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Seroprevalence of HIV-1, HIV-2, and HIV-1 Group O in Nigeria: Evidence for a Growing Increase of HIV Infection

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Summary: To determine current data on HIV infection and to further confirm the presence of HIV-1 group O infection in Nigeria, 2300 samples from five states were tested for the presence of HIV antibody. A convenience sampling was obtained from pregnant women, tuberculosis (TB) patients, commercial sex workers (CSWs), blood donors, patients with sexually transmitted diseases (STDs), patients with skin diseases, male clients of CSWs, outpatients suspected to have AIDS, truck drivers, and community dwellers. With the exception of pregnant women, the HIV prevalences in all these groups were high: 60.6% in CSWs, 16.2% in TB patients, 7,7% in blood donors in some states, and 16% in the rural area of Kano State. Male clients of CSWs, truck drivers, and STD patients had prevalences of 7.8%, 8.6%, and 21.2%, respectively. Regional differences in relation to HIV prevalences were observed; HIV-2 and most of the HIV-1/2 infections were found in the southern states of Nigeria. Higher HIV prevalences were observed in the north-northeast in pregnant women, TB patients, and CSWs, but for blood donors, higher rates were seen in the southeast-southwest. One asymptomatic 50-year-old woman, a community dweller in Kano, was identified to be HIV-1 group O–positive. Compared with data from national surveillance studies in 1991/1992 and 1993/1994, a substantial increase in HIV infection was observed. Our results show a growing incidence of HIV infection in Nigeria and suggest the presence of a rural HIV epidemic. The identification of HIV-1 group O in Kano shows that this virus strain is geographically widespread in Nigeria. **Key Words:** Nigeria—HIV seroprevalence—HIV-1 group O—Rural area.

Throughout sub-Saharan Africa, HIV and AIDS constitute a major social and community health problem, with growing evidence of rising levels of HIV infection and AIDS in most parts of the continent. The distribution and the spread of HIV are not uniform within any country and some population groups are disproportionately affected by the virus. It is also evident that some countries and certain regions of the continent are particularly affected by the epidemic, whereas in other countries relatively low and stable levels of HIV infection are observed (1).

With an area of 923,768 km^2, situated to the eastern tip of the West African region, the Federal Republic of Nigeria is bordered to the west by the Republic of Benin, to the north by Niger, and to the east by Chad and Cameroon. Divided administratively into 30 states (the country was redivided into 36 states after this study was concluded), it has approximately 110 million inhabitants, about 35% of whom live in urban areas (2). Nigeria

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reported its first case of AIDS in 1986. It has been estimated that by 1996, at least 25,000 cases of AIDS will have occurred and that 4 million people will have been infected by HIV (3). Studies reported so far have focused on seroprevalence data in general population groups and high-risk groups (4–9). These reports and data from national sentinel surveillance studies provide evidence for the continuing spread of HIV in discrete population groups such as commercial sex workers (CSWs) and patients patients with sexually transmitted diseases (STDs).

Because it is geographically located between the well-established HIV-1 epidemic of Central Africa and the epicentre of HIV-2 infection, found mainly on the extreme west coast of Africa, HIV-1, HIV-2, and dual infection (HIV-1/2) have been documented (5,6,8,10).

It has been suggested from these studies that HIV-1 is the predominant HIV viral type in circulation in the Nigerian population, whereas HIV-2 appears to be found mainly in CSWs and is more likely to be found in the south of the country. A preliminary report has indicated, though at a very low level (0.2% of HIV-1–positive samples), the presence of HIV-1 group O in the Cross River State. The state borders the Republic of Cameroon to the east, where HIV-1 group O was first documented (11).

Between March and May 1996, we conducted a large serosurvey on selected population groups from different geographic locations in Nigeria (southwest, southeast, north, northeast), to expand our previous studies and to diversify into a more representative sample in terms of geographic and ethnic diversity. The purpose of the study was to generate current data on HIV infection in Nigeria, especially relative prevalence by HIV types and population groups and further explore the presence of HIV-1 group O infection in Nigeria.

