HIV-2 in West Africa. Epidemiological studies
Schim van der Loeff, M.F.

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Incidence of HIV-2 in a rural community in Guinea-Bissau, West Africa

Submitted

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Incidence of HIV-2 in a rural community in Guinea-Bissau, West Africa

ABSTRACT

Background: HIV-2 is thought to be transmitted by the same routes as HIV-1, but there are few studies examining the incidence of HIV-2 in the community.

Methods: Sero-surveys of HIV infection were conducted in 1989-92 and in 1996-8 in the same rural population of Guinea-Bissau, West Africa. We estimated the incidence rate of HIV-2 infection and examined risk factors for incident infection.

Results: The prevalence among 3109 adults in 1996-8 was 2.7% for HIV-1 and 7.9% for HIV-2. Of 2257 adult subjects who were not infected with HIV-2 in the first survey and still resident in the area during the second survey, 1522 (67%) provided a second blood sample. Fifty-one incident HIV-2 infections were identified, 13 in men and 38 in women. The overall incidence rate (IR) of HIV-2 was 4.8 per 1000 person-years (95% confidence interval (CI) 3.7-6.4). The IR among men was 3.8 (95%CI 2.2-6.5) and among women 5.3 (95%CI 3.9-7.3). The IR was significantly higher in men younger than 30 years (P=0.02); in women there was no variation by age.

Conclusions: There is continuing heterosexual transmission of HIV-2 in this rural area of West Africa, where new infections occur in women of all ages and in young men.
Introduction

HIV-2 can be transmitted by the same routes as HIV-1, but transmission rates are lower [1,2]. This has been attributed to the generally lower plasma viral load (PVL) [3-5]. Cross-sectional studies have shown that risk factors for HIV-2 infection are similar to risk factors for HIV-1 infection, among them history of sexually transmitted diseases (STDs), serological evidence of genital ulcer disease, having had sex with a commercial sex worker (CSW), high number of lifetime sexual partners, blood transfusion, and lack of circumcision in men [6-16]. The only consistent difference is that HIV-2 is more common in older adults [7,17]. Studies of seroprevalent cases may be biased, as participants who die more rapidly from the infection will be under-represented.

Incidence rates of HIV-1 have been estimated in several prospective community-based or occupational cohort studies in sub-Saharan Africa, and range between 5 and 15 per 1000 person-years of observation (pyo) [18-23]. Six cohort studies have reported incidence rates of HIV-2, all from West Africa: two studies among CSW’s [1,24], one occupational cohort [21,25,26], one cohort of women recruited at an antenatal clinic (ANC) [27], and two community-based studies [14,28-31]. The largest study had 46 sero-incident cases [1]; the smallest zero [24,27]. The incidence rate (IR) was 0 and 1.1 per 1000 pyo in the CSW cohorts, and varied between 0 and 8.3 per 1000 pyo in the other cohorts.

Three of the studies with sero-incident data have reported on risk factors. In a community-based study from Bissau, Guinea-Bissau, a history of a sexually transmitted disease (STD) and higher age were risk factors among women [14,28,29]. In a cohort of police officers from Guinea-Bissau, a positive Treponema pallidum haemagglutination assay (TPHA) and history of genital ulcer disease (GUD) were associated with HIV-2 incidence, though not-significantly so (P=0.06 and P=0.08 respectively) [25]. In a cohort of CSW’s in Dakar, Senegal, sex workers from other countries than Senegal and Ghana were more likely to acquire HIV-2 than Senegalese women (P < 0.05) [1].
The objectives of this study are to estimate the incidence rate of HIV-2, and to examine risk factors for incident HIV-2 infection in a high-prevalence community in a rural area in West Africa.

