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Levels and determinants of breast and cervical cancer screening uptake in HIV-infected women compared to the general population in France

Running head: Cancer screening in HIV-infected women

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Abstract

**Objectives:** Cancer is a growing concern for HIV-infected people and screening plays a major role in alleviating the burden it causes. We sought to investigate the levels and determinants of breast cancer screening (BCS) and cervical cancer screening (CCS) in HIV-infected women as compared to the general population.

**Methods:** The ANRS-Vespa2 study was conducted in 2011 among a national representative sample of 3,022 HIV-infected hospital outpatients in France. The rates and correlates of BCS and CCS among HIV-infected women were compared to those in the general population using multivariate Poisson regression models.

**Results:** The BCS rate during the two years preceding the survey interview was 80.7% among HIV-infected women vs. 89.1% in the general population (p=0.146). The CCS rate during the three preceding years was 88.1% among HIV-infected women vs. 83.1% in the general population (p=0.021). During the preceding year, the CCS rate among HIV-infected women was 76.5%. The barriers to BCS and CCS were a low educational level (BCS: adjusted prevalence rate ratio: 0.88, 95% confidence interval: [0.80-0.97]; CCS: 0.91 [0.83-0.99]), not having supplementary health insurance (CCS: 0.92 [0.86-0.98]), an irregular gynaecological follow-up (BCS: 0.77 [0.64-0.92]; CCS: 0.72 [0.64-0.81]) and a low CD4 count (BCS: 0.83 [0.71-0.97]; CCS: 0.78 [0.63-0.98]). The disparities in CCS uptake in terms of age, employment and gynaecological follow-up were less pronounced among HIV-infected women than in the general population.

**Conclusions:** BCS and CCS uptake was not lower among HIV-infected women than in the general population, but CCS was suboptimal. Specificities in the profile of barriers to screening emerged.

**Keywords:** HIV infection, screening, cervical cancer, breast cancer, France
Introduction

In recent years, cancer has consistently been described as a growing burden among people living with HIV (PLWHIV) in Western countries (1-6). In 2010, it accounted for one-third of all deaths among HIV-infected people in France (7). Cancer control strategies for limiting this burden in the future are based on prevention and especially on screening (secondary prevention) (8). In particular, breast cancer screening (BCS) and cervical cancer screening (CCS) are widely used to alleviate the burden of two of the major gynaecological cancers.

Breast cancer is one of the most prevalent non-AIDS-related malignancies (1, 4). Although the change in its incidence over time among PLWHIV is unclear (2, 6, 9), breast cancer is becoming a matter of concern in this population, which is now ageing and experiencing more and more age-related conditions, such as cancer (3-5, 9, 10). Cervical cancer is one of the most common AIDS-defining cancers (4, 5). It occurs more often among HIV-infected than HIV-uninfected women (2, 6, 11-19) and appears to be diagnosed at a later stage, more aggressive and less responsive to treatment (15, 17-20) than in the general population.

Previous research showed high variability in BCS (24-67% (21-26)) and CCS (25-83% (20, 23-38)) rates among HIV-infected women, which could have been partly due to over/underestimations caused by differences in the study populations (urban (31), low income (33), mostly African-Americans (27, 34) or smokers (35)), in data collection (self-reported (20, 22, 27-33), measured (23-26, 34-37) or repeated (34, 38)) and in the definitions (screening during the study period (22, 23, 28) or being up-to-date for screening measured with different cut-offs (21, 23-27, 29-35, 37)). Studies generally report lower (21, 24, 36, 37) or similar (29, 30) levels of BCS and CCS in HIV-infected women compared to the general population. Nevertheless, although the marked differences in demographic characteristics between HIV-infected women and those in the
general population are likely to influence the level of screening, these characteristics were not taken into account in most of those previous studies. The barriers to cancer screening uptake in HIV-infected women reported in previous studies (20-23, 28-31, 34-39) were a younger or older age, unfavourable socioeconomic conditions, not having any healthcare coverage, an insufficient medical follow-up, negative health behaviours, a high viral load and a low CD4 count. Since HIV-infected women live with a chronic disease and receive specific care, it can be assumed that the factors associated with cancer screening might differ from those observed in the general population. However, to our knowledge no study has formally compared the determinants of cancer screening uptake between PLWHIV and the general population.