MATERIALS AND METHODS

Background

Nigeria is divided into 30 states. The study was conducted in five of them (Fig. 1):

1. Lagos State (southwest): in Lagos, Nigeria's largest city and key commercial center

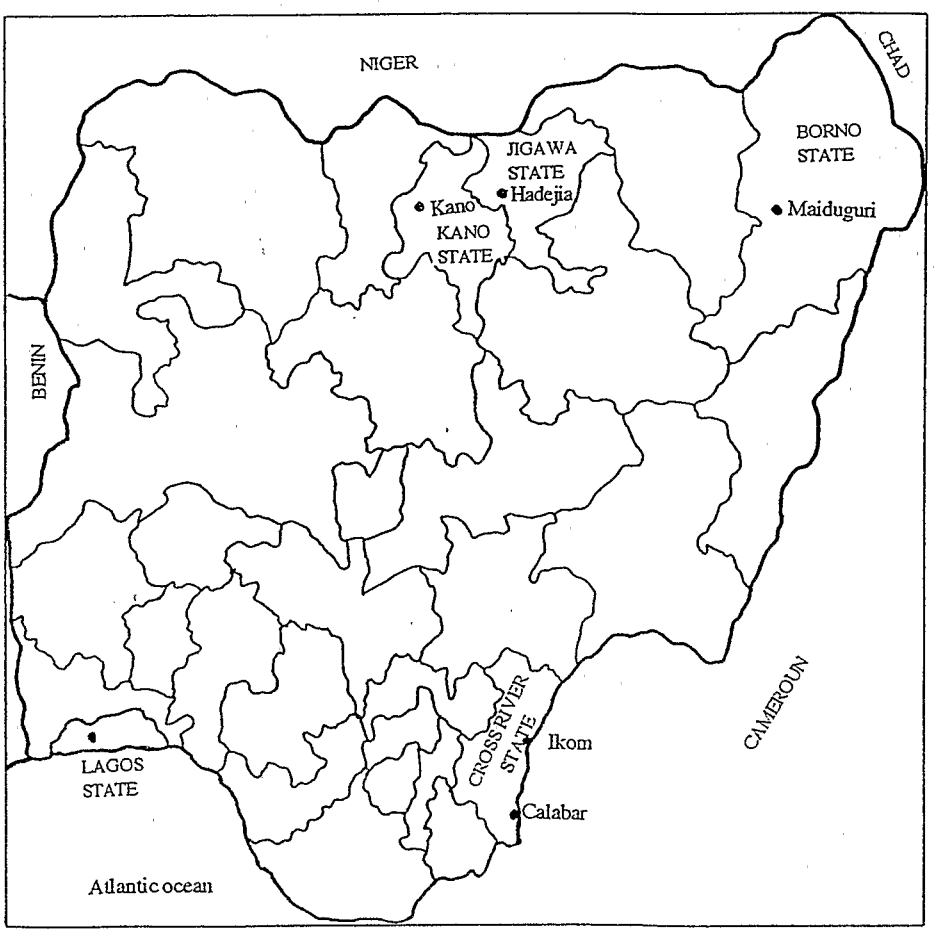

FIG. 1. Map of Nigeria showing study sites.

2. Cross River State (southeast): in Calabar, the state capital and a seaport, and in Ikom, a border town adjacent to Cameroon
3. Borno State (northeast): in Maiduguri, the state capital, which borders Cameroon and Chad
4. Kano and Jugawa States (north): in Kano, the state capital, and Hadejia town

Study Populations

We conducted a convenience sampling of 10 population groups: CSWs, male clients of CSWs, truck drivers, STD patients, suspected AIDS patients, dermatology patients, patients with tuberculosis (TB), blood donors, pregnant women, and patients living in vulnerable communities with a high risk potential for HIV transmission. In these communities, people are marginalized and live in poor conditions, in which they are exposed to risk behaviors such as injection drug use, alcoholism, and prostitution.

Data Collection

Participants were CSWs, pregnant women, TB patients, and blood donors were recruited from Lagos, Cross River, and Borno States. In addition, pregnant women were also recruited from Kano State and CSWs from Jigawa State.

