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AN EPIDEMIOLOGICAL REVIEW OF HIV/AIDS IN SUB-SAHARAN AFRICA

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Available data from Sub-Saharan Africa have tended to show a large differential in HIV infection levels between urban and rural areas of a country. Results from several studies indicate significant differences in infection levels between urban and rural areas. It is equally important to emphasize the geographic variation in current levels of HIV infection between countries.

Results from a mathematical model applied to Sub-Saharan Africa show a decrease in the population growth rate and an increase in the crude death rate. But since birth rates may be little affected by an epidemic, African countries should continue to have positive growth rates.

The area in which the population impacts of AIDS in Africa will occur most rapidly is in the survival of infants and children. Modelling results for urban areas in Sub-Saharan Africa suggest increases from about one-quarter to 50 percent in the infant mortality rate and a doubling in the total mortality under age 5 in the presence of a strong epidemic.

The best summary measure of a population's mortality experience is the life expectancy at birth. Because of the increases in both childhood and young adult ages, AIDS has a substantial impact on the life expectancy at birth.

AIDS is rapidly becoming a fact of life in Africa. Over the next decade, AIDS and its impact will become a fact of life for demographic and behavioral researchers working in Africa. Despite the medical and biological emphasis in much of AIDS research, AIDS is at its roots intrinsically bound to social and sexual patterns of behavior. Therefore, social and behavioral scientists have much to contribute to addressing the roots of this epidemic.

SUMMARY

This report examines the distribution of HIV infection among various population groups in Sub-Saharan Africa and looks at trends over time in selected countries in the region. The report also looks at the likely current and future impact of AIDS on population growth and other demographic measures. Data presented in this report are taken from the ***HIV/AIDS Surveillance Data Base***, developed and maintained at the U.S. Bureau of the Census.

As of mid-1993, the World Health Organization estimated that over 8 million adult infections had occurred in Africa. Of this total, about half to two-thirds were in east and central Africa, an area which accounts for only about one-sixth of the total population of Sub-Saharan Africa. Given the predominant role that heterosexual transmission plays in the HIV epidemic in Africa, it should be no surprise that commercial sex workers (CSWs) and their clients play a central role in this epidemic. In several countries, more than half of the CSWs tested were infected.

Patients attending sexually transmitted disease (STD) clinics can be considered a sample of the population with frequent casual sexual contacts. Patterns of increase in HIV infection among large samples of STD patients for several Sub-Saharan African countries have been seen. Quite rapid increases were noted recently in Tanzania, Kenya, Côte d'Ivoire and Ethiopia. Infection levels in the capital cities of these countries has reached over 20 percent for STD patients.

Samples of pregnant women are often used as surrogates for the general population. Since 1985, HIV seroprevalence studies of pregnant women have been conducted in a number of African countries. A variety of studies over the past 7 or more years in Uganda, Zambia, and Malawi show a consistent and rapid increase in HIV infection levels among pregnant women in the capital cities of these countries. Very recently, alarming increases in rates of HIV seroprevalence have been recorded in Botswana among this population group.

There is increasing evidence that women are more at risk of HIV infection per exposure. Available data from several African countries from the first round of sexual behavior surveys suggest that a differential in sexual behavior exists such that males are more likely to engage in casual sexual contacts than females. The result is that the overall sex ratio of HIV-infected population in Africa is not far from 1:1, although this ratio varies from country to country. Another factor of importance in the epidemic is age-mixing--the tendency for males to chose a younger female as a partner. This behavior results in HIV infection levels in younger women tending to be higher than males in the same age cohort, while older males tend to have higher infection levels than females of the same age.

Preface

The Center for International Research conducts specialized studies of population, economics, labor force, health and aging issues. However, the use of data not generated by the U.S. Bureau of the Census precludes performing the same statistical reviews normally conducted on its own data.

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have improved markedly in recent years. Nevertheless, many biases still remain, and caution must be used in the interpretation of results.

Only a handful of nationally-representative seroprevalence surveys have been conducted in Sub-Saharan Africa, largely due to concerns regarding cost, diversion of skilled manpower, and an understanding that a nationally-representative sample may not provide much useful information about the groups at greatest risk for HIV infection. Thus, in recent years, sentinel surveillance programs have been developed to monitor defined populations for changes in HIV infection levels. For example, countries may develop programs that monitor infection among antenatal women attending government clinics, patients receiving treatment for sexually-transmitted diseases, and women engaged in commercial sex activities. Results from these studies can provide rapid feedback on infection levels and trends in populations at various levels of risk without the time and effort required to mount a national survey.

Data presented in the following discussion are taken from the ***HIV/AIDS Surveillance Data Base***, developed and maintained at the U.S. Bureau of the Census, with funding support from the U.S. Agency for International Development. Data are regularly compiled from the scientific and technical literature as well as presentations at major international conferences. The ***HIV/AIDS Surveillance Data Base*** currently contains over 18,000 data records drawn from over 2,300 publications and presentations.

MODES OF TRANSMISSION IN SUB-SAHARAN AFRICA

The World Health Organization (WHO) Global Programme on AIDS (Mann and Chin, 1988) has developed a typology to describe the various patterns of infection and spread of AIDS around the world. Within this typology, Africa is characterized as a Pattern II region, with a predominance of heterosexual transmission and substantial vertical (mother to child) transmission. As of mid-1993, WHO estimated that over 8 million adult infections had occurred in Africa. Of this total, about half to two-thirds were in east and central Africa, an area which accounts for only about one-sixth of the total population of Sub-Saharan Africa (WHO, 1993). Infected blood is thought to account for only about 10 percent of all HIV infections. Homosexual transmission and transmission through intravenous drug use are generally considered to have minimal impact on the epidemic in Sub-Saharan Africa.

INTRODUCTION

As infection by the Human Immunodeficiency Virus (HIV) and the impact of the Acquired Immune Deficiency Syndrome (AIDS) spreads within population groups throughout Africa, it threatens to become the overriding demographic and social issue for Africa in the 1990's. In this review, we examine the distribution of HIV infection among various population groups in Sub-Saharan Africa and look at trends over time in selected countries in the region. We identify several areas of particular concern in terms of the regional spread of HIV infection and present available data to highlight the current understanding of those issues.

In addition, concern has been expressed regarding the potential impact of AIDS on population growth rates in the region and the accompanying motivation for the provision of family planning services. We discuss the likely current and future impact of AIDS on population growth and other demographic measures. As we will show, the impact of AIDS threatens the important gains in mortality in Africa won over the past several decades.

Finally, we discuss the demographic impact of an African AIDS epidemic based both on mathematical modelling of such an epidemic as well as on the patterns and trends already presented.

DATA SOURCES AND ISSUES

Our knowledge of the infection and spread of HIV and AIDS in Sub-Saharan Africa is based on a variety of reports and studies which are known to be incomplete and nonrepresentative. AIDS case reporting, for example, from African countries to the World Health Organization has been estimated to be about 10 percent complete due to a variety of factors, including inadequate reporting systems in country and particularly in the early years of the AIDS epidemic, a reluctance on the part of countries to report AIDS cases to an international organization. A knowledge of AIDS cases alone, moreover, is not sufficient for an understanding of the dynamics of the epidemic due to the extended incubation period between initial infection and later development of HIV-related illness. Thus, even the most accurate AIDS case data would only provide a picture of the epidemic of infection as it existed as many as 10 years ago.

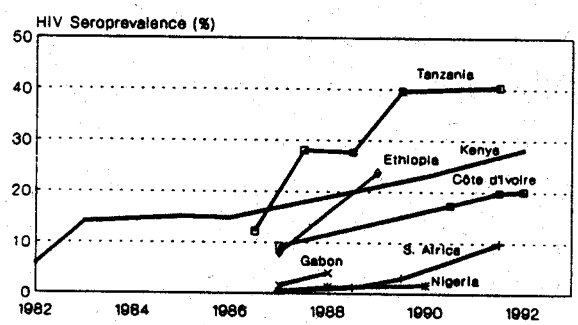
As a result, there has been considerable attention paid to the collection of data on HIV infection among various population groups. In the early years of the epidemic, many of these studies were conducted in a nonscientific manner and may have provided results that were not representative even of the population group that was targeted by the study. More recently, increasing attention has been paid to such issues as increased sample sizes, representativeness of the sample selection, geographic coverage, and confirmatory testing of HIV positive results. Consequently, both the quantity and the quality of seroprevalence data to 86 percent in 1992-93.[1] Although data on commercial sex workers are not available for all countries, based on these 21 it could be safely said that infection levels in this population group are much higher than in the general population.