We sought to evaluate the levels and determinants of BCS and CCS among HIV-infected women and to specifically compare them to those in the general population, using a large national representative survey among PLWHIV in France.
Methods

Sources of data

Data on HIV-infected individuals were obtained from the ANRS-Vespa2 study, a national representative, cross-sectional survey aimed primarily at assessing the various aspects of the socioeconomic conditions and health status of PLWHIV in France (40, 41). The study was conducted between April 2011 and January 2012 in 73 hospital outpatient departments randomly selected from among all the hospital settings that deliver HIV care in metropolitan France. All outpatients aged 18 or older with a diagnosis of HIV infection of at least six months duration and who were either French citizens or immigrants who had been living in France for at least six months were eligible. In each participating department, a sample of eligible patients randomly selected according to the order of their appointment were invited to participate by their physician. The 3,022 participants included in the ANRS-Vespa2 study signed an informed consent form and answered a standardised questionnaire, administered face-to-face by a trained interviewer, containing detailed questions about their socioeconomic status, living conditions, health behaviours and healthcare use (including cancer screening). Clinical and laboratory data were collected from their medical records. Individual weights were computed to account for unequal probabilities of sampling and for characteristics associated with nonparticipation. The study was approved by the French National Commission for Data Protection and Liberties (CNIL).

The data on the general population were obtained from the Baromètre Cancer 2010 survey on knowledge, attitudes, practices and beliefs regarding cancer, which was conducted in 2010 by the French Institute for Health Promotion and Health Education (INPES) and the National
Cancer Institute (INCa). The data were obtained by telephone interviews among a national representative sample of 3,727 noninstitutionalised individuals aged 15-85 years (42).

Data collection

Cancer screening uptake was assessed through the same standardised questions in both surveys. The participants were asked whether they had ever had a mammogram or a Pap test and when they had last had it. They could respond by giving the number of years since the last test or the calendar year in which they had had it. In all the women aged 50-75 years a mammogram is advised every two years (8). Therefore, we considered that women aged 50-75 years in both surveys were up-to-date with BCS if they reported having had a mammogram within the two years/calendar years preceding the interview. In women in the general population aged 25-65 years a Pap test every three years is advised, while in the HIV-women an annual Pap test is recommended (or a Pap test twice a year for women with a CD4 count <200 cells/mm$^3$) (8). We therefore considered that women aged 25-65 years in both surveys were up-to-date with CCS according to the general population guidelines if they reported having had a Pap test within the three years/calendar years preceding the interview and that HIV-infected women in the ANRS-Vespa2 survey were up-to-date with CCS according to the HIV-specific guidelines if they reported having had a Pap test in the preceding year/calendar year.

Other indicators of interest known to be associated with the level of cancer screening were available in both surveys. Sociodemographic characteristics were collected, including age and household composition (cohabiting couple, living with children <14 years of age). Additionally, nationality and country of birth were collected in the HIV-infected sample. HIV-infected women were classified into three mutually exclusive socio-epidemiological groups: former or active intravenous drug users (IDU), non-IDU migrants originating from sub-Saharan Africa (SSA migrants)
and non-IDU non-African women. The socioeconomic characteristics were educational level (low (no diploma or primary school), intermediate (≤ high school) or high (> high school)), employment status (employed, unemployed, retired, other inactive/people with a disability) and income (defined as the monthly income per consumption unit and dichotomized according to the median in the general population as low (<1466€) or high (≥1466€)). The data on healthcare coverage included the type of coverage (standard health insurance, health insurance for the disadvantaged (CMU, ‘couverture maladie universelle’) or health insurance for undocumented foreigners (AME, ‘aide médicale de l’Etat’)) and access to supplementary health insurance. Healthcare use was measured by the frequency of visits to a general practitioner (GP) (at least one visit in the past year) and to a gynaecologist (at least one visit in the past two years in the general population and annual visits in the HIV-infected population). The indicators concerning health behaviours included the body mass index (BMI), tobacco smoking (current vs. non-smokers, including past smokers) and alcohol consumption (none, moderate or risky, assessed through the AUDIT-C scale (43)). In the HIV-infected sample, the available information on HIV characteristics included the time since HIV diagnosis (<8 years, 8-16 years, ≥16 years), the CD4 cell count at the last check-up (<200, 200-350, 350-500 or >500 cells/mm³) and virological control (defined as being treated with ART with an undetectable viral load) at the time of the interview.