A simple questionnaire was designed to collect basic demographic data, such as age, sex, marital status, and occupation. It also sought to identify risk factors associated with HIV, such as number of sexual partners, travel history, and a history of STD infection.

After informed consent from each subject, a questionnaire was administered before whole blood was collected in tubes of ethylene diamine tetra-acetic acid (EDTA). Each subject was counseled and on request, condoms were given.

Laboratory Procedures

All samples were initially screened for HIV antibodies in Nigeria using a rapid HIV-1/2 assay, based on the principle of latex agglutination (Capillus HIV-1/2, Cambridge Diagnostic, Galway, Ireland). From each specimen, serum was aliquoted and stored at −20°C. All sera were retested by a commercial enzyme-linked immunosorbent assay (ELISA) (ICE 102, Murex, Dartford, U.K.). All elisa-reactive sera were confirmed and discriminated by a line immunoassay (LIA, Innolia HIV-1/2, Innogenetics, Ghent, Belgium).

All HIV-reactive samples were tested for the presence of HIV-1 group O antibodies as previously described (12). Briefly, sera were tested by a specific Elisa coated with V3 peptides from ANT-70 and MVP-5180 (Research product, Innogenetics). Samples reactive on this ELISA were further confirmed by a line immunoassay wherein V3 peptides from group O and M strains were applied as lines on a nylon strip (Research product, Innogenetics). Samples suspected to contain HIV-1 group O antibodies were further analyzed by polymerase chain reaction (PCR) using specific group O primers in the pol region, envelope region, or both (13).

Statistical Analysis

The data collected through the questionnaire and the data obtained in the laboratory were analyzed with EPIINFO (Centers for Disease Control and Prevention, Atlanta, GA, U.S.A.). χ^2 Tests were used to compare differences in HIV prevalences or other parameters.

RESULTS

Description of Study Populations

Overall, 487 female CSWs were recruited from Lagos (n = 236), Ikom (n = 82), Hadejia (n = 32), and Maiduguri (n = 137). All women were full-time, low-income CSWs with a mean of 4.2 partners per day. Their mean age was 26.3 years, and >90% were single. Fewer than 5% had traveled outside Nigeria within the past 3 months. Condom use was not common in these different populations.

A total of 633 pregnant women were recruited from Lagos (n = 399), Calabar (n = 60), Maiduguri (n = 24) and Kano (n = 150). The mean age was 26.9 years. Only 7% of them reported a history of travel outside Nigeria within the past 3 months, and only 1.4% were single.

Most of the blood donors' samples (n = 243) were obtained from Lagos (n = 103) and Kano (n = 99). The mean age of the donors was 30.9 years. All were male, 68% of them were married, and about 17% reported that they had traveled outside Nigeria.

The TB patients (n = 339) were recruited from Lagos (n = 206), Calabar (n = 48.4), and Maiduguri (n = 85). The male-to-female ratio was 1.6/1; the average age for men was 35 years and for women was 29 years. Approximatively 50% of these patients were married.

In addition to the four main groups described, samples were collected from other population groups. Because of the small sample sizes and the large heterogeneity within some groups, the population groups are not comparable. They include: 205 patients presenting with skin diseases in Lagos; 23 truck drivers from Calabar; 33 STD patients from Kano and Lagos; 177 outpatients suspected to have AIDS from Lagos, Calabar, Kano, and Maiduguri; 89 male clients of CSWs from Lagos and Ikom; 21 residents of Shitta community in Lagos; and 50 people randomly selected from Gadar Tumburuwa in Kano State.

HIV-1 and HIV-2 Prevalences in the Various Population Groups

In these groups, HIV-1 was the predominant infection (315 of 330), although there were confirmed cases of HIV-2 (n = 3) and dual HIV-1/2 infection (n = 12). All 330 HIV-antibody–positive sera were tested for the presence of antibodies to HIV-1 group O viruses. Only 1 serum reacted on LIA only with the group O V3 peptides and was considered positive for the presence of HIV-1 group O antibodies. The corresponding primary lymphocytes were also confirmed by PCR as group O.

The HIV-1 group O sample was obtained from an

asymptomatic 50-year-old woman from Gabar Tumburuwa in Kano. The woman did not have a history of travel outside Nigeria.