**Methods**

**Subjects**
The study was conducted in a rural area in North-western Guinea-Bissau. The methods have been described in detail elsewhere [32]. In brief, in 1989-1992 a first survey among the adult population was conducted, consisting of a short questionnaire and HIV serology [17,33]. During the second survey in 1996-1998 [32], a questionnaire was administered to all participants and a blood sample obtained. Questions were asked regarding a range of possible risk factors for STDs, including HIV. The blood sample was tested for syphilis and HIV serology, haemoglobin, and malaria parasites. Samples with dual sero-reactivity (positive for both HIV-1 and HIV-2) were subjected to further testing by a line-immuno assay and polymerase chain reaction (PCR). Diagnosis of dual infection with both HIV-1 and HIV-2 (HIV-D) was based on PCR in 16 of the 17 cases; one sample was insufficient and the diagnosis was based on a convincing serological pattern. Active syphilis was defined as positive reactions of any titre by both TPHA (Microsyp TP, Porton Cambridge, Newmarket, UK) and the Rapid Plasma Reagin test (Becton Dickinson, Cockeysville, Maryland, USA).

**Treatment & feedback**
Subjects with health problems were referred by the field worker to the project physician for examination and treatment the same day. Field workers re-visited all homes to provide the results of malaria, haemoglobin, and syphilis tests, and provide treatment if indicated. Anti-retroviral therapy was not available. The study was approved by the Gambia Government / MRC Joint Ethics Committee, and by the Science Committee of the Ministry of Health in Guinea-Bissau. All subjects gave verbal informed consent for
their participation. Participants could obtain their HIV test result from the study counsellor, in accordance with Guinea-Bissau HIV policy.

**Statistical methods**

An analysis of risk factors for incident HIV-1 infection has been published separately [32]. The observation time per subject was calculated as the time between the first and the last blood sample. HIV infections were assumed to have occurred midway between the dates of the last seronegative and the first seropositive sample. Incidence rates were calculated as the number of HIV-2 infections per 1000 pyo. Poisson regression was used to assess independent significant risk factors for HIV-2 incidence. All analyses were done separately for men and women. Age at entry was used throughout the analysis, except in the estimation of the age of infection. Age group was kept *a priori* in the models.

**Results**

**Prevalence**

In 1996-8, 3109 subjects provided a blood sample: 49 (1.6%) were singly HIV-1 positive, 211 (6.8%) singly HIV-2 positive, and 36 (1.2%) HIV-D. Considering HIV-D as both HIV-1 and HIV-2 infected, the overall HIV-1 prevalence was 2.7%, and the overall HIV-2 prevalence 7.9%. The overall prevalence of HIV-2 had not changed significantly compared to 1989-91 (from 8.3% to 7.9%; $P = 0.62$, $\chi^2$ test), nor had the gender-specific prevalences changed significantly (from 9.3% to 9.0% for women [$P = 0.81$], and from 6.6% to 6.3% for men [$P = 0.77$], $\chi^2$ test). The prevalence of HIV-1 had increased significantly since the first survey, from 0.5% to 2.7% ($P < 10^{-7}$).

**Subjects with blood samples in two surveys**

In the first survey, conducted between 1989 and 1992, 3064 subjects provided a blood sample, but 36 of whom no further details were available and 83 who were younger than 15 years were excluded from the analysis. Of the 2945 adult subjects, 230 had HIV-2
and 10 HIV-D, and were no longer at risk of HIV-2 infection. Of the remaining 2705 at risk of HIV-2 infection, 284 died and 164 moved permanently from the village. Of the 2257 still resident in the village 1522 (67%) provided a valid blood sample in 1996-8. The reasons a second blood sample was not provided were: travelled but expected back (n = 325), not at home when visited (n = 276), refusal (n = 131), and insufficient sample (n = 3). Those with a second sample were more often female than those with only a baseline sample (P < 0.0005, $\chi^2$ test), but there were no significant differences in median age, in proportion CSW's among women, or in proportion living in the central area (data not shown).

Incidence rate of HIV-2

Fifty-one incident HIV-2 cases were identified: 34 HIV-2 single and 17 HIV-D infections. The overall incidence rate was 4.8 per 1000 pyo (95% CI 3.7-6.4), the IR among men being 3.8 (95% CI 2.2-6.5) and among women 5.3 (95% CI 3.9-7.3; $\chi^2$ test, d.f. = 1, P = 0.28). The median age at infection was 31 years among men, and 34 years among women (P = 0.31; ranksum test). All subjects with incident HIV-2 infections had had sexual intercourse. Only one incident infection occurred among the 21 subjects who had had a blood transfusion since 1989.