STD Clinic Patients

Knowledge of levels of HIV infection among the population with frequent casual sexual contacts is high priority. But the selection of such a sample is understandably problematic. However, patients attending STD clinics can be considered a sample of that population since they or their partners are likely to have had sexual contact with others. They are at elevated risk both due to the presence of multiple partners, as well as due to the potentially enhanced risk of HIV infection among those with various other STDs (see Wasserheit, 1990). For example, various studies have estimated those with a recent STD to be at several times higher risk for HIV infection than those with no such exposure.

Several factors, on the other hand, may result in the data on HIV infection among STD patients not being representative of the total population with casual sex behavior. Among these are biases in the propensity to seek treatment at public facilities and variation (e.g., by sex) in the presence of symptomatic infections, etc. Nevertheless, such studies provide valuable information on a potentially large population at high risk of HIV infection at a time when surveys of AIDS Knowledge, Attitudes, Behaviors and Practices (KABP) are beginning to shed some light on sexual contacts outside of marital partnerships (see Carael, Carballo, et al., 1991).

HIV Seroprevalence for STD Patients in Urban Areas of Selected African Countries: 1982-92



Note: Includes infection from HIV-1 and/or HIV-2.

Figure 2

Patterns of increase in HIV infection among large samples of STD patients for several Sub-Saharan African countries are show in Figure 2. Quite rapid increases are noted recently in Tanzania, Kenya, Côte d'Ivoire, and Ethiopia. Infection levels in the capital cities of these countries has reached over 20 percent for STD patients. Although both Gabon and South Africa (results for black females) show relatively low levels of infection, the increases noted in the most recent data are ominous. In contrast with these

[1] Source references for the figures are contained in a separate listing following the bibliography.

TRENDS IN SELECTED POPULATION GROUPS

The following discussion focuses on four groups at varying levels of risk for HIV infection, namely, commercial sex workers, patients at sexually-transmitted disease (STD) clinics, pregnant women, and blood donors. The purpose is to describe the HIV/AIDS epidemic in Africa as it has been documented in these groups. This categorization is based on a desire to track infection patterns in populations at elevated risk of infection (prostitutes and STD patients), as well as to describe infection in samples which may be more representative of the general population (pregnant women and blood donors). Due to the lack of large numbers of surveys of the general population, this description is also determined by data availability issues.

Commercial Sex Workers

Given the predominant role that heterosexual transmission plays in the HIV epidemic in Africa, it should be no surprise that prostitutes and their clients play a central role in this epidemic (Padian, 1988). As Larson (1989) has described, the organization of the commercial sex industry and the availability of casual sex partners can play a key role in the spread of HIV infection in a country. Modelers in the field of sexually-transmitted diseases have documented the importance of "core groups" in the spread of infection (Hethcote and Yorke, 1984). Prostitutes, because of the number of sexual partners, are in many countries the group most at risk for HIV infection. Unfortunately, in many African cities, this risk has resulted in infection levels approaching 50 percent. In some, and especially among low SES prostitutes (who tend to have more clients), infection has become nearly universal.

Data are available on HIV infection among samples of urban prostitutes in the ***HIV/AIDS Surveillance Data Base*** for 21 countries in Sub-Saharan Africa (Figure 1). In 11 of these 21 countries, the most recent data show infection levels over 30 percent. In several countries more than half of the women are infected. As we will see with data from other population groups, infection levels in many countries are increasing. For example, in Abidjan, Côte d'Ivoire, seroprevalence among commercial sex workers rose from 69 percent in 1990

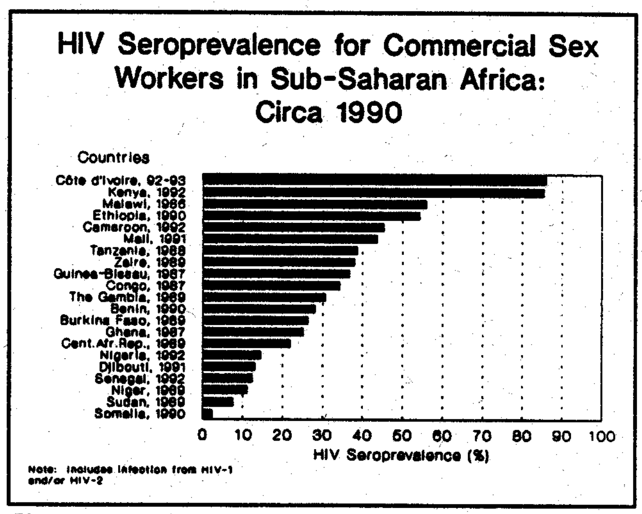


Figure 1

Lilongwe were well below 10 percent. Kigali, Rwanda (not shown in Figure 4), with a reported infection rate of over 30 percent in 1989, is another major urban area with high levels of infection.

In contrast, pregnant women in Nairobi and Bangui have shown quite moderate increases in comparison, and infection levels in Kinshasa have been relatively stable at around 5-6 percent. Infection levels for pregnant women in Abidjan increased rapidly to around 10 percent by 1987, appeared to have plateaued by 1990, but have started increasing again. Alarming increases in rates of HIV seroprevalence have been recorded in Botswana. In Francistown, HIV seroprevalence increased from less than 10 percent in 1991 to over 30 percent in 1993. (Issues of possible upper level to the epidemic and rates of increase are discussed further below.)

Blood Donors

HIV seroprevalence data from blood banks, for many countries, represents a readily-accessible sample for use in monitoring changes in HIV infection in the population. However, comparisons with general-population samples in several areas raise questions regarding the representativeness of the blood donor samples (Torrey, Mulligan, and Way, 1990). Donors tend to be predominantly male and in their young adult ages. In addition, female donors appear to be a higher-risk group than the general population or male donors. Screening and self-selection processes may act to further bias the sample. An example of such processes can be seen in data from blood donors in Uganda (Figure 5). Female volunteer donors are about twice as likely to be HIV positive as their male volunteer counterparts, while family donors, perhaps more representative of the population, are more evenly balanced. Studies in Zaire and other countries have confirmed this tendency for family donors to be more infected than volunteers.

HIV Seroprevalence for Blood Donors by Age, Sex, and Type of Donor Uganda: 1990

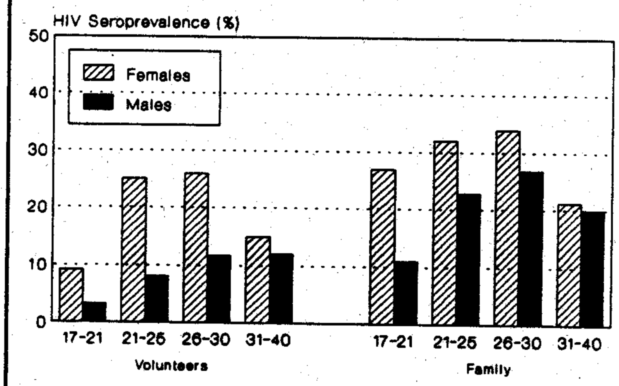


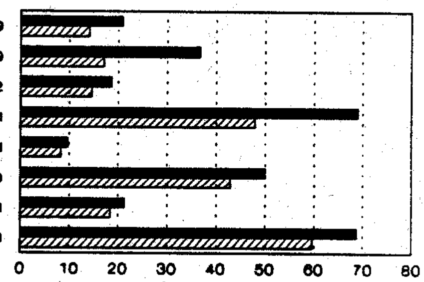
Figure 5

Obviously, issues related to the quality of the blood supply influence decisions regarding the monitoring of blood donors. But, from the available data to date, it does not appear that this group represents a valid proxy for the general population.

other countries, Nigeria has documented only a slow increase in infection among this population group.

Studies of STD patients in several other countries have documented HIV infection levels over 50 percent (Figure 3). Patterns of sex differentials in HIV infection are consistent. In all of these cases, females have higher HIV infection levels than males. The stage of the epidemic or patterns of treatment in public facilities may contribute to these observations.

HIV Seroprevalence for STD Patients by Sex in Selected African Countries



Note: Includes infection from HIV-1 and/or HIV-2.

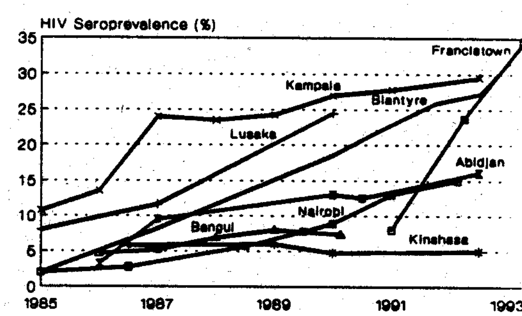
Figure 3

Pregnant Women

Samples of pregnant women are often used as surrogates for the general population. This is convenient, since in many countries women attend government clinics to receive antenatal care. To some extent, pregnant women can be considered to be at somewhat higher risk that the general population since they are sexually active. On the other hand, they also are drawn from a limited age range, may be biased toward those in marital (formal or informal) unions, and tend to be younger than adult women in general, given typical age-specific fertility rate patterns. Nevertheless, for many countries, data on pregnant women provides the most representative picture of HIV infection in the general population.