Statistical analyses

Analyses of BCS were conducted among the women aged 50-75 years who did not report a personal history of breast malignancy. Analyses of CCS were performed among the women aged 25-65 years, excluding those who had undergone a hysterectomy or who reported a personal history of cervical cancer. In all the analyses, women were included if they had complete data. Missing values were rare (<5%) for all the covariates, except income in the general population.
sample (13.8% and 7.2% among the women eligible for BCS and CCS, respectively) and the BMI in the HIV-infected population sample (7.1% and 6.6% among the women eligible for BCS and CCS, respectively).

We used direct standardisation to estimate age-standardised rates of BCS and CCS among the HIV-infected women, considering women in the general population as the reference. In addition, we computed age-adjusted prevalence rate ratios (aPRRs) to compare the proportion of women who were up-to-date with BCS and CCS between the HIV-infected and the general population, using Poisson regression models with robust variance.

The factors associated with being up-to-date with BCS and CCS were investigated in the HIV-infected women using Poisson regression models with robust variance. The covariates included in the models were sociodemographic and economic characteristics, indicators of healthcare coverage, healthcare use, health behaviours and HIV characteristics. Multivariate models were constructed by stepwise regressions using backward elimination until all the covariates had a p-value <0.10. In a sensitivity analysis, models including all the HIV-infected women were run to check that the restriction to the age range of 25-65 years did not change the results.

Then, in order to compare the correlates of BCS and CCS between the HIV-infected and the general population, multivariate models including both samples were run. The models included the interaction terms between each covariate and the study population. They did not include the country of birth/nationality or HIV characteristics, since they were not available from or relevant to the Baromètre Cancer 2010 survey. To check that this did not affect our results, we performed sensitivity analyses stratifying by nationality in the HIV-infected women.
All the analyses were performed using Stata/SE12® (Stata Corporation, College Station, TX) and accounted for the sampling design and the data weighting so that the estimates would be representative of the entire HIV-infected population followed at hospitals in France in 2011.
Results

Breast cancer screening

The BCS study population consisted of 225 HIV-infected women and 661 women from the general population aged 50-75 years (Table 1). Among the former, the median time since HIV diagnosis was 16 years, and 66.2% of them had a CD4 count >500 cells/mm³. Female IDU accounted for 14.7% of the HIV-infected women, immigrants originating from sub-Saharan Africa accounted for 25.3% and non-IDU non-African women accounted for 60.0%. The median age was 56 years in the HIV-infected women, and 59 years in the general population women.

Of the HIV-infected women, 84.6% had had a mammogram within the two years preceding the interview. The age-standardised rate of up-to-date BCS in the HIV-infected women was 80.7% (95% confidence interval (CI): 70.3-88.1) compared to 89.1% of the general population women. When age is controlled for, the level of BCS between the HIV-infected and the general population was not different (aPRR: 0.94, CI: 0.87-1.02, p=0.146).

In univariate analyses (Table 2), the factors significantly associated with lower BCS uptake in the HIV-infected women were a low/intermediate (vs. high) educational level (PRR: 0.83, CI: 0.75-0.92), an irregular (vs. regular) gynaecological follow-up (PRR: 0.74, CI: 0.60-0.90) and a CD4 count <500 (vs. >500) cells/mm³ (PRR: 0.79, CI: 0.66-0.94). In addition, being unemployed/inactive/having a disability (vs. employed) (PRR: 0.88, CI: 0.77-1.01) and having a low (vs.high) income (PRR: 0.88, CI: 0.77-1.00) tended to be associated with lower BCS uptake. In the final multivariate model (Table 2), those with a low/intermediate educational level (aPRR: 0.88, CI: 0.80-0.97), an irregular gynaecological follow-up (aPRR: 0.77, CI: 0.64-0.92) or a CD4 count <500 cells/mm³ (aPRR: 0.83, CI: 0.71-0.97) were less likely to be up-to-date with BCS.
The correlates of BCS in the HIV-infected population were mostly consistent with those in the general population (Figure 1), with the exception of a low/intermediate educational level, which were associated with higher BCS uptake in the general population but with lower BCS uptake in the HIV-infected women (p-value for interaction: 0.002).