Risk factors in women

Table 1 shows the incidence rates stratified by risk factors for women. The incidence rate did not vary by age. Various risk factors reflecting mobility, multiple sex partners, and (history of) STDs were significantly associated with HIV-2 incidence. In a multivariable model for incident HIV-2 infection in women the following remained independent significant risk factors after adjusting for age group (see Table 1): having ever been divorced, having had injections in the last 12 months, having ever had foul-smelling vaginal discharge, having drunk alcohol on day of interview, having lived in Bafata or Gabu (two towns up-country) for longer than one month, and having active syphilis. Having 3 or more living children was protective. History of sex work, blood transfusions or genital ulcers were not significant in the multivariate model.
<table>
<thead>
<tr>
<th>Age group</th>
<th>N</th>
<th>HIV-2 incident cases</th>
<th>Person years of observation</th>
<th>Incidence rate per 1000 pyo (95% CI)</th>
<th>Crude Incidence rate ratio (95% CI)</th>
<th>P value</th>
<th>Adjusted Incidence rate ratio (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1021</td>
<td>38</td>
<td>7115</td>
<td>5.3 [3.9 – 7.3]</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-29 years</td>
<td>495</td>
<td>18</td>
<td>2935</td>
<td>6.1 [3.9-9.7]</td>
<td>1</td>
<td>1</td>
<td>1.4 [0.6-3.3]</td>
<td>0.5</td>
</tr>
<tr>
<td>30-49 years</td>
<td>292</td>
<td>12</td>
<td>2033</td>
<td>5.9 [3.4-10.4]</td>
<td>1.0 [0.5-2.0]</td>
<td>0.45</td>
<td>1.0 [0.3-3.1]</td>
<td>0.96</td>
</tr>
<tr>
<td>=&gt;50 years</td>
<td>304</td>
<td>8</td>
<td>2147</td>
<td>3.7 [1.9-7.5]</td>
<td>0.6 [0.3-1.4]</td>
<td>--</td>
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</tr>
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<table>
<thead>
<tr>
<th>Schooling</th>
<th>N</th>
<th>HIV-2 incident cases</th>
<th>Person years of observation</th>
<th>Incidence rate per 1000 pyo (95% CI)</th>
<th>Crude Incidence rate ratio (95% CI)</th>
<th>P value</th>
<th>Adjusted Incidence rate ratio (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal schooling</td>
<td>756</td>
<td>24</td>
<td>5307</td>
<td>4.5 [3.0-6.7]</td>
<td>1</td>
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<tr>
<td>Any formal schooling</td>
<td>228</td>
<td>13</td>
<td>1542</td>
<td>8.4 [4.9-14.5]</td>
<td>1.9 [1.0-3.7]</td>
<td>0.07</td>
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<table>
<thead>
<tr>
<th>Commercial sex work</th>
<th>N</th>
<th>HIV-2 incident cases</th>
<th>Person years of observation</th>
<th>Incidence rate per 1000 pyo (95% CI)</th>
<th>Crude Incidence rate ratio (95% CI)</th>
<th>P value</th>
<th>Adjusted Incidence rate ratio (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>992</td>
<td>34</td>
<td>6927</td>
<td>4.9 [3.5-6.9]</td>
<td>1</td>
<td>--</td>
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<tr>
<td>Yes</td>
<td>29</td>
<td>4</td>
<td>188</td>
<td>21.3 [8.0-56.8]</td>
<td>4.3 [1.5-12.2]</td>
<td>0.002</td>
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<table>
<thead>
<tr>
<th>Area</th>
<th>N</th>
<th>HIV-2 incident cases</th>
<th>Person years of observation</th>
<th>Incidence rate per 1000 pyo (95% CI)</th>
<th>Crude Incidence rate ratio (95% CI)</th>
<th>P value</th>
<th>Adjusted Incidence rate ratio (95% CI)</th>
<th>P value</th>
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<tbody>
<tr>
<td>Periphery</td>
<td>342</td>
<td>5</td>
<td>2391</td>
<td>2.1 [0.9-5.0]</td>
<td>1</td>
<td>--</td>
<td></td>
<td></td>
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<tr>
<td>Central</td>
<td>679</td>
<td>33</td>
<td>4723</td>
<td>7.0 [5.0-9.8]</td>
<td>3.3 [1.3-8.6]</td>
<td>0.008</td>
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<table>
<thead>
<tr>
<th>Marital status</th>
<th>N</th>
<th>HIV-2 incident cases</th>
<th>Person years of observation</th>
<th>Incidence rate per 1000 pyo (95% CI)</th>
<th>Crude Incidence rate ratio (95% CI)</th>
<th>P value</th>
<th>Adjusted Incidence rate ratio (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>married</td>
<td>782</td>
<td>25</td>
<td>5464</td>
<td>4.6 [3.1-6.8]</td>
<td>1</td>
<td>--</td>
<td></td>
<td></td>
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<tr>
<td>single</td>
<td>43</td>
<td>5</td>
<td>255</td>
<td>19.6 [8.2-47.1]</td>
<td>4.3 [1.6-11.2]</td>
<td>--</td>
<td></td>
<td></td>
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<tr>
<td>widowed</td>
<td>174</td>
<td>6</td>
<td>1244</td>
<td>4.8 [2.2-10.7]</td>
<td>1.1 [0.4-2.6]</td>
<td>--</td>
<td></td>
<td></td>
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<tr>
<td>divorced</td>
<td>22</td>
<td>2</td>
<td>152</td>
<td>13.2 [3.3-52.7]</td>
<td>2.9 [0.7-12.2]</td>
<td>0.054</td>
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</tr>
</tbody>
</table>