Since 1985, HIV seroprevalence studies of pregnant women have been conducted in a number of African countries. Seroprevalence data from those studies provide an initially confusing picture of regional trends (Figure 4). A variety of studies over the past 7 or more years in Uganda, Zambia, and Malawi show a consistent and rapid increase in HIV infection levels among pregnant women in the capital cities of these countries. By 1990, more than 20 percent of the samples of pregnant women in those areas were infected, while in 1986 infection levels in both Lusaka and

HIV Seroprevalence for Pregnant Women in Selected Urban Areas of Africa: 1985-1993



Note: Includes infection from HIV-1 and/or HIV-2.

Figure 4

Urban/Rural Differentials

Available data from Sub-Saharan Africa have tended to show a large differential in HIV infection levels between urban and rural areas of a country. A representative population survey in Rwanda in 1987, for example, found 17 percent of the adult population in Kigali to be infected, while only 2.1 percent of the rural population sampled were HIV positive. Data from the Rakai District in Uganda demonstrate both the typical age pattern of infection and urban/rural differentiation in infection levels (Figure 7).

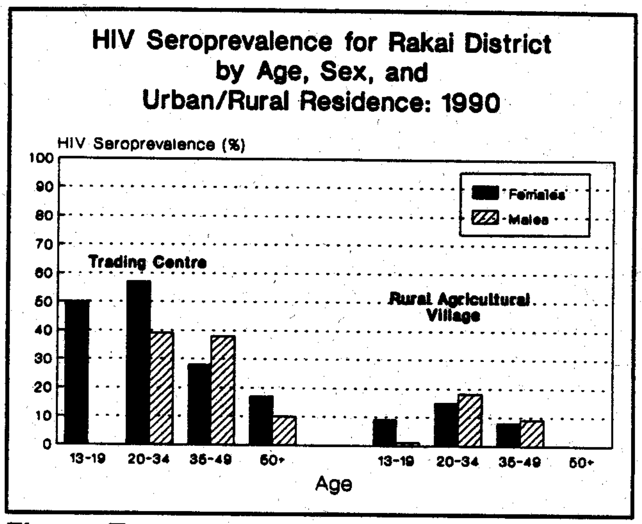


Figure 7

Such patterns are likely to result from differences in the timing of the introduction of HIV into the population and perhaps differences in patterns of sexual behavior between urban and rural populations. However, many exceptions to this generalization can be identified. For example, the Rakai district in rural Uganda has recorded HIV infection levels that equal those in Kampala, while, on balance, rural infection levels are about one-half of the urban infection levels. Across the border in Tanzania, the Bukoba district has a higher HIV seroprevalence than Dar Es Salaam. However, within the Bukoba district, urban areas exhibited higher rates of infection than did rural areas (24 percent vs. 5 percent, respectively). The availability of adequate transportation routes to and through rural areas and the level of rural/urban migration both contribute to the speed of the spread of HIV infection to these areas. Thus, countries with well-developed transportation infrastructures and high levels of rural/urban migration may experience rapid spread of HIV infection to rural areas.

Geographic Variation

Results from seroprevalence surveys presented above have tended to highlight the trends in particular population groups and focus on the differentials among populations at different levels of risk. It is equally important to emphasize the geographic variation in current levels of HIV infection between countries, based on

ISSUES

Age and Sex Patterns of Infection

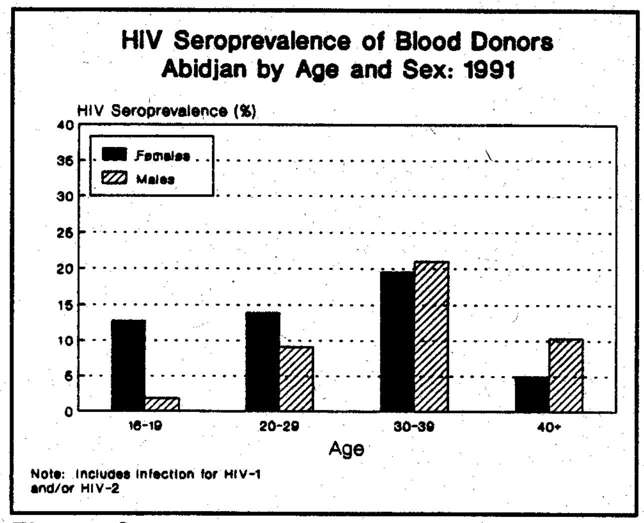


Figure 6

Although the precise values are not yet known, there is increasing evidence that women are more at risk of HIV infection when considered either on a *per contact or per partnership* basis. In this respect, HIV is no different from other STDs where a similar relation exists. On the population level, however, the risk of HIV infection for women will be a result of the sexual behavior of those women and (secondarily) the behavior of their sexual partners. Available data from several African countries in the latest round of sexual behavior surveys suggests that a differential in sexual behavior exists such that males are more likely to engage in casual sexual contacts than females. This will tend to counterbalance the female's biologically higher susceptibility to infection. The result is that, as the WHO has suggested, the overall sex ratio of HIV-infected population in Africa is not far from 1:1.

This does not mean that in every African country one can expect equal levels of infection, as the timing of the epidemic and sexual behavior patterns will differ. Several serosurveys in Uganda, for example, yield sex ratios for infected respondents of 1:1.4 (Berkley, et al., 1990). In Côte d'Ivoire, on the other hand, nationally-representative rural seroprevalence levels applied to the population, by age and sex, imply nearly 2 infected males per infected female in the rural area.

Another factor of importance is age-mixing--the tendency for males to choose a younger female as a spouse (as well as a casual sexual partner). This behavior results in HIV infection levels in younger women tending to be higher than males in the same age cohort, while older males tend to have higher infection levels than females of the same age. This pattern is shown in Figure 6 for Côte d'Ivoire and in Figure 7 for Uganda.

DEMOGRAPHIC IMPACTS

Results in this section are based primarily on the Center for International Research's work with the iwgAIDS model, a collaborative research and development project sponsored by the U.S. Department of State (Stanley, Seitz, Way, et al., 1991). This model, although still undergoing change, has been applied to the population of Uganda (by the Future's Group under the AIDSTECH project) and Sub-Saharan Africa (Way and Stanecki, 1991), and has more recently been used in policy dialogue with the government of Thailand.

Population Growth Rates/Crude Death Rates

Africa's current high rate of population growth (about 3 percent per year) will help to protect African countries from experiencing negative population growth as a result of the AIDS epidemic. Results from the iwgAIDS model applied to Sub-Saharan Africa showed a decrease in the growth rate by about 0.5 percentage points resulting from an epidemic infecting about 8 percent of the total population. This decrease in growth rate was the result of an increase in the future crude death rate from an expected 10 per 1000 population to 15 per 1000 population. Urban infection levels, which had reached 16 percent of the total population (with peak rates of around 30 percent in some age groups) resulted in a doubling of the crude death rate and a reduction of the population growth rate by about 1 percentage point.

Thus, even with a relatively severe AIDS epidemic (e.g., 25 percent of sexually active adults infected) reaching into <u>both</u> urban and rural areas of the country, total population growth rates may decrease by only about 1 percentage point, corresponding to an increase of about 10 per 1000 in the crude death rate. Since modeling results show that birth rates may be little affected by an epidemic, African countries should continue to have strong positive growth rates, despite the presence of an AIDS epidemic. In other regions of the world, on the other hand, such infection levels would have a real potential to result in declining populations, due to the lower initial rates of population growth.

Other models have demonstrated the potential for negative population growth in African countries (e.g., Anderson, May, and McLean, 1988; Potts, Anderson, Boily, 1991). Such an effect was demonstrated, however, only when general adult population seroprevalence levels reached levels exceeding even those of STD patients in urban Africa today (e.g., 50-60 percent). As yet, we have no indication that the sexual behavior and transmission parameters within Africa would lead to such prevalence levels in urban populations, much less throughout both urban and rural areas.

