

Seroprevalence of HIV Infection in the General Population of the Côte d'Ivoire, West Africa

*†Soro N. Benoit, †‡Guy Michel Gershy-Damet, *Adama Coulibaly, ‡Konan Koffi, *Victor S. Sangare, *David Koffi, *Roger Houdier, *Roger Josseran, *Jerome Guelain, §Eba Aoussi, †§Koudou Odehouri, ‡Armand Ehouman, and *Nangbele Coulibaly

**Institut National de Santé Publique, Abidjan; †Programme National de Lutte Contre le SIDA; ‡Institut Pasteur de Côte d'Ivoire; and §Centre Hospitalier Universitaire d'Abidjan, Côte d'Ivoire, West Africa*

Summary: A seroepidemiological survey to determine the prevalence of human immunodeficiency virus (HIV) infection in the general population of the Ivory Coast was carried out in February 1989. Sera were collected from subjects between 15 and 65 years old in urban areas (not including Abidjan) and rural areas using the cluster sample technique. A total of 1,700 people were tested in urban areas, and 125 (7.3%) were HIV positive. This rate varied significantly with age and sex; a maximum rate of 16.3% was observed among men between 35 and 44 years old. In rural areas, a total of 3,199 people were tested, and 159 (4.9%) were positive for HIV; the highest rate (10.7%) was noted in the men aged 25-34 years. The high seroprevalence recorded in the general population in urban and rural areas is compatible with the incidences of acquired immune deficiency syndrome (AIDS) cases reported in hospitals all over the country. **Key Words:** Seroprevalence—HIV-1—HIV-2—General population—Ivory Coast.

The acquired immune deficiency syndrome (AIDS) problem in the Côte d'Ivoire has been assessed by examination of hospital records and data from surveys performed among risk groups (1,2). These data point out the existence of the epidemic, but they do not reflect the spread of the human immunodeficiency virus (HIV) in the general population. Since preventive measures are being planned, it is important to determine the prevalence of HIV infection in the general population in order to determine efficient prevention strategies.

Address correspondence and reprint requests to Dr. S. N. Benoit, Institut National de Santé Publique, BP V47 Abidorojan, Côte d'Ivoire, West Africa.

SUBJECTS AND METHODS

Study Population

The Côte d'Ivoire is a West African country of 322,500 square kilometers, with 11 million inhabitants, of whom 2 million live in Abidjan (the major city). Fifty-three percent of the population lives in urban areas, and 47% in rural areas. People under the age of 15 years represent 46% of the total population.

Subjects were selected by the cluster sampling technique, a method recommended by WHO for immunization coverage assessment (3). The strategy used is known as "probability proportionate to size" cluster sampling (4). A subset of geographical groups (clusters) is selected from the complete list of clusters by random numbers. The selection is

done in such a way that it is possible for a large cluster to be selected more than once. In our study, a cluster is a set of households chosen at random; in each cluster, specific households are also selected at random. All subjects between 15 and 65 years of age and living in the household for at least 3 months were examined. The door-to-door method was used to reach the predetermined size of the cluster.

Two kinds of samples were set up: one for urban areas (excluding Abidjan) and one for rural areas. *Urban areas* are defined as all 60 cities in the Côte d'Ivoire with more than 10,000 inhabitants. As the expected seroprevalence rate was 2%, with a 1% confidence interval, we estimated the size of the sample to be up to 1,568 subjects—i.e., 30 clusters of about 53 subjects. *Rural areas* are defined as all 8,400 villages in the Côte d'Ivoire with fewer than 10,000 inhabitants. The expected seroprevalence rate was 1%, with a 0.5% confidence interval; therefore, 3,168 subjects were examined—i.e., 30 clusters of 106 subjects each.

The survey was performed in February of 1989. From each individual, a 7–10-ml blood sample was taken, and age and sex were noted. Samples were collected anonymously, and subjects were not informed about the nature of the study or about their results.