**Cervical cancer screening**

The CCS study population consisted of 740 HIV-infected women and 1,269 women from the general population aged 25-65 years (Table 1). Among the former, the median time since HIV diagnosis was 10 years. The CD4 count was <200 cells/mm$^3$ in 4.6% of them and >500 cells/mm$^3$ in 59.2%. Female IDU accounted for 13.4% of the HIV-infected women, immigrants originating from sub-Saharan Africa accounted for 47.3% and non-IDU non-African women accounted for 39.4%. The median age was 44 years in both the HIV-infected and the general population women, and those aged 35-55 years accounted for 69.6% of the HIV-infected women and 54.8% of the general population women.

Of the HIV-infected women, 93.3% had had a Pap test since their HIV diagnosis, 88.9% reported having had one within the three years preceding the interview, and 76.5% reported having had one in the preceding year. The age-standardised rate of CCS within the three preceding years was 88.1% (CI: 84.5-91.0) in the HIV-infected population compared to 83.1% in the general population. When age is accounted for, the level of CCS was higher in the HIV-infected than in the general population (aPrr: 1.05, CI: 1.01-1.10, p=0.021).

In univariate analyses (Table 3), the factors significantly associated with lower rates of CCS within the three preceding years in the HIV-infected women were a low (vs. high) educational level (Prr: 0.87, CI: 0.79-0.96), low (vs. high) income (Prr: 0.94, CI: 0.89-0.99), not having (vs. having) supplementary health insurance (Prr: 0.89, CI: 0.82-0.96) and an irregular (vs. regular)
gynaecological follow-up (PRR: 0.69, CI: 0.61-0.79), while a CD4 count of 350-500 (vs. >500) cells/mm$^3$ was associated with higher CCS uptake (PRR: 1.06, CI: 1.01-1.11). A CD4 count <200 cells/mm$^3$ tended to be a predictor of low CCS uptake. In the final multivariate model (Table 3), the factors associated with CCS uptake within the three preceding years in the HIV-infected women were a low educational level (aPRR: 0.91, CI: 0.83-0.99), not having supplementary health insurance (aPRR: 0.92, CI: 0.86-0.98), an irregular gynaecological follow-up (aPRR: 0.72, CI: 0.64-0.81), and a CD4 count <200 cell/mm$^3$ (aPRR: 0.78, CI: 0.63-0.98). The results regarding the correlates of CCS uptake in the preceding year in the HIV-infected women were consistent with those reported for CCS uptake within the three preceding years (Table 4). Moreover, the results concerning CCS remained stable in the sensitivity analysis performed on all the HIV-infected women (with no age restriction).

The associations with CCS uptake within the three preceding years were consistent between the HIV-infected and the general population (Figure 2) in terms of educational level, income and supplementary insurance. However, the associations between low CCS uptake and younger age (p-value for interaction: 0.03), being unemployed (p-value for interaction: 0.03) and an irregular gynaecological follow-up (p-value for interaction: <0.001) were significantly less pronounced in the HIV-infected than in the general population.
Discussion

Our findings show that 84.6% of the HIV-infected women had undergone BCS within the two preceding years and that 88.9% had undergone CCS within the three preceding years. However, almost 1 in 4 of the HIV-infected women had not had CCS in the preceding year. The level of BCS was similar while that of CCS was 5% higher in the HIV-infected than in the general population. Moreover, the HIV-infected women had a specific profile regarding barriers to screening uptake.

In this study, we were able to provide rates of BCS and CCS among HIV-infected women based on recent data and on definitions of screening uptake consistent with the national guidelines. Our findings show a higher level of BCS among HIV-infected women than those previously reported in the literature (21-26). This difference could be explained by the level of screening having being assessed through very different methods (mostly medical records (23-26)) and/or indicators (a mammogram in the preceding year (21, 24, 25), in the past five years (21) or during the follow-up period (22, 23)) in those previous studies. Moreover, although we found a high level of CCS within the three preceding years, CCS uptake among the HIV-infected women in the preceding year was suboptimal. The proportion of HIV-infected women who reported having undergone CCS in the preceding year was consistent with previous studies based on self-reported data and on comparable indicators (20, 27, 30-33, 44).