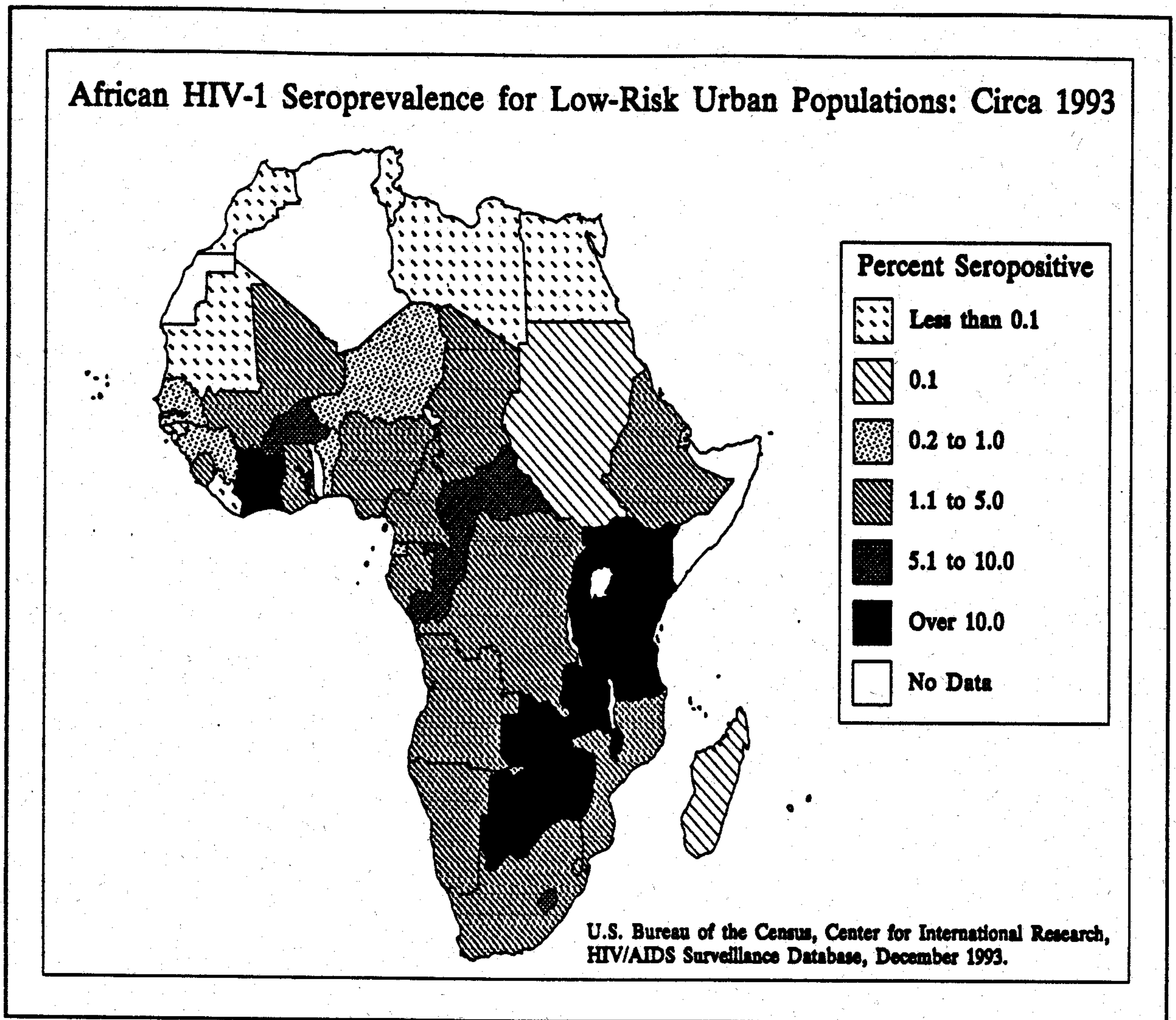


Figure 8

a comparison of "low-risk" urban population groups. Figure 8 shows the most recent available data by county for Africa.[2] Factors that can be shown or hypothesized to contribute to the observed variation include the timing of the introduction of the HIV virus to the population, marriage practices and sexual behavior before and outside of marriage, prevalence of STDs in the population, and male circumcision practices. This geographic pattern will be changing over time, as HIV infection levels continue to increase in some countries, while others experience some plateauing of infection. (See Appendix B for regional maps of HIV-1 and HIV-2 for low-risk populations.)

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[2] Data, in tabular form, for high and low risk population groups in urban areas and outside of urban areas are provided in Appendix A.

Life Expectancy at Birth

The best summary measure of a population's mortality experience is the life expectancy at birth, because it represents an accumulation of mortality across all ages and captures the differential impact of a death at various ages. Because of the increases in both childhood and young adult ages, AIDS has a substantial impact on the life expectancy at birth. As a result of AIDS, substantial increases in mortality rates occur in the adult ages, where relatively few deaths are typically expected. The cumulative effect of this increased mortality is substantial.

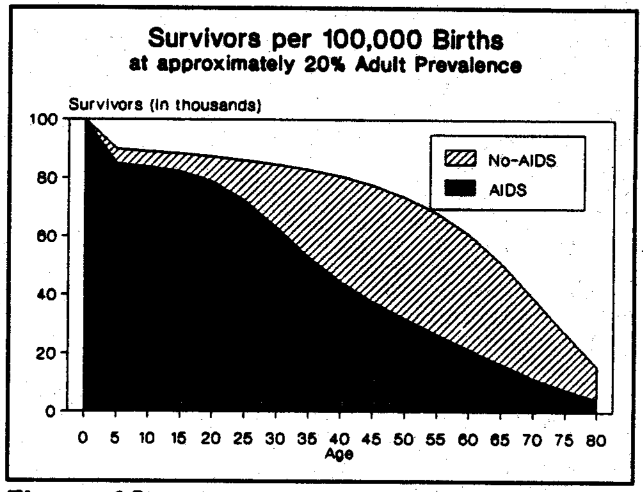


Figure 10

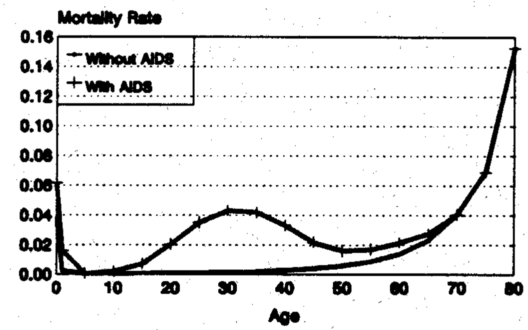
Once again using modeling results, the effect of AIDS on cumulative survival after birth can be shown (Figure 10). In this severe urban epidemic, the survival to age 50 is less than 50 percent the survival expected without AIDS. The net effect of this AIDS epidemic is to reduce urban life expectancy at birth 17 years, or approximately 1 year decrease in life expectancy for each percentage-point increase in HIV prevalence levels in the population.

Age and Sex Structures

How different will future age and sex structures be because of AIDS? AIDS has relatively little direct affect on fertility rates, due to the delay between HIV infection and AIDS mortality. Similarly, an AIDS epidemic has only a slight effect on the population dependency ratio because AIDS mortality occurs both in the numerator and the denominator of that measure. Thus, although AIDS mortality occurs primarily in the childhood and middle adult years, it is perhaps less concentrated in particular ages than, for example, the effects of military deaths during war.

Mortality Rates

Illustrative Impact of HIV on Age-Specific Mortality Rates at Approximately 20% Adult Prevalence



Source: Center for International Research, U.S. Bureau of the Census.

Figure 9

Studies based both on models and on empirical information have identified the most important aspects of the impact of HIV infection and an AIDS epidemic on a population. New HIV infections among adults are concentrated in the ages of peak sexual activity--from the late teens to about age 30 or 35. Because of the 7 to 10 year average incubation period between infection and the onset of AIDS, and about a 1-year survival period after acquiring AIDS, deaths from AIDS are shifted into older ages and tend to occur most often in the 30 to 45 year age range. These ages are characterized by non-AIDS mortality rates for most causes of deaths that are among the lowest of all age groups. Thus, AIDS can increase the mortality rates in these age groups many times over (Figure 9).

Infant and Child Mortality

The area in which the population impacts of AIDS in Africa will occur most rapidly is in the survival of infants and children, given the predominant transmission modes and since studies have shown the progression to AIDS and death more rapid for those under 5 years of age. Although perhaps only one-third of those born to HIV-infected mothers are themselves infected, the more rapid progression means that HIV-related infant and child deaths will often occur before the deaths of their parents.

Although the attribution of HIV-related deaths to the infant (under 1 year) or child (1-4 years) period is somewhat problematic due to the lack of a sufficient number of cohort studies, it appears clear that virtually none of the infected infants will survive past their 5th birthday. Due to the survival of HIV-infected infants past their 1st birthday, however, child mortality levels may be more affected than infant mortality.