Overall, HIV prevalence was 40.7% (198 of 487) in the CSWs: 30.5% (72 of 236) in women in Lagos, 48.7% (40 of 82) in Ikom, 60.5% (83 of 137) in Maiduguri, and 9.3% (3 of 32) in Hadejia ($p < .00001$) (Table 1).

Stratified by age group, the highest HIV-1 prevalence occurred in younger women (<20 years) in Maiduguri. In Ikom, highest infection rates were seen in CSWs aged between 20 and 30 years. The mean number of clients per day for HIV-1–seropositive CSWs was 3.3 compared with 2.4 in HIV-1–seronegative women ($p = .00002$). There was no significant difference in HIV serostatus when history of travel outside Nigeria was analyzed for CSWs.

In the pregnant women, the overall HIV-1 prevalence was 1.7% (11 of 633): 0.8% (3 of 399) in women in Lagos, 2.7% (4 of 150) in Kano, 6.6% (4 of 60) in Calabar, and 0% (0 of 24) in Maiduguri ($p = .008$).

Together, patients with TB in the different locations had an HIV prevalence of 10.6% (36 of 339): 8.7% (18 of 206) in Lagos, 8.3% (4 of 48) in Calabar, and 16.2% (14 of 85) in Maiduguri ($p = .1$). The majority of HIV-infected female TB patients were between 20 and 30 years of age, whereas in male TB patients most HIV infection occurred in individuals older than 30 years of age.

Overall HIV-1 prevalence was 4.9% (12 of 243) in the blood donors: 7.7% (8 of 103) in Lagos, 2% (2 of 99) in Kano, 4% (1 of 28) in Maiduguri, and 8% (1 of 13) in Calabar. Although the numbers of samples from blood donors from Calabar and Maiduguri were small, prevalence levels were different when the nothern (Kano and Maiduguri) and southern locations (Lagos and Calabar) were compared. Given an adequate sample size from Lagos and Kano, a comparison by age groups showed that the majority of those infected in Kano were between 31 and 40 years old.

As expected, a high HIV prevalence was observed in outpatients: 13.7% (11 of 80) in Lagos, 25% (41 of 6) in Calabar, 75% (9 of 12) in Maiduguri, and 23% (16 of 69) in Kano. The prevalence of HIV in male clients of CSWs was 7.8% (7 of 89) and in truck drivers was 8.6% (2 of 23); 21.2% (7 of 33) of STD patients also had elevated levels of infection.

Finally, a high prevalence (16%; 8 of 50) of HIV was observed in a rural community in Kano state, that indicates an already ongoing HIV epidemic in that part of Nigeria.

Trends in HIV Prevalence in Nigeria

Data from our study are compared with results from national sentinel surveillance studies for 1991/1992 and 1993/1994 in Table 2. Our study locations were in the national sentinel surveillance sites. The groups with data

TABLE 1. *HIV prevalence per population groups and per state*

Population group	No. tested	HIV-1 *n* (%)	HIV-1 + -2 *n* (%)	HIV-2 *n* (%)	HIV *n* (%)	χ^2 Test	*p* Value
Pregnant women							
Lagos	399	3 (0.8)	—	—	3 (0.8)		
Calabar	60	4 (6.6)	—	—	4 (6.6)	11.99	.008
Maiduguri	24	—	—	—	—		
Kano	150	4 (2.6)	—	—	4 (2.6)		
Tuberculosis patients							
Lagos	206	14 (6.7)	3 (1.5)	1 (0.5)	18 (8.7)		
Calabar	48	4 (8.3)	—	—	4 (8.3)	4.10	.1
Maiduguri	85	13 (15.0)	1 (1.2)	—	14 (16.2)		
Female commercial sex workers							
Lagos	236	69 (29.2)	3 (1.3)	—	72 (30.5)		
Ikom	82	39 (47.5)	1 (1.2)	—	40 (48.7)	47.84	<.001
Maiduguri	137	81 (59.1)	2 (1.4)	—	83 (60.5)		
Hadejia	32	3 (9.3)	—	—	3 (9.3)		
Blood donors							
Lagos	103	8 (7.7)	—	—	8 (7.7)		
Calabar	13	1 (7.6)	—	—	1 (7.6)	3.87	.027
Maiduguri	28	1 (3.5)	—	—	1 (3.5)		
Kuno	99	2 (2.0)	—	—	2 (2.0)		
Clinic out patients							
Lagos	80	10 (12.5)	1 (1.2)	—	11 (13.7)		
Calabar	16	2 (12.5)	—	2 (12.5)	4 (25.0)		
Maiduguri	12	9 (75)	—	—	9 (75.0)	22.49	<.001
Kano	69	16 (23.1)	1 (1.4)	—	16 (23.1)		