Additionally, we were able to compare the levels of screening between the HIV-infected and the general population using indicators collected through the same standardized questions in both datasets and controlling for age, which enabled us to account for demographic differences between the two populations. We found a similar level of BCS in the HIV-infected and in the
general population, a finding inconsistently reported in previous studies (21, 22, 24). In contrast, our results indicate that HIV-infected women have a higher rate of CCS than women in the general population. Previous studies generally suggested a lower (24, 36, 37) or similar (29, 30) CCS uptake in HIV-infected women compared to women in the general population. However, only one (37) accounted for differences in the age distribution between the two populations. Thus, our results do not support the hypothesis of lower screening rates among HIV-infected women, even though such a result has been reported among women living with other chronic diseases (45). Our results suggest that the HIV-specific recommendation of an annual Pap test enhances CCS uptake among HIV-infected women.

Our findings suggest that there are potential barriers to screening uptake in PLWHIV. Consistent with previous studies (31, 38, 39), we found that a poor educational level was a barrier to both BCS and CCS among the HIV-infected women. This may reflect differences in health behaviours, access to care, awareness of the importance of preventive care and/or medical practices according to patients’ educational level. Additionally, an irregular gynaecological follow-up was associated with lower BCS and CCS uptake among the HIV-infected women, which points to the major influence of gynaecologists with regard to gynaecological screening. The fact that not having supplementary health insurance is a predictor of low CCS uptake suggests that there are financial barriers to screening access among HIV-infected women, despite the fact that HIV care-related expenses are completely covered by health insurance. Not having supplementary insurance was not a barrier to BCS, which suggests that these financial barriers may have been reduced, thanks to the dedicated national free BCS program. Consistent with previous research (20, 23, 28, 30, 34), we found that a low CD4 count was a barrier to both BCS and CCS, which suggests that, HIV-related concerns might preclude attention to other health problems. This result
would mean that CCS should be reinforced among women with a low CD4 count, who are at higher risk for cervical cancer.

Finally, we were able to formally compare the determinants of cancer screening uptake between PLWHIV and the general population. We found that HIV-infected women presented certain particularities. With regard to BCS uptake, we identified specific disparities according to educational level among HIV-infected women that were not observed in the general population. On the other hand, the disparities in CCS uptake according to age, employment and gynaecological follow-up were less pronounced in the HIV-infected than in the general population. This suggests that the HIV-specific screening guidelines may reduce disparities in access to CCS, unlike what we observed for BCS, which is not the subject of a specific recommendation among HIV-infected women. Therefore, better integration of BCS as part of HIV care might help reduce disparities.

The main strength of our study is its nationally representative design, which enabled us to provide detailed data on cancer screening practices that is generalisable to the entire population of PLWHIV followed at hospitals in France, where the health system provides free access to care. To our knowledge this is the first study that provides such data in France and that formally compares screening levels and predictors between the HIV-infected and the general population. However, our study presents some potential limitations. First, we may have overestimated the level of screening uptake because we used self-reported data (46-48) and allowed a certain amount of leeway in the estimation of the length of time since the last test by using the calendar year instead of the exact date (even though this is a common practice (23, 34, 37, 38)). However, since the data collection and the outcome definition were identical in both surveys, it seems unlikely that this potential overestimation had an impact on the results of the comparisons between PLWHIV and the general population. In addition, we cannot exclude a possible bias in the
analyses comparing HIV-infected women and women of the general population, due to a difference in data collection modalities (face-to-face vs. telephone interview respectively). However, a previous study suggested that telephone and face-to-face interviews provided similar information for various indicators of health practices and health behaviours including uptake of cancer screening (49). Then, in our study, we could not account for geographic origin/nationality. However, the findings concerning the association between nationality and BCS or CCS in the literature are inconsistent (39); also, in univariate analyses we did not find a significant difference in screening rates according to geographic origin (SSA migrants vs. non-IDU non-African women), and the sensitivity analyses that we performed by stratifying the HIV-infected population according to nationality led to the same conclusions as our main results. Moreover, our findings do not apply to HIV-infected individuals who are not hospital outpatients. However, they represent a very small part of all PLWHIV (50), especially since at least one annual hospital visit is recommended for all PLWHIV in France (8).

