women. In the other three cities, the prevalence was higher in women than in men. In Yaoundé, the prevalence was 4.1% in men and 7.8% in women. In Kisumu and Ndola, the prevalence was around 20% in men and around 30% in women. Not surprisingly the HIV prevalence was much higher in sex workers than in women in the general population. In Cotonou 58% of sex workers were HIV positive. This was in stark contrast to the relatively low prevalence of 3% in men. In Yaoundé, 33% of sex workers were HIV positive, in Kisumu it was 75%, and in Ndola it was 69%.

We explored risk factors for HIV infection—behavioral and biological—in two ways. We first explored them as individual risk factors for HIV infection in each sex and in each city separately. This was done with multivariate risk factor analysis. Then, we compared the prevalence of the different risk factors between the cities with high HIV prevalence and the cities with relatively low HIV prevalence.

For men, the risk factors that were statistically significantly associated with HIV infection in at least one city included older age; being married or having been married; reporting a high lifetime number of sex partners; drinking alcohol; being infected with HSV-2 and/or with syphilis; reporting a history of symptoms suggestive of urethritis in the year before the interview; and not being circumcised. For women, the factors that were statistically significantly associated with HIV infection in at least one city were: younger age; being married or having been

married; reporting a high lifetime number of sex partners; reporting one or more nonspousal partners in the past year; having had sex in exchange for money; being infected with HSV-2 and or syphilis.

It was only in Kisumu that we had enough power to fully explore the association between HIV infection and male circumcision. In Cotonou and Yaoundé, very few men were uncircumcised, whereas in Ndola we had only 44 circumcised men in the sample. In Kisumu, we found a strong protective effect of male circumcision with an odds ratio of 0.25, after adjusting for possible confounding by sexual behavior and other factors.

When comparing the prevalence of different risk factors, we found that the only sexual behavior factors that were different between the two high HIV prevalence cities and the two low HIV prevalence cities were young age at first sex, young age at marriage, and large age differences between spouses. In our study, young age at first sex was not found to be an independent risk factor for HIV infection. Young age at marriage was a risk factor but it is unlikely that this would explain the differences in prevalence between the four cities.

HSV-2 infection was more prevalent in the two high HIV prevalence cities than the two low HIV prevalence cities. The prevalence of HSV-2 infection in men was 12% in Cotonou, 27% in Yaoundé, and around 35% in Kisumu and Ndola. The same pattern was seen in women: the prevalence of HSV-2 infection was 30% in Cotonou, 51% in Yaoundé, 68% in Kisumu, and 55% in Ndola. The difference between Ndola and Yaoundé was not very big here; however, contrast was larger in the younger age groups. In women there was also a difference in trichomonas prevalence between Kisumu and Ndola and Cotonou and Yaoundé. In Kisumu and Ndola, the prevalence was 29% and 34%; in Cotonou it was 3% and in Yaoundé 18%. With regards to circumcision status, in Cotonou and Yaoundé nearly all men were circumcised, in Kisumu, about a quarter of the men were circumcised and in Ndola 9% of men were circumcised.

The most common HIV-1 subtype in Cotonou, Yaoundé, and Kisumu was subtype A. In Cotonou also subtype G was common; in Yaoundé—as could be expected—we found a large variety of subtypes besides subtype A; and in Kisumu the other common subtypes were subtypes D and C. In Ndola we only found subtype C. So, the subtypes that were most prevalent in the two high HIV prevalence cities were A, D, and C. A was also very prevalent in Cotonou and Yaoundé, D was found in Yaoundé, and C has been isolated from patients in Cameroon in the past. One could argue that if C were a major determinant of epidemic spread then we should find it in higher frequency in Yaoundé.

We concluded that differences in sexual behavior could not explain the observed differences in prevalence between the four cities. We think that differences in sexual behavior were outweighed by differences in factors that influence the transmission of HIV during sexual intercourse, i.e., male circumcision, HSV-2 infection and possibly trichomoniasis. However our study was a cross-sectional study and we cannot determine from our study whether HSV-2 is responsible for the rapid spread of HIV in

Kisumu and Ndola or whether the high prevalence of HIV is responsible for the enhanced spread of HSV-2. It is likely that both mechanisms have been at work and that the epidemics of HIV and of HSV-2 have been reinforcing each other.

What are the implications for prevention? First of all, in each of the four cities, men and women reported high-risk sexual behavior and there continues to be a need for behavioral interventions, especially interventions targeted at youth. Second,

male circumcision should be seriously considered as a prevention strategy. Third, we need to do more research on HSV-2, especially vaccine research.

#### REFERENCE

1. Caraël, M., and Holmes, K. (eds.) (2001) The multicentre study of factors determining the different prevalences of HIV in sub-Saharan Africa. *AIDS* 15(Suppl 4), 51-5132.