Serology

The blood samples were centrifuged within 24 h, and different aliquots of serum were immediately stored in iceboxes until arrival at the laboratory. Each serum was tested for antibodies to HIV-1 and HIV-2 by the corresponding commercial enzyme-linked immunosorbent assay (ELISA) (Elavia-1 and Elavia-2, Diagnostics Pasteur, France). All the sera positive by ELISA ($OD \geq 0.3$) were retested by a corresponding Western blot test (HIV-1 Blot, Bio-Rad, Hercules, CA, U.S.A., and Lav Blot-2, Diagnostics Pasteur, France). The criteria for positivity were the presence of antibodies to at least two envelope proteins (gp160 or gp120 and gp 41 for HIV-1; gp140 or gp105 and gp36 for HIV-2) with or without the presence of antibodies to the core proteins (5). Sera with antibodies to envelope proteins of both viruses were retested with synthetic peptides (Peptilav 1 and 2, Diagnostics Pasteur, France). In this test, two peptides are used, one representing the HIV-1 transmembrane protein and the other representing the HIV-2 transmembrane protein. All sera that reacted with the envelope proteins of both

viruses on Western blot and on the Peptilav test were considered dually reactive.

Statistical Analysis

The Student *t* test was used to compare the differences observed among groups.

RESULTS

Figure 1 is a map of the Côte d'Ivoire and the clusters from our survey. Some parts of the country are less represented, but these areas are national parks or tropical rain forest. In Table 1, we show the overall HIV seroprevalence rates for the different age and sex groups and the type of virus infection in urban and rural areas.

Urban Areas

A total of 1,700 subjects between 15 and 65 years old were tested (44.6% female and 55.4% male subjects). Among them, 125 (7.35%) showed antibodies to HIV (68 male and 57 female subjects). Differ-

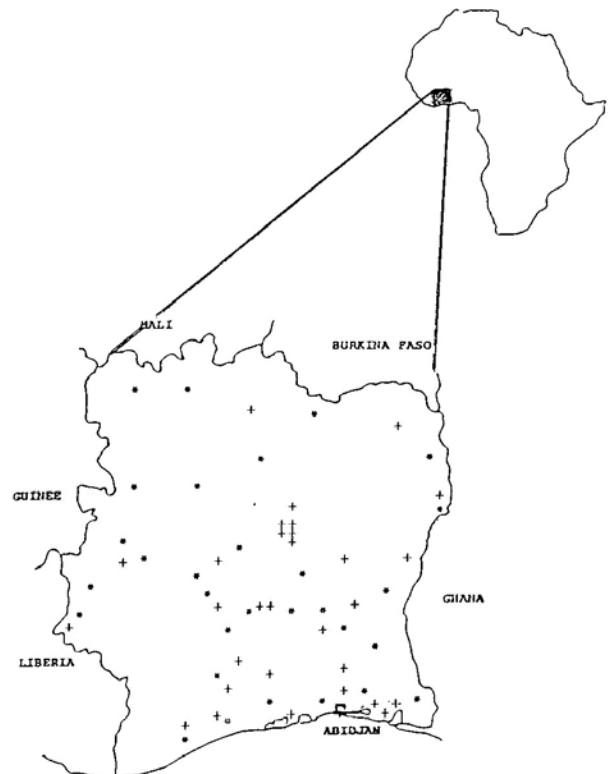


FIG. 1. Côte d'Ivoire map showing locations of clusters; *, rural areas; +, urban areas.

TABLE 1. Distribution of HIV-positive results by age, sex, type of virus, and areas

Age group (yr)	Number investigated	Urban areas								Rural areas									
		Positive								Positive									
		HIV-1		HIV-2		Dually reactive		Total		HIV-1		HIV-2		Dually reactive		Total			
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
15-24																			
Men	316	11	3.5	5	1.6	2	0.6	18	5.7	517	13	2.5	7	1.3	1	0.2	21	4	
Women	403	15	3.7	5	1.2	4	1	24	5.9	507	10	1.9	8	1.5	1	0.2	19	3.7	
25-34																			
Men	182	10	5.5	4	2.2	3	1.6	17	9.3	373	25	6.7	8	2.1	7	1.9	40	10.7	
Women	253	8	3.1	9	3.5	3	1.2	20	7.9	419	15	3.5	4	0.9	2	0.4	21	5	
35-44																			
Men	104	8	7.7	7	6.7	2	1.9	17	16.3	221	8	3.6	8	3.6	4	1.8	20	9	
Women	154	3	1.9	3	1.9	1	0.6	7	4.5	314	4	1.2	6	1.9	0	—	10	3.2	
45-54																			
Men	87	8	9.2	3	3.4	1	1.1	12	13.8	177	7	3.9	2	1.1	0	—	9	5.1	
Women	85	2	2.3	2	2.3	1	1.2	5	5.9	246	4	1.6	1	0.4	0	—	5	2	
55-65																			
Men	69	2	2.9	1	1.4	0	—	3	4.3	256	3	1.1	6	2.3	0	—	9	3.5	
Women	47	1	2.1	1	2.1	0	—	2	4.2	169	2	1.2	2	1.2	1	0.6	5	3	
Total																			
Men	758	39	5.1	20	2.6	8	1	67	9	1544	56	3.6	31	2	12	0.7	99	6.4	
Women	942	29	3.0	20	2.1	9	0.9	58	6	1655	35	2.1	21	1.2	4	0.2	60	3.6	
Total	1700	68	4	40	2.3	17	1	125	7.3	3199	91	2.8	52	1.6	16	0.5	159	4.9	