IRR = Incidence rate ratio; 95% CI = 95% Confidence interval; HIV-D = HIV-1 and HIV-2 dual infection; pyo: person-years of observation; a. age at time of first survey (1989-1992). b. The IRR's shown are adjusted for all other factors in the model; c. These P values are based on likelihood ratio tests.
Table 1. (continued) HIV-2 incidence rates and crude and adjusted rate ratios among 1021 women in north-western Guinea-Bissau 1989-98

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>HIV-2 incident cases</th>
<th>Person years of observation</th>
<th>Incidence rate per 1000 pyo (95% CI)</th>
<th>Crude Incidence rate ratio (95% CI)</th>
<th>P value</th>
<th>Adjusted Incidence rate ratio b (95% CI)</th>
<th>P value c</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ever been divorced</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>899</td>
<td>26</td>
<td>6274</td>
<td>4.1 [2.8-6.1]</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>122</td>
<td>12</td>
<td>841</td>
<td>14.3 [8.1-25.1]</td>
<td>3.4 [1.7-6.8]</td>
<td>&lt;0.0005</td>
<td>2.3 [1.1-5.1]</td>
<td>0.03</td>
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<tr>
<td><strong>Number of living children</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>59</td>
<td>3</td>
<td>395</td>
<td>7.6 [2.5-23.6]</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 or 2</td>
<td>308</td>
<td>17</td>
<td>2107</td>
<td>8.1 [5.0-12.9]</td>
<td>1.1 [0.3-3.6]</td>
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<td>1.2 [0.3-4.2]</td>
<td>0.78</td>
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<tr>
<td>3 or more</td>
<td>654</td>
<td>18</td>
<td>4612</td>
<td>3.9 [2.5-6.2]</td>
<td>0.5 [0.2-1.7]</td>
<td>0.09</td>
<td>0.4 [0.1-1.5]</td>
<td>0.19</td>
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<tr>
<td><strong>Active syphilis</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>927</td>
<td>30</td>
<td>6469</td>
<td>4.6 [3.2-6.6]</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>92</td>
<td>8</td>
<td>632</td>
<td>12.7 [6.3-25.3]</td>
<td>2.7 [1.3-6.0]</td>
<td>0.008</td>
<td>3.7 [1.5-9.3]</td>
<td>0.004</td>
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<tr>
<td><strong>Ever foul-smelling vaginal discharge</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>882</td>
<td>26</td>
<td>6174</td>
<td>4.2 [2.9-6.2]</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>137</td>
<td>12</td>
<td>925</td>
<td>13.0 [7.4-22.8]</td>
<td>3.1 [1.6-6.1]</td>
<td>0.001</td>
<td>2.8 [1.3-6.0]</td>
<td>0.01</td>
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<tr>
<td><strong>Ever had a genital ulcer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>881</td>
<td>29</td>
<td>6176</td>
<td>4.7 [3.3-6.8]</td>
<td>1</td>
<td></td>
<td>--</td>
<td></td>
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<tr>
<td>Yes</td>
<td>140</td>
<td>9</td>
<td>939</td>
<td>9.6 [5.0-18.4]</td>
<td>2.0 [1.0-4.3]</td>
<td>0.056</td>
<td>--</td>
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<tr>
<td><strong>Having drunk alcohol on day of interview</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>713</td>
<td>21</td>
<td>4993</td>
<td>4.2 [2.7-6.5]</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>224</td>
<td>13</td>
<td>1550</td>
<td>8.4 [4.9-14.4]</td>
<td>2.0 [1.0-4.0]</td>
<td>0.046</td>
<td>2.6 [1.3-5.3]</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Table continues overleaf
Table 1. (continued) HIV-2 incidence rates and crude and adjusted rate ratios among 1021 women in north-western Guinea-Bissau 1989-98