TABLE 2. *Comparison of HIV prevalence for 1991/1992 and 1993/1994 national surveillance results with current study*

Population groups	Years	No. states	No. samples	HIV prevalence	χ^2 test	p value
Pregnant women	1991/92	11	4517	1.4%[a]		
	1993/1994	16	15666	3.8%	69.65	<.001
	Present study (1996)	4	633	1.7%		
Female commercial sex workers	1991/1992	6	1339	17.3%[a]		
	1993/1994	11	2061	22.5%	110.35	<.001
	Present study (1996)	4	487	40.6%		
Tuberculosis patients	1991/1992	7	944	2.2%[a]		
	1993/1994	13	173	7.9%	42.20	<.001
	Present study (1996)	3	339	10.6%		
STD patients	1991/1992	11	1356	4.6%		
	1993/1994	13	2627	8.9%	32.06	<.001
	Present study (1996)	2	33	21.2%		

[a] Data in 1991/1992 and 1993/1994 Sentinel Seroprevalence Report published in 1995 by the National AIDS/HIV/STD Control and Prevention Programme, Federal Ministry of Health and Social Services, Lagos, Nigeria.

that can be compared across these studies are pregnant women, CSWs, TB patients, and STD patients.

In CSWs tested in 1993/1994, HIV infection was 22.5% compared with our prevalence of 40.6% in 1996. The difference in HIV infection levels for TB patients between 1993/1994 and 1996 was also marked. One key difference, however, was the lower level of HIV found in pregnant women in this study compared with the national survey of 1993/1994.

The prevalence in this study was 1.7% (1996) versus 3.8% reported in 1993/1994. This difference was significant (χ^2, 69.6; $p < .00001$). The HIV prevalence level for pregnant women in our study approximates the level of 1.4% reported in 1990/1991.

It can also be seen that HIV prevalence in CSWs, TB patients, pregnant women, and STD patients obtained from the present study were 2 to 5 times higher than corresponding results obtained in 1991/1992. We have thus observed substantial proportions of increase in HIV infection in CSWs over 5 years based on these comparisons, taking into account the limitations of our data and those of the national sentinel surveys.

DISCUSSION

Between 1986 and 1989, the reported HIV prevalences were low, so that Nigeria was for a long time regarded as a low–HIV-prevalence country. Since then, different studies have shown a growing increase in HIV prevalence in the general population and in groups at risk of infection (4,5,9). These reports have all provided evidence for the presence of HIV-1, HIV-2, and dual HIV-1/2 infection in Nigeria, but with a predominance of HIV-1. Recently the presence of HIV-1 group O infection was also documented (11).

Our present study confirms that HIV-1 is the predominant type in Nigeria, accounting for 95.5% of all HIV infections. However, HIV-2, HIV-1/2, and HIV-1 group O infection coexist at a much lower rate with HIV-1.

Compared with previous studies, the difference in prevalence between HIV-1 and HIV-2 showed a much wider gap. Whereas Olaleye et al. (10) reported a ratio of 1/0.6 for HIV-1 to HIV-2, and Dada et al. (8) reported a ratio of 5/1 in CSWs, this study shows a ratio of 10/0.5, which supports data from Abimuku et al. (6), who more recently suggested that HIV-1 is the predominant HIV type in Nigeria. These Nigerian studies confirm observations from other West African countries showing that the rate of spread of HIV-2 is much slower than that of HIV-1.