Modeling results for urban areas in Sub-Saharan Africa suggest increases from about one-quarter to 50 percent in the infant mortality rate, and a doubling in the total mortality under age 5 in the presence of a strong epidemic (U.S. Bureau of the Census, forthcoming). Other analysis, using recent seroprevalence data for pregnant women, found that in African urban areas with high HIV seroprevalence levels, between one-tenth and one-third of all deaths under age 5 already may be attributable to HIV infection (Valleroy, Harris, and Way, 1990, p. 670).

infection areas may help to shed light on possible upper limits to infection levels in the general population.

- Results from several settings have shown relatively stable and moderate levels of infection in some general population samples over a period of several years, for example, in Kinshasa. Thus, there appears to be hope that not all countries will follow the path toward high infection levels.

- Infection levels in rural populations will generally lag behind urban prevalence levels and may plateau at lower levels.

WHAT THE FUTURE HOLDS

The patterns and trends presented above allow some extrapolation to the future, however tentative, based on the brief documented history of HIV/AIDS in Africa and borrowing from the experience of those countries most affected in the region. This extrapolation provides the following glimpses of the future:

- HIV infection and the impact of AIDS will continue to increase in most African countries in the near future. Infection will spread into rural areas for which little information currently exists.

- The population will continue to be exposed to varying degrees of risk, depending on their behavior and that of their sexual partner. Differentials in HIV infection levels will persist, reflecting the variation in risk.

- AIDS will have an increasing impact on the African population, primarily through increased mortality in the population under age 5 and between 30 and 50 years of age. In many countries, gains in infant and child survival and in life expectancy, hard-won over the past several decades, will be reversed.

- Unfortunately, due to the weak systems for demographic data collection and reliance on indirect measures of mortality, the documentation of much of this impact will be handicapped by delays in data collection and the inability of current methods to provide precise dating of events. Current measures of adult mortality in Africa are particularly weak and subject to these limitations.

- Efforts to implement interventions to limit the spread of HIV will challenge behavioral scientists working in the region both in terms of measuring relevant behaviors as well as identifying their determinants.

The absolute size of each age cohort is shown in the population pyramid (Figure 11), reflecting differences in both the number of AIDS deaths and the reduced population growth. The greatest relative differences in population size by cohort are evident in the youngest age groups and in those 30 to 50 years of age.

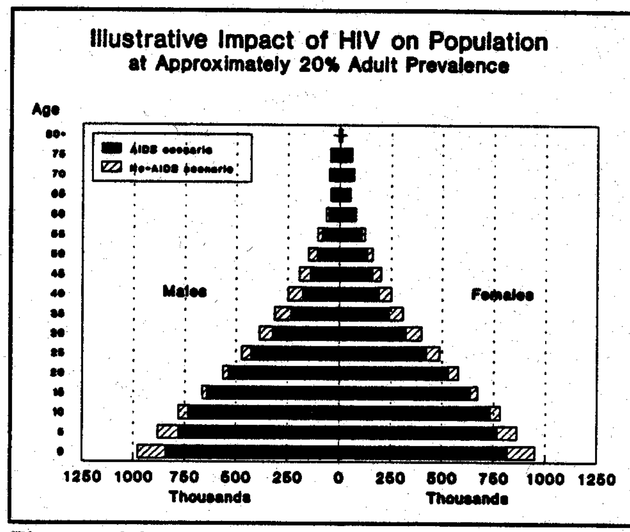


Figure 11

EPIDEMIC GROWTH--HOW HIGH, HOW FAST?

Given the variation in observed levels of infection and epidemic growth rates described above, a series of questions relating to the epidemic naturally follow. How rapidly will HIV continue to spread in the future? At what point in current high-prevalence countries will HIV infection become endemic, that is, stabilize? Will countries with currently low levels of infection inevitably progress to HIV prevalence levels currently recorded e.g., in Kampala or Kigali, or is a plateauing at a lower level possible?

Although crystal ball technology continues to lag, valuable insights can be obtained from the available seroprevalence data as well as results of mathematical modeling, described more below. These data suggest the following tentative responses to the above questions:

- Variation in the speed of increase in HIV infection and in the endemic level of infection will result from variations in sexual behavior, presence of STDs and other cofactors, and perhaps other unknown factors.

- Although by no means definitive, available studies have not found infection levels in general population or antenatal women samples above around 30 percent. This raises the question of how much above this level can HIV infection in the general population be supported. However, several high prevalence sites appear to be still increasing. Studies conducted over the next several years in high-

- The need to evaluate interventions will further challenge researchers to identify relevant proximate and intermediate outcome measures, estimate these measures with accuracy and efficiency, and provide adequate linkages to program interventions to demonstrate program efficacy to donor agencies.

AIDS is rapidly becoming a fact of life in Africa. Over the next decade AIDS and its impact will become a fact of life for demographic and behavioral researchers working in Africa, if it has not already. Despite the medical and biological emphasis in much of AIDS research, AIDS is, at its roots, intrinsically bound to social and sexual patterns of behavior. Therefore, social and behavioral scientists have much to contribute to addressing the roots of this epidemic.

APPENDIX A

Table 1: Estimates of HIV-1 Seroprevalence, by Residence and Risk Factor, for Developing Countries: Circa 1993

REGION AND COUNTRY	CAPITAL/MAJOR CITY		OUTSIDE MAJOR CITY		URBAN CITY SOURCES		OUTSIDE CITY SOURCES	
	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK
ASIA AND OCEANIA								
Bahrain	-	.0	-	-		F0038		
Bangladesh	.0	-	-	-	W0076			
Bhutan	.0	-	-	-	W0076			
Burma	2.2	11.4	0.1	15.5	F0055	F0055	F0055	F0055
China, People's Republic of	-	14.2	-	-		Z0036		
French Polynesia	.0	.0	-	-	A0047	C0005		
Hong Kong	.0	.0	-	-	L0097	W0078		
*India	.8a	26.6	-	-	J0022	B0144		
Indonesia	.0	-	-	-	W0076			
Israel	.0	1.1	-	-	M0204	M0186		
Japan	.0	.1	-	-	S0161	S0161		
Korea, Dem. People's Rep.	.0	-	-	-	W0076			
Korea, Rep.	.0	.1	-	-	M0274	Y0013		
Kuwait	.0	.0	-	-	B0078	M0101		
Laos	.1	-	-	-	K0007			
Macau	.0	-	-	-	V0017			
Malaysia	.0	29.5	-	-	B0082	S0215		
Maldives	.0	-	-	-	W0076			
Mongolia	.0	-	-	-	W0076			
Nepal	0.1	1.6	-	-	W0076	P0096		
New Caledonia	.0	.0	.0	-	C0089	C0089	C0089	
Pakistan	.0	-	-	-	M0228			
Papua New Guinea	.0	.7	-	-	V0017	V0017		
Philippines	.0	.1	-	.1	D0033	D0033		H0025
Saudi Arabia	.0	-	-	-	B0137			
Singapore	.0	0.4	-	-	V0017	C0138		
Sri Lanka	.0	0.1b	-	-	W0076	A0105		
Syria	.0	-	-	-	M0139			
*Taiwan	.0	.4	-	-	C0131	H0092		
Thailand	1.9	35.9	-	-	T0100	T0100		
Turkey	.0	1.6	-	-	R0044	B0088		
Vietnam	.0	0.1	-	-	V0044	F0059		
LATIN AMERICA/CARIBBEAN								
Antigua & Barbuda	-	1.7	-	-		G0123		
Argentina	.3	6.3	.2	2.0	F0024	Z0030	F0037	F0037
Bahamas, The	3.6	18.4	-	-	B0179	B0179		
Barbados	1.2c	4.7	-	-	B0186	G0123		
					B0187			
					B0188			
					B0189			
Bolivia	.0	.0	-	-	M0078	M0078		
*Brazil	0.8	24.0a	0.3	.0b	M0275	F0047	C0152	T0046
British Virgin Islands	2.8b	-	-	-	B0206			
Cayman Islands	0.0	-	-	-	G0123			
Chile	0.0	1.0	-	-	L0123	L0123		
Colombia	.1	14.6	-	-	B0027	B0043		
Costa Rica	1.1c	4.3c	-	-	L0125	L0128		
*Cuba	.0	.0	-	-	M0287	M0297		
Dominican Rep.	1.3	5.0	-	-	G0106	G0100		
Ecuador	.0b	0.5	-	-	R0093	R0093		
El Salvador	0.3b	2.2	-	-	M0235	E0036		
Grenada	0.0	2.4b	-	-	G0140	G0139		
Guatemala	.0	.7	-	-	M0205	T0065		
Guyana	6.9	25.0b	-	-	G0137	G0123		

Table 1: Estimates of HIV-1 Seroprevalence, by Residence and Risk Factor, for Developing Countries: Circa 1993