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>HIV-2 incident cases</th>
<th>Person years of observation</th>
<th>Incidence rate per 1000 pyo (95% CI)</th>
<th>Crude Incidence rate ratio (95% CI)</th>
<th>P value</th>
<th>Adjusted Incidence rate ratio (^b) (95% CI)</th>
<th>P value (^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at first sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(\geq 19) years</td>
<td>572</td>
<td>17</td>
<td>3885</td>
<td>4.4 [2.7-7.0]</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\leq 18) years</td>
<td>448</td>
<td>21</td>
<td>3085</td>
<td>6.8 [4.4-10.4]</td>
<td>1.6 [0.8-2.9]</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>No of partners in last 12 months</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>none</td>
<td>418</td>
<td>14</td>
<td>2957</td>
<td>4.7 [2.8-8.0]</td>
<td>1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>one</td>
<td>583</td>
<td>21</td>
<td>4024</td>
<td>5.2 [3.4-8.0]</td>
<td>1.1 [0.6-2.2]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>two or more</td>
<td>18</td>
<td>3</td>
<td>120</td>
<td>24.9 [8.0-77.3]</td>
<td>5.3 [1.5-18.3]</td>
<td>0.09</td>
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<tr>
<td><strong>History of blood transfusion since 1989</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>No</td>
<td>1002</td>
<td>37</td>
<td>6988</td>
<td>5.3 [3.8-7.3]</td>
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<td>7.9 [1.1-56.0]</td>
<td>1.5 [0.2-10.9]</td>
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<td><strong>History of injections in last 12 months</strong></td>
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<td>&lt;0.0005</td>
<td>3.4 [1.6-7.3]</td>
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<td><strong>Ever lived (&gt;1) month in Bafata or Gabu</strong></td>
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<td>3.6 [1.3-10.1]</td>
<td>0.01</td>
<td>3.7 [1.2-11.0]</td>
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</table>
HIV-2 in West Africa

Risk factors in men
There were 13 incident HIV-2 infections among 501 men. The median age at enrolment of the 13 male seroconverters was 27 years (IQR 21-30). Age less than 30 years ($p = 0.02$), serological evidence of active syphilis ($p = 0.01$), and history of injections outside clinics ($p < 0.0005$) were significantly associated with incident HIV-2 infection; in a Poisson multivariable model these three factors remained independently associated. Sex with a CSW, circumcision, and history of STD's were not associated with HIV-2 infection.

Discussion

The incidence rate of HIV-2 in this rural West African area was 4.8 per 1000 pyo. This is similar to the rates found in previous cohort studies in Guinea-Bissau [21,29]. In the same period the HIV-1 incidence was 4.4 per 1000 pyo in the study area [32], although the prevalence of HIV-1 is much lower (2.7%, versus 7.9% for HIV-2). Significant risk factors for HIV-2 infection were travel, history of vaginal discharge, co-infection with syphilis, history of divorce, history of recent injections, drinking alcohol on the day of the interview in women; and young age, history of injections outside clinics, and syphilis in men.

A second blood sample was not available from 33% of the subjects enrolled in the first survey. This was mainly due to the mobility of the population. More men were lost than women ($P < 0.0005$). As incidence was associated with travel (in women at least), the estimated incidence rates may be underestimates.