We previously reported the presence of HIV-1 group O infection in the Cross River State. The identification of this viral type in Kano suggests that although low in frequency, HIV-1 group O may be geographically more widely dispersed.

The results from this study were compared, where possible, with the national surveillance studies. Although we are conscious of the limitations of our data and those of the national sentinel surveys, we believe that these results provide a useful basis for examining HIV trends over the last 5 years. With the exception of pregnant women, a significant increase in HIV infection was observed in all the groups. The HIV prevalence in pregnant women from our study (1.7%) is in contrast with the prevalence reported in the 1993/1994 sentinel survey (3.8%), but is similar to the level of 1.4% in 1990/1991. The reason for this difference is difficult to explain, especially inasmuch as our sample included some of the same sites used in sentinel surveys.

It is possible that the high cost now required for antenatal care, especially in Lagos, may have changed the social class of clinic users, ensuring that only women

who can afford the higher charges have access to the antenatal clinics.

Our study showed regional differences in relation to HIV prevalences. North-south differences were particularly noticeable for CSWs. The HIV prevalence in CSWs from Maiduguri (60.5%) was significantly higher than those observed in Lagos (30.5%) and Ikom (48.7%).

North-south differences were also observed for TB patients with rates of 16.2% in Maiduguri versus 8.7% and 8.3% in Lagos and Calabar respectively. In contrast, the HIV prevalences in blood donors were higher in the south (Lagos) than in the north (Kano). In Nigeria, blood donation is mainly a commercial venture, and blood donors are associated with behavior patterns likely to expose them to HIV infection (7,9). Different approaches for recruiting blood donors may explain the differences observed between the north and the south. The HIV prevalence rate, ranging from 2,0% to 7,7% for blood donors, points to the need for an effective transfusion policy. Even though testing facilities have been provided in many parts of the country, sustaining regular supply of good testing reagents and upgrading technical skills continue to pose a challenge.

Age and gender present important variables for understanding the spread of HIV in Nigeria. In our study, using TB patients (female and male), pregnant women, CSWs, and blood donors (all male), we observed gender differences in relation to HIV prevalence. The majority of HIV-positive women were between 21 and 30 years old, whereas infected men were >40 years old. The observed difference between infection levels in male and female populations provide evidence of a great risk of HIV infection of young female in Nigeria. This finding is similar to observations made in other parts of Africa (14–16).

It can be said that the HIV epidemic is rapidly spreading in all population groups in Nigeria, although the fastest growing rate continues to be seen in CSWs. HIV prevalence rates in CSWs in Nigeria are rapidly approaching the levels of 80% reported in CSWs in other major cities in Africa (17,18).

The epidemiologic significance of high infection rates in this population group in Nigeria is critical, because it portends a likehood for further rapid diffusion of HIV into the general population.

Our study provides evidence to suggest that a rural HIV epidemic may be emerging in parts of Nigeria. From a rural village, Gadar Tumburuwa in Kano, we obtained an HIV prevalence rate of 16%. Because about 65% of Nigeria's population live in rural areas, this finding gives cause for great concern. Given the dearth of health facilities, poor access roads to reach many areas in the education campaigns, and the resistance to condom use by many people, curtailing the spread of HIV in rural areas must become one of the major priorities of the national strategy to control HIV/AIDS. With a rising HIV prevalence, Nigeria is already witnessing an increase in the number of AIDS cases.

According to the National AIDS Control Programme, it is estimated that about 1% to 2% of hospital beds in urban areas are occupied by AIDS patients. The existence of AIDS orphans is now an emerging feature of the epidemic in Nigeria, although no reliable data show the extent of the problem. Linked to the rising level of HIV infection is a growing epidemic of tuberculosis in Nigeria. Ten percent (36 of 339) of tuberculosis patients are also infected with HIV.

The high degree of poverty now experienced in Nigeria as a result of the socioeconomic and political crisis and a high rate of population growth has created an environment that is conductive to the rapid spread of HIV.

Annually, <$5 U.S. per capita is spent on health and GNP per capita has fallen below $200 U.S.

Deteriorating standards of living and low employment opportunities are forcing many young unemployed women to migrate to cities in West Africa and Europe where they work as prostitutes (19).