REGION AND COUNTRY	CAPITAL/MAJOR CITY		OUTSIDE MAJOR CITY		URBAN CITY SOURCES		OUTSIDE CITY SOURCES	
	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK
AFRICA								
Algeria	-	-	-	-				
*Angola	1.7	14.2a	-	-	P0103	S0043		
*Benin	.6	25.3a,b	.4	-	D0114	B0132	D0114	
Botswana	22.5c	31.9c	7.5	-	N0097	N0097	N0087	
*Burkina Faso	8.8a	17.2a	4.1a	44.7a,b	S0145	L0086	O0029	B0092
Burundi	19.9	-	1.6	-	B0174		B0174	
*Cameroon	1.6c	45.3	2.9	-	G0112	M0272	S0195	
*Cape Verde	.0	-	.0	-	A0046		A0046	
Central African Rep.	7.4	16.5	8.5	22.0	W0069	W0069	W0069	W0069
Chad	4.1	-	-	-	M0266			
Comoros	-	0.1	-	-		P0059		
Congo	9.0	17.5c	2.6	-	B0127	G0073	B0162	
*Cote d'Ivoire	14.8a	86.0a	3.3a	-	D0112	T0085	B0108	
*Djibouti	.3	43.0	.0b	-	B0037	C0141	F0017	
Egypt	.0	.2	-	-	H0086	C0101		
*Equatorial Guinea	.3	-	-	-	J0009			
Ethiopia	2.1	54.2	.0	65.6	H0046	N0083	Z0009	N0083
*Gabon	2.5	3.6a	-	3.7	M0146	M0146		S0152
*Gambia, The	.1	4.6a	-	-	W0027	P0062		
*Ghana	2.2	37.5b	-	-	M0143	D0096		
*Guinea	.6a	.6	.3	-	K0074	L0074	J0028	
*Guinea-Bissau	.1	.0b	.5a	-	A0042	K0033	R0059	
Kenya	15.0b	85.5	6.3b	-	G0105	M0243	M0251	
Lesotho	5.5b	5.8b	0.5b	0.6b	M0267	M0267	M0267	M0267
Liberia	.0	.0b	-	-	F0007	M0060		
Libya	.0	-	-	-	G0091			
*Madagascar	0.1	0.1	-	-	K0076	K0076		
Malawi	31.6	55.9	-	-	O3703	G0005		
*Mali	3.7	42.6a	-	-	M0247	K0116		
*Mauritania	.0b	-	-	-	C0093			
Mauritius	.0	0.8	-	-	K0026	P0074		
Mayotte	-	-	-	-				
*Morocco	.0	7.1b	-	-	Z0022	R0046		
*Mozambique	1.1	1.2a	.8	3.7a	D0020	V0053	B0025	F0050
*Namibia	2.5	-	-	-	L0040			
*Niger	.6a	5.9a	-	-	O0044	O0044		
*Nigeria	1.2a,c	12.3a,c	-	-	A0101	D0120		
Reunion	-	-	-	-				
Rwanda	33.4	69.0b	9.8	-	L0119	K0127	C0132	
St. Helena	-	-	-	-				
*Sao Tome & Principe	.0	-	-	-	L0022			
*Senegal	.3a	3.9a	0.2b	2.0b	D0113	D0105	W0071	W0071
Seychelles	-	-	-	-				
*Sierra Leone	3.5a	27.5b	-	-	K0060	M0237		
Somalia	-	2.4	-	-		C0122		
South Africa	1.7	8.2	-	-	R0089	R0065		
Sudan	.1	16.0b	-	-	A0071	M0134		
Swaziland	2.3b	2.2b	-	-	W0060	W0060		
*Tanzania	11.5	42.9	10.2b	34.3b	K0125	M0256	R0090	R0090
Togo	-	-	-	-				
*Tunisia	0.0	1.9	-	-	B0169	G0015		
Uganda	29.5	45.0	5.0	86.0b	A0086	G0095	K0155	N0003
Western Sahara	-	-	-	-				
Zaire	5.0c	38.0	2.9	25.4	M0265	M0265	M0265	G0092
Zambia	24.5b	54.0b	16.0b	36.0b	T0040	T0040	K0096	K0096
Zimbabwe	18.0	28.6b	12.8	34.4	M0241	H0061	W0061	W0061

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Table 1: Estimates of HIV-1 Seroprevalence, by Residence and Risk Factor, for Developing Countries: Circa 1993

REGION AND COUNTRY	CAPITAL/MAJOR CITY		OUTSIDE MAJOR CITY		URBAN CITY SOURCES		OUTSIDE CITY SOURCES	
	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK	LOW RISK	HIGH RISK
LATIN AMERICA/CARIBBEAN CONT'D								
Haiti	15.7	41.9	4.0	-	B0138	G0048	A0097	
Honduras	.2	19.8	-	-	M0242	Z0035		
Jamaica	.3	14.6b	-	-	J0034	W0036		
Martinique	.5	38.9b	-	-	C0067	C0033		
Mexico	.1b	2.2	-	-	H0083	U0005		
Monsterrat	0.0c	-	-	-	M0278			
					M0279			
					M0280			
Nicaragua	.0	1.6b	-	-	N0110	N0110		
Panama	.0	-	-	-	P0018			
Paraguay	.0	.1	-	-	V0058	C0112		
Peru	.1	.3	-	-	A0014	A0014		
St. Kitts & Nevis *	2.0c	-	-	-	S0227			
					S0241			
					S0242			
St. Lucia	0.0c	1.2c	-	-	S0218	S0217		
					S0220	S0218		
					S0221	S0220		
						S0221		
St. Vincent & Grenadines	0.2	1.4c	-	-	S0235	S0234		
						S0235		
						S0236		
Suriname	.8c	2.6	-	-	S0244	S0246		
					S0245			
Trinidad & Tobago	.2c	14.7	-	-	T0091	C0143		
					T0092			
					T0093			
					T0095			
Uruguay	0.1	5.6	-	-	A0118	S0209		
Venezuela	.1	6.1b	.0	-	E0024	E0024	A0022	

- No data found
* See table 2 for HIV-2 data
a Rate represents infection with HIV1 only and dual infection (HIV1 & HIV2), therefore addition of rates from table 1 and 2 is not advised.
b Data are best available but are not necessarily reliable due to small sample size (<100).
c Data combined.

NOTES:
Definition: High risk--prostitutes and clients, STD patients, or other persons with known risk factors
Low risk--pregnant women, blood donors, or other persons with no known risk factors.

SOURCE: U.S. Bureau of the Census, HIV/AIDS Surveillance Data Base, 12/93 Update

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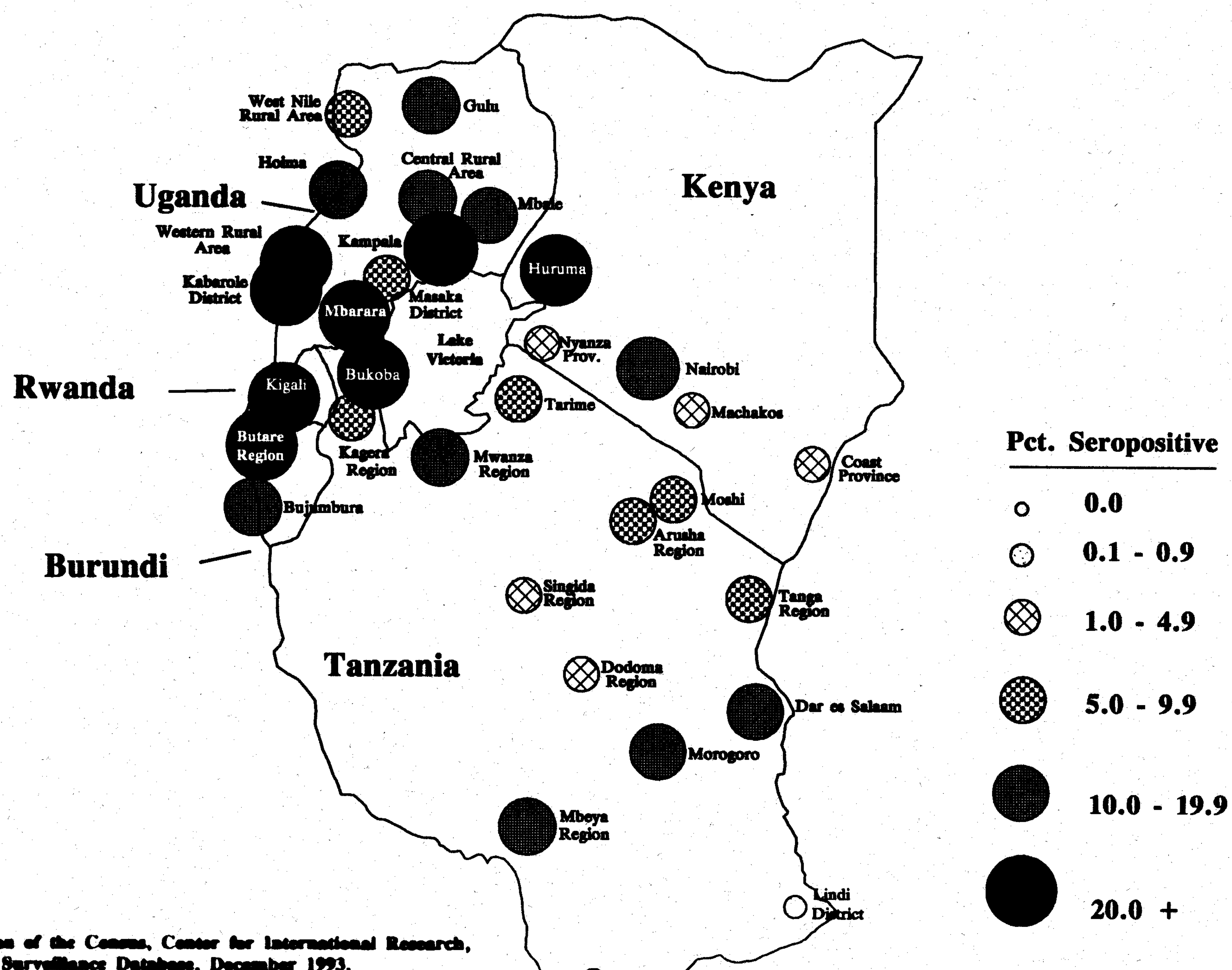
APPENDIX B