The median period between the first sample and the second was very long (7.2 years [interquartile range (IQR) 6.7 – 7.7]), and therefore the seroconversion dates could not be estimated with precision. For the calculation of HIV-2 incidence we assumed a mid-point seroconversion date. Although this is imprecise on an individual level, this will have had little effect on the estimation of the incidence rate.
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Because a history of infections in the last 12 months could be a consequence of HIV-2 infection (seeking health care for HIV-2 induced illness) rather than a cause of then infection, we repeated the multi-variable analysis leaving out injections in the last 12 months from the model. The same variables as mentioned above remained in the final model, and the size of the rate ratios was not materially different (data not shown). As it is unknown which came first, HIV-2 infection or injections, no conclusions about causality can be drawn.

Blood transfusions after 1989 were not a risk factor for HIV-2 in this population. In view of the significant risk factors, many directly or indirectly related to sexual activity, it appears that transmission of HIV-2 in this population is predominantly sexual. This is in agreement with earlier studies on HIV-2 and similar to what is known about HIV-1 in sub-Saharan Africa. Surprisingly, commercial sex work was not a risk factor for HIV-2. The majority of known CSWs in the area were already infected with HIV-2 in 1989-92, and were no longer at risk for incident HIV-2. This study included only 29 CSW's, and the power to confirm sex work as a risk factor was therefore small.

In this same population significant risk factors for incident HIV-1 infection were history of commercial sex work, preceding HIV-2 infection, and age 30 years or higher in men [32]. As the epidemics of HIV-2 (established and stable) and HIV-1 (emergent) are in a different phase in this area, it is hard to draw firm conclusions about these different patterns of risk factors.

Among men active syphilis was a strong independent risk factor. Ten out of 13 incident infections occurred in men who were younger than 30 years at enrolment, and young age was a strong independent risk factor. It may be the case that young men (often unmarried) more frequently have sexual contacts with CSWs, putting them at higher risk for HIV-2. Sex with sex workers was not an independent risk factor, but that may have been under-reported. The power to detect significant risk factors in men was limited due to small numbers.

In most societies incidence of sexually transmitted infections (including HIV-1) is highest among young adults (15-30 years of age). This is also the case for HIV-2 in men in this rural
population, and this observation supports the hypothesis that the high prevalence of HIV-2 found in older men in the area [17] may be due to a cohort effect. Among women no effect of age on incidence was found, and the high prevalence among older women may be due to new infections, or to a cohort effect or both. It is striking that the incidence of HIV-2 did not decline with age in women. Assuming a decreasing sexual activity with age, this lends support to the hypothesis of an increased susceptibility to retroviral infections in older women [33, 34].

The adult prevalence of HIV-2 in the study area was stable at around 8.0% during a 7-year period. Most other studies in West Africa have found a stable prevalence [35,36], although two Guinea-Bissauan studies have found a declining prevalence [21,29]. In the same period the HIV-1 prevalence increased sharply from 0.5% to 2.7%. HIV-1 may soon overtake HIV-2 as the predominant retrovirus in Guinea-Bissau, as has happened in The Gambia [36].

In conclusion, HIV-2 transmission is ongoing in rural Guinea-Bissau at an incidence rate of around 5 per 1000 pyo. Risk factors indicate that transmission is now mostly sexual.

Acknowledgements

We are grateful to the population of Caio for participating in the studies over the years. We thank Dr Andrew Wilkins, Dr Dominic Ricard, and Margaret Buckner for the initial work on which this study is built; Dr Abraham Alabi, Alhajie Bayang, Dr Tom Blanchard, Dr Assan Jaye, Pa Tamba N’gom, Mamady Njie, Bakary Sanneh and Ramu Sarge-Njie, for the lab work; the team of Caio field assistants for the field work; Chad Anderson, Margaret Buckner, Stephanie Constantine, Bryan Savage, Glyn Taylor and Lucy Pembrey, for supervising the field work; Dr. Mame Barbosa (Ministério de Saúde Pública, Bissau) for her support; Dr Robin Bailey, Prof. Roel Coutinho, Prof. Richard Hayes and Dr Emmanuel Lagarde for advice; and Peter Langfield and M’bemba Ceexay for transport.
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References


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