In conclusion, our findings provide new evidence for better addressing barriers to BCS and CCS in HIV-infected women and for improving cancer screening and risk management. Overall, the level of BCS was relatively high, but more attention is needed to reduce the remaining disparities. Even if HIV-specific guidelines seem to have a positive impact on CCS uptake, the level of screening is suboptimal, considering the elevated risk of cervical cancer in this population. Both BCS and CCS should better target those who are less educated or with a low CD4 count. Preventive care should be strengthened, and PLWHIV should be advised to seek comprehensive care at the primary care level to take advantage of the entire range of health/medical follow-up activities, including cancer screening.
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L.T., R.D.-S. and F.L. contributed to the study design, data interpretation and manuscript preparation. L.T. and R.D.-S. wrote the paper. L.T. performed the statistical analyses. B.S. critically reviewed the manuscript.
### Tables and figures

Table 1. Characteristics of women targeted by breast cancer screening (BCS) and cervical cancer screening (CCS) in the HIV-infected population and in the general population

<table>
<thead>
<tr>
<th></th>
<th>BCS study population (50-75 years)</th>
<th>CCS study population (25-65 years)</th>
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<tbody>
<tr>
<td></td>
<td>HIV-INFECTED POPULATION (N=225)</td>
<td>GENERAL POPULATION (N=661)</td>
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<tr>
<td></td>
<td>%*</td>
<td>%*</td>
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<tr>
<td></td>
<td>HIV-INFECTED POPULATION (N=740)</td>
<td>GENERAL POPULATION (N=1,269)</td>
</tr>
<tr>
<td></td>
<td>%*</td>
<td>%*</td>
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<tr>
<td><strong>Age (years) Median (IQR)</strong></td>
<td>56 (52-61)</td>
<td>59 (54-65)</td>
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<tr>
<td><strong>Cohabiting couple</strong></td>
<td>69.6 (33.9)</td>
<td>59.1 (41.0)</td>
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<td></td>
<td>30.4 (66.1)</td>
<td>26.8 (73.2)</td>
</tr>
<tr>
<td><strong>Living with children &lt;14 years old</strong></td>
<td>90.7 (96.1)</td>
<td>62.5 (37.5)</td>
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<tr>
<td></td>
<td>9.3 (3.9)</td>
<td>57.8 (42.2)</td>
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<tr>
<td><strong>Educational level</strong></td>
<td>27.7 (36.7)</td>
<td>26.4 (19.4)</td>
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<td></td>
<td>47.3 (46.4)</td>
<td>54.3 (52.5)</td>
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<td></td>
<td>25.0 (16.9)</td>
<td>19.4 (28.1)</td>
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<td><strong>Employment status</strong></td>
<td>38.1 (35.4)</td>
<td>49.8 (68.5)</td>
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<td></td>
<td>5.3 (4.0)</td>
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<td></td>
<td>28.7 (15.6)</td>
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<td></td>
<td>27.9 (45.0)</td>
<td>5.2 (9.3)</td>
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<tr>
<td><strong>Income</strong></td>
<td>64.4 (54.9)</td>
<td>77.1 (60.2)</td>
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<td></td>
<td>35.6 (45.1)</td>
<td>22.9 (39.8)</td>
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<td><strong>Health insurance</strong></td>
<td>84.4 (92.9)</td>
<td>73.0 (91.6)</td>
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<td>15.6 (7.1)</td>
<td>27.0 (8.4)</td>
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<tr>
<td><strong>Supplementary health insurance</strong></td>
<td>22.9 (6.2)</td>
<td>34.7 (6.2)</td>
</tr>
<tr>
<td></td>
<td>77.1 (93.8)</td>
<td>65.3 (93.9)</td>
</tr>
<tr>
<td><strong>Annual visit to a GP</strong></td>
<td>14.4 (12.1)</td>
<td>14.2 (11.6)</td>
</tr>
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<td>85.8 (88.5)</td>
</tr>
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<td><strong>Regular visits to a gynaecologist</strong></td>
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<td>23.7 (19.4)</td>
</tr>
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<td>76.3 (80.6)</td>
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<td>Normal weight</td>
</tr>
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<td>Alcohol consumption</td>
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<td>Non-smoker</td>
<td>Current smoker</td>
</tr>
<tr>
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<td></td>
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<tr>
<td>Time since HIV diagnosis</td>
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<td>8-16 years</td>
</tr>
<tr>
<td></td>
<td>19.1</td>
<td>27.9</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>Virologically controlled</td>
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<td>No</td>
</tr>
<tr>
<td></td>
<td>92.0</td>
<td>8.0</td>
</tr>
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</tr>
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<td>200-350</td>
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<tr>
<td></td>
<td>4.6</td>
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</tr>
</tbody>
</table>

*Weighted percentage, unless otherwise stated.