Seroprevalence of HIV-1 for Low-Risk Populations in East Africa



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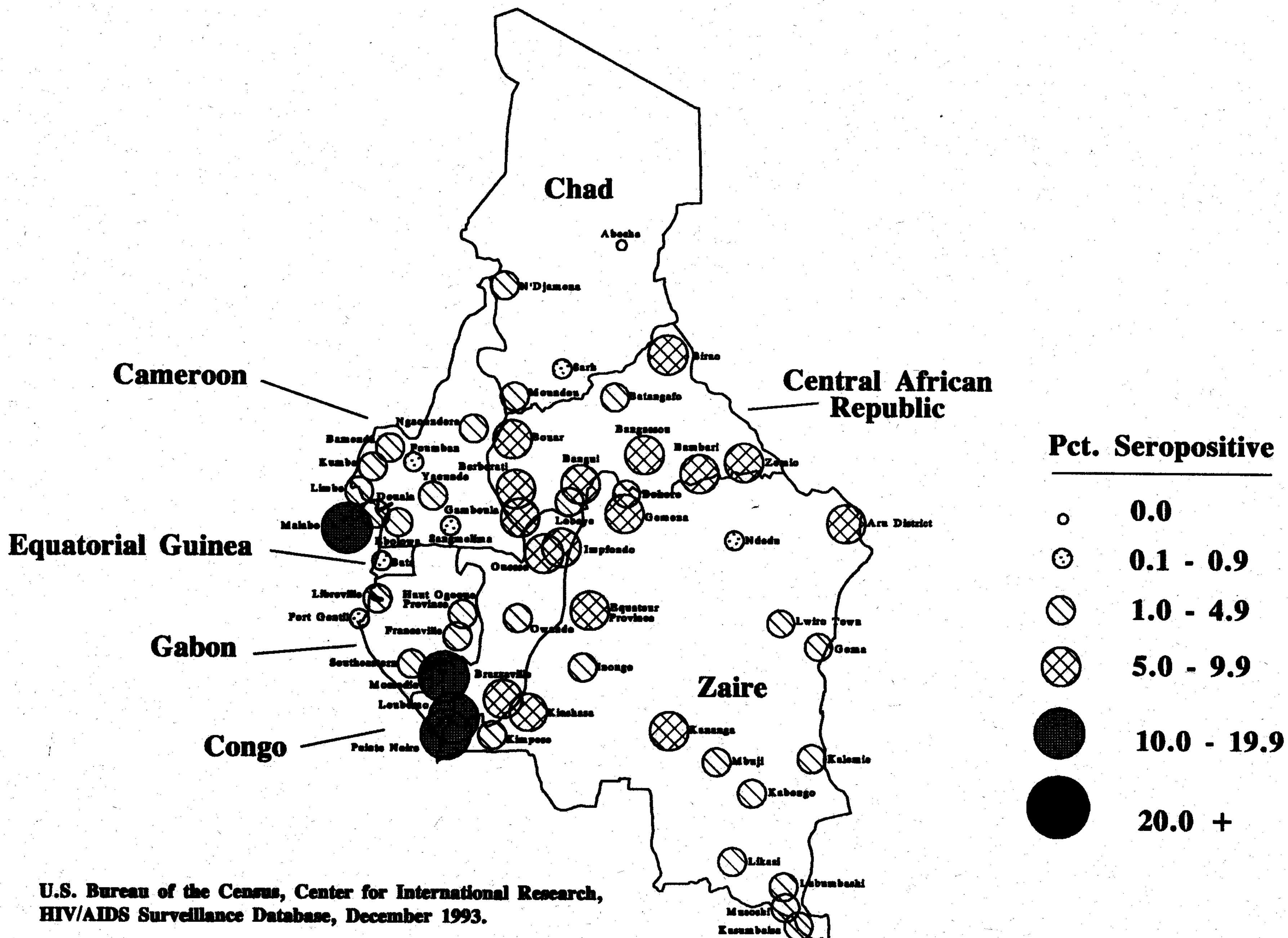
Seroprevalence of HIV-1 for Low-Risk Populations in Central Africa



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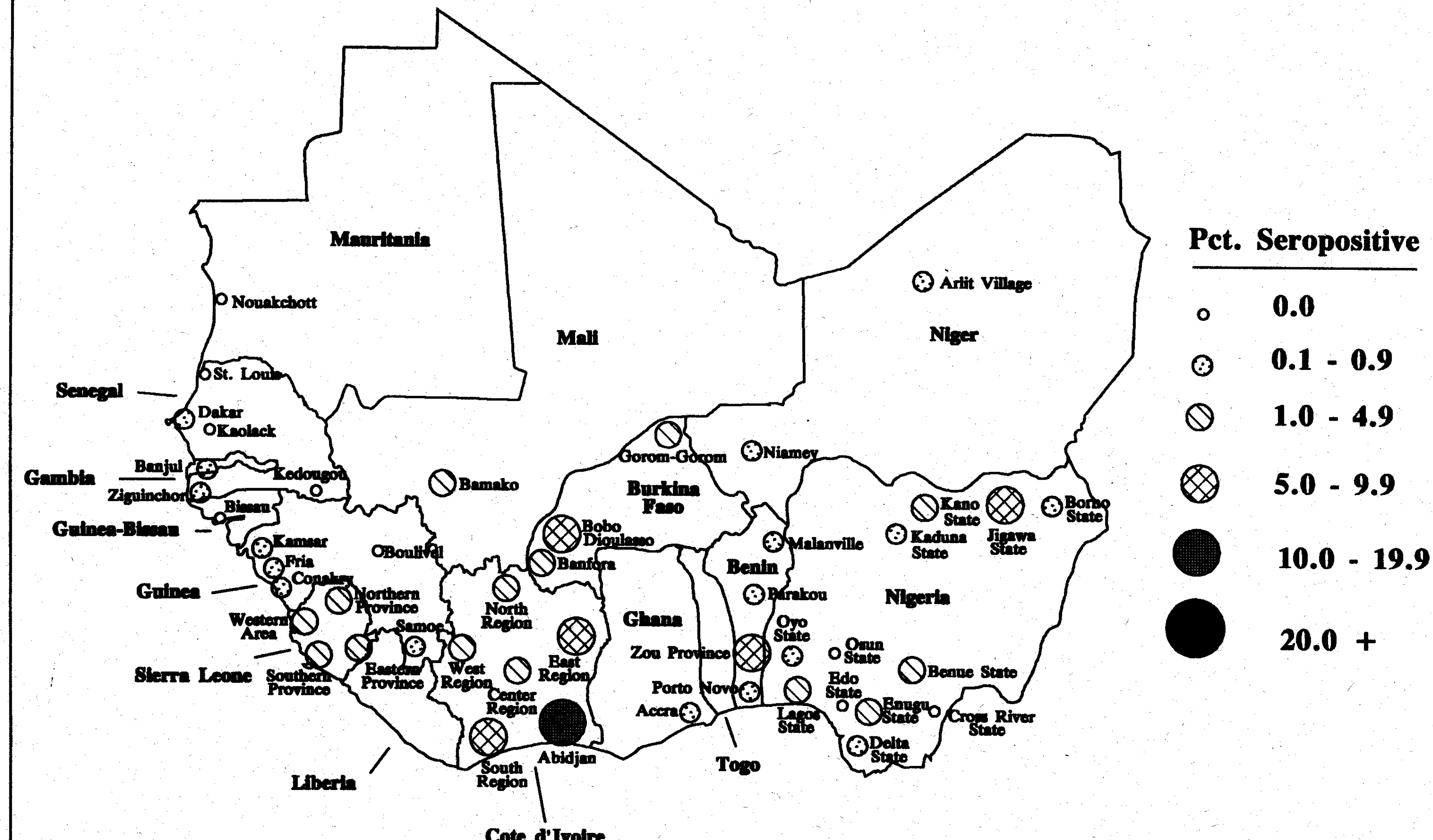
Seroprevalence of HIV-1 for Low-Risk Populations in West Africa