The strategic commercial links between Nigeria and other West African cities, the nonrestrictive travel policies under the Economic Community of West African States (ECOWAS), facilitating free movements of people and materials in West Africa, made the entire subregion vulnerable to the HIV epidemic that will parallel the situation in Central and East Africa. National, regional, and global actions need to be directed towards arresting the escalating rise of HIV/AIDS in Africa's most populous country.

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REFERENCES

1. Quinn, T. Global burden of the HIV pandemic. *Lancet* 1996;348: 99–106.
2. United Nations Development Programme. *Human development report.* New York: United Nations, 1996.
3. The Joint United Nations Programme on HIV/AIDS. The status and trends of the global HIV/AIDS pandemic, final report, July 5–6, 1996. Geneva, Switzerland: United Nations, 1996.
4. Williams EE, Mohamed I, Chikwem JO, et al. HIV-1 and HIV-2 antibodies in Nigerian populations with high and low risk behaviour patterns. *AIDS* 1990;4:1041–2.
5. Harry TO, Ekenna O, Chikwem JO, et al. Seroepidemiology of human immunodeficiency virus infection in Borno State of Nigeria by sentinel surveillance. *J Acquir Immune Defic Syndr* 1993;6:99–103.
6. Abimuku AG, Zwandor A, Gomwalk N, et al. HIV-1, not HIV-2 is prevalent in Nigeria: need for consideration in vaccine plans. *Vaccine Res* 1994;3:101–3.
7. Okpara RA, Akinsete I, Williams E, et al. Antibodies to human immune deficiency virus (HTLV-III/LAV) in people from Lagos and Cross River states of Nigeria. *Acta Haematol* 1988;79:91–3.
8. Dada AJ, Oyewole F, Onofowokan R, et al. Demographic characteristics of retroviral infections (HIV-1, HIV-2 and HTLV-I) among female professional sex workers in Lagos, Nigeria. *J Acquir Immune Defic Syndr* 1993;6:1358–63.
9. Offor E, Okafor L, Osunde I. Changes in HIV seroprevalence among blood donors in Benin City, Nigeria. *AIDS* 1994;8:1352–4.
10. Olaleye OD, Bernstein L, Ekweozor, CC et al. Prevalence of human immunodeficiency virus type 1 and 2 infections in Nigeria. *J Infect Dis* 1993;163:710–14.
11. Mulanga-Kabeya C, Williams EE, Eni E, et al. Evidence for HIV-1 group O infection in Nigeria. *Lancet* 1995;346:308.
12. Peeters M, Gueye A, Mboup S, et al. Presence of HIV-1 group O infection in West Africa. *AIDS* 1996;10:343–4 .
13. Janssens W, Fransen K, Loussert-Ajaka I, et al. Diagnosis of HIV-1 group O infection by polymerase chain reaction. *Lancet* 1995;346:451–2.
14. Piot P, Laga M, Ryder R, et al. The global epidemiology of HIV infection: continuity, heterogeneity and change. *J Acquir Immune Defic Syndr* 1990;3 793–6.
15. Ryder RW, Ndilu M, Hassig SE, et al. Heterosexual transmission of HIV-1 among employees and their spouses at two large businesses in Zaire. *AIDS* 1990;4:725–32.
16. Gjomand G, Greenberg A, Sassan-Marokro M, et al. The epidemic of HIV/AIDS in Abidjan, Côte Ivoire; a review of data collected by projet RETRO-CI from 1987-1993. *J Acquir Immune Defic Syndr Hum Retrovirol* 1995;10:358–65.
17. Koffi K, Gershy-Damet G, Peeters M, Soro B, Rey JL, Delaporte E. Rapid spread of HIV infection in Côte d'Ivoire. *Eur J Clin Microbiol* 1992;11:271–3.
18. Kreiss J, Koech D, Plummer FA, et al. AIDS virus infection in Nairobi prostitutes: spread of the epidemic to east Africa. *N Engl J Med* 1986,314:414–18.
19. Decosas J, Kane F, Anarfi JK, et al. Migration and AIDS. *Lancet* 1995;346:826–8.

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