ences were observed between the different age and sex groups. The highest seroprevalence rate (16.3%) was observed in the group of 35-44-year-old men ($p < 0.001$), while only 4.5% of women of the same age group were positive for HIV. In the groups of subjects 15-24 and 25-34 years old, no significant differences were observed between male and female subjects. In urban areas, the seroprevalence rate for HIV-1 was 4.0%; for HIV-2, it was 2.3%; 1% were dually reactive.

Rural Areas

Of the total of 3,199 people tested (51.8% male and 48.2% female subjects), 159 individuals were positive for HIV antibodies, for an overall seroprevalence rate of 4.9%. Of the 159 HIV-positive individuals, 99 were male and 60 were female. In rural areas, the seroprevalence rate for HIV-1 was 2.8%; for HIV-2, it was 1.6%; 0.5% of the sera were dually reactive.

Overall HIV seroprevalence (all types considered) was higher in urban than in rural areas. The proportional distribution of reactivity to HIV-1, HIV-2, or both viruses was similar in both areas.

DISCUSSION

This study was done on a sample representative of the sexually active general population. The sam-

pling method was respected, and no refusal was observed. However, the overall ratio of adult men to women (aged 15 years and above) is lower in our sample (0.9) than in the general population because of the investigating hours: women were more likely to be at home than men.

High seroprevalence rates were observed all over, although HIV seroprevalence rates were significantly higher in urban than rural areas ($p < 0.001$). Without age stratification, the seroprevalence rate was higher among men in both areas. This difference did not exist among extreme ranges of age (lowest and highest), but it was maintained among people aged between 25 and 44 years. In this age group, the male:female sex ratio among HIV-positive individuals was 2.7 in urban areas and 2.1 in rural areas. The same trend in sex ratios was observed among AIDS patients admitted to hospitals (6).

The overall male:female ratio among subjects infected in the Côte d'Ivoire in both areas was higher than generally described in Africa (7,8). Also, the observed prevalence rates were higher than our estimated rates and higher than rates observed in previous studies among groups representative of the general population, such as blood donors (1).

The high seroprevalence rate corresponded to the high incidence of AIDS cases observed in the two major hospitals of the country (6). The distribution of the viruses shows that HIV-1 and HIV-2 are

present in all age and sex groups. HIV-1 is more frequent, being reported in more than 50% of the overall cases. No difference was observed in the distribution of the types of HIV infection between urban and rural areas.

This survey enables us to estimate that about 400,000 people aged between 15 and 65 years are infected with HIV in the Côte d'Ivoire. This estimation does not consider people younger than 15 years or babies born to HIV-infected mothers.

In conclusion, this study shows the importance and the widespread nature of infection by HIV in the Côte d'Ivoire as compared with other West African countries (9). We must expect a rapid development of the AIDS epidemic in this previously low-risk area of Africa, considering the migratory movement into and out of the Côte d'Ivoire by people from neighboring countries. In order to best control this epidemic, it is necessary to identify strong preventive actions that will reach all members of the population.

Acknowledgment: We are grateful to the Minister of Public Health and Population for permission to perform this survey. We also express our gratitude to the Ministry of Scientific Research; their effective cooperation has helped us conduct our survey. We are also grateful to the political and official authorities of the study areas, and

thanks to M. Peeters and J. Silué for their assistance. This study was supported by WHO/GPA and UNICEF, Côte d'Ivoire.

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