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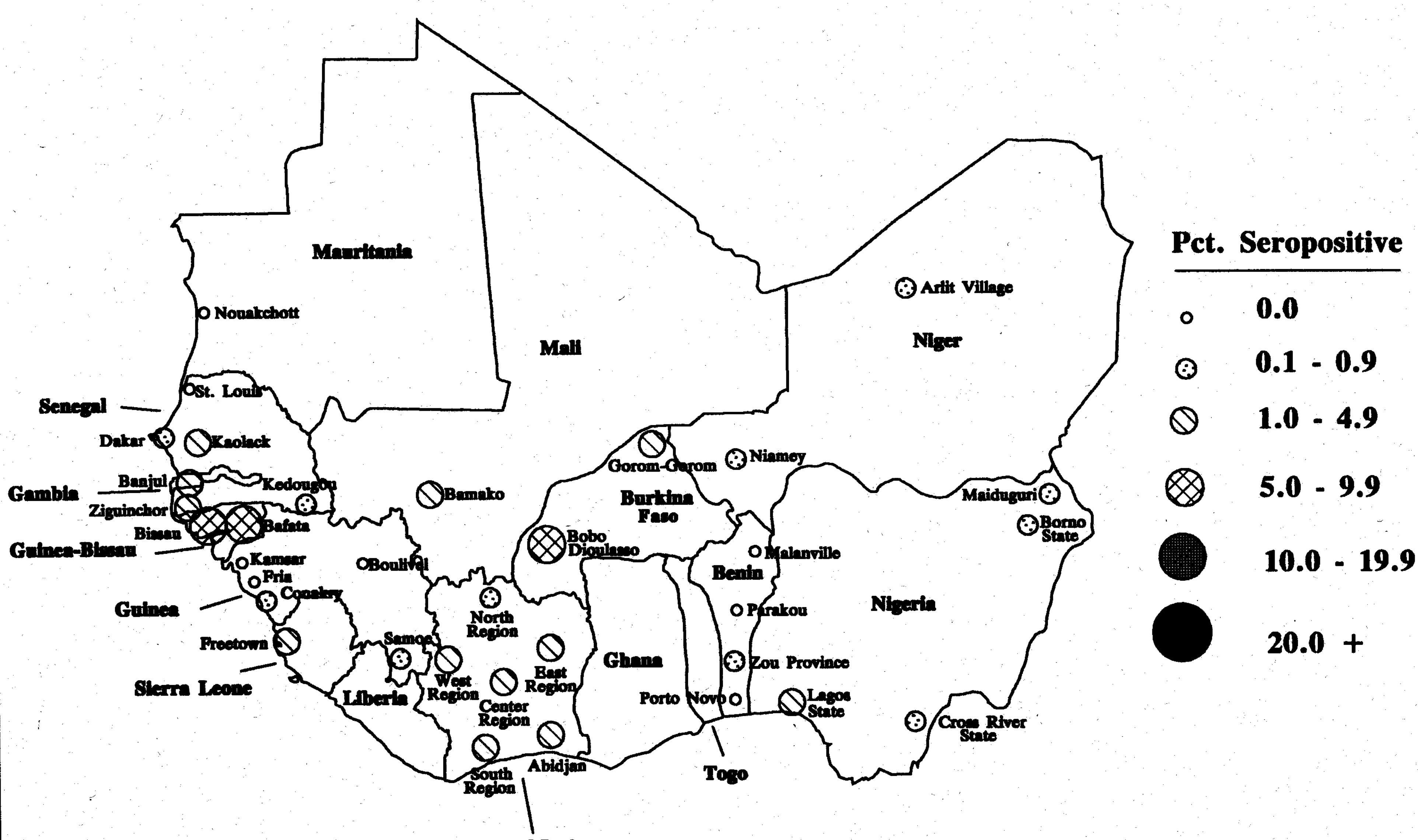

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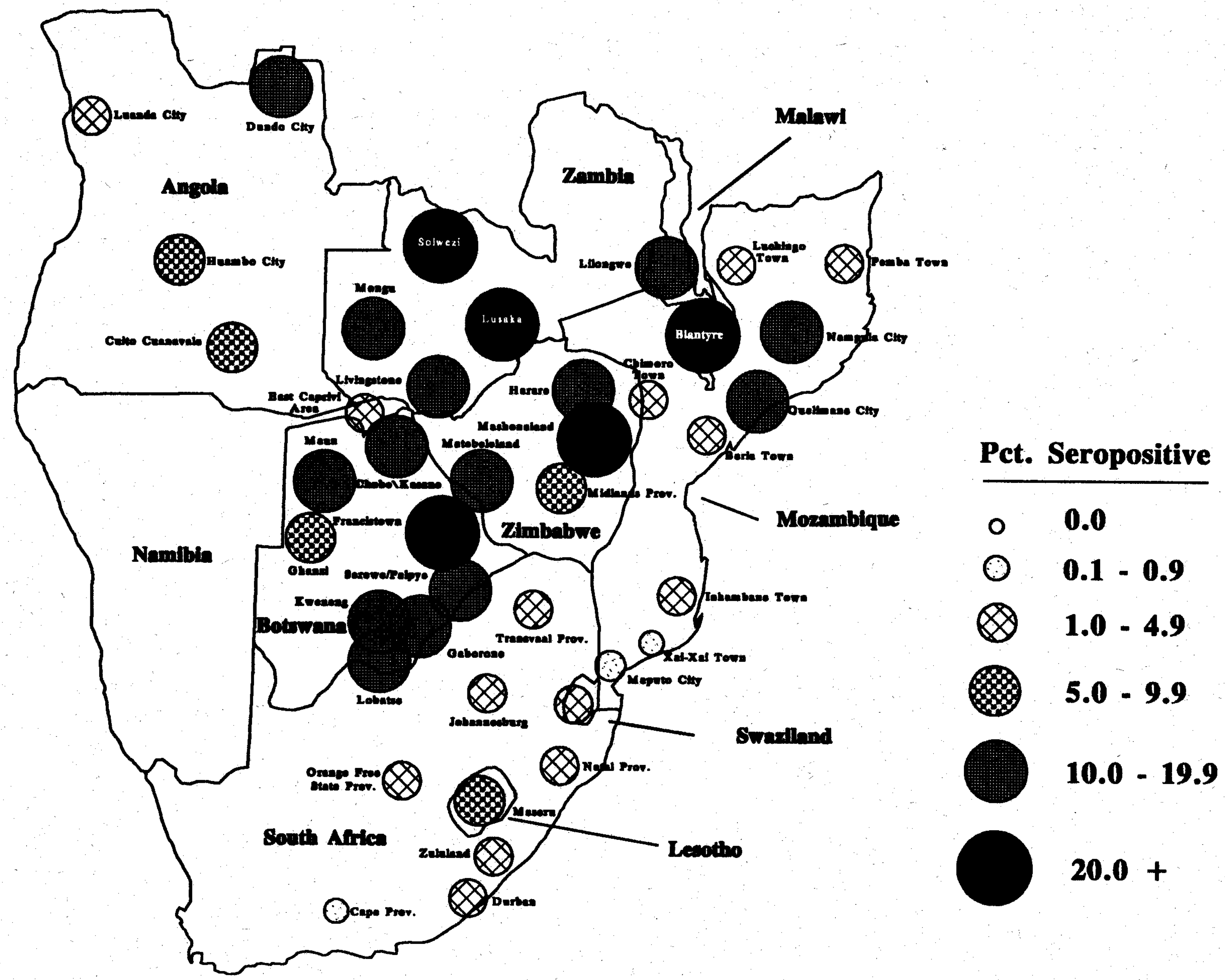

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Figure 9

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Figure 10

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Figure 11

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