BCS: breast cancer screening; CCS: cervical cancer screening; IQR: interquartile range; CMU: health insurance for the disadvantaged; AME: health insurance for undocumented foreigners; GP: general practitioner; BMI: body mass index.
Table 2. Factors associated with being up-to-date with breast cancer screening among the HIV-infected women aged 50-75 years in Poisson regression models (N=225)

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<td>%*</td>
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<td><strong>Age</strong></td>
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<tr>
<td>50-55 years</td>
<td>105</td>
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</tr>
<tr>
<td>55-65 years</td>
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<td>87.0</td>
</tr>
<tr>
<td>65-75 years</td>
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<td>65.7</td>
</tr>
<tr>
<td><strong>Socio-epidemiological group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDU</td>
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<td>75.9</td>
</tr>
<tr>
<td>SSA migrants</td>
<td>53</td>
<td>86.0</td>
</tr>
<tr>
<td>Non-IDU non-African women</td>
<td>135</td>
<td>86.2</td>
</tr>
<tr>
<td><strong>Cohabiting couple</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>164</td>
<td>81.6</td>
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<tr>
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<td>61</td>
<td>91.5</td>
</tr>
<tr>
<td><strong>Educational level</strong></td>
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<td></td>
</tr>
<tr>
<td>Low/Intermediate</td>
<td>175</td>
<td>80.5</td>
</tr>
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<td>High</td>
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<tr>
<td>Employed</td>
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<td>91.8</td>
</tr>
<tr>
<td>Retired</td>
<td>58</td>
<td>79.6</td>
</tr>
<tr>
<td>Unemployed/Disability/Other inactive women</td>
<td>85</td>
<td>80.6</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>151</td>
<td>80.7</td>
</tr>
<tr>
<td>High</td>
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<td><strong>Health insurance</strong></td>
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<td>Standard</td>
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<td>CMU/AME or other</td>
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<td>74.0</td>
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<tr>
<td><strong>Supplementary health insurance</strong></td>
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<td></td>
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<td>No</td>
<td>51</td>
<td>75.3</td>
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<tr>
<td>Yes</td>
<td>174</td>
<td>87.4</td>
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<td><strong>Annual visit to a GP</strong></td>
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</tr>
<tr>
<td>No</td>
<td>33</td>
<td>85.3</td>
</tr>
<tr>
<td>Yes</td>
<td>192</td>
<td>84.5</td>
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<tr>
<td><strong>Regular visits to a gynaecologist</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>71</td>
<td>68.4</td>
</tr>
<tr>
<td>Yes</td>
<td>154</td>
<td>93.0</td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>19</td>
<td>62.8</td>
</tr>
<tr>
<td>Normal weight</td>
<td>106</td>
<td>90.4</td>
</tr>
<tr>
<td>Overweight</td>
<td>63</td>
<td>86.7</td>
</tr>
<tr>
<td>Obese</td>
<td>37</td>
<td>74.1</td>
</tr>
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<td><strong>Alcohol consumption</strong></td>
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<td></td>
</tr>
<tr>
<td>None</td>
<td>89</td>
<td>89.8</td>
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<tr>
<td>Moderate</td>
<td>84</td>
<td>84.9</td>
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<td>Risky</td>
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<td>74.2</td>
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<td>Category</td>
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<td>Mean</td>
</tr>
<tr>
<td>---------------------------------------</td>
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<td>------</td>
</tr>
<tr>
<td>Non-smoker</td>
<td>156</td>
<td>86.8</td>
</tr>
<tr>
<td>Current smoker</td>
<td>69</td>
<td>79.2</td>
</tr>
<tr>
<td><strong>Time since HIV diagnosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;8 years</td>
<td>50</td>
<td>85.9</td>
</tr>
<tr>
<td>8-16 years</td>
<td>62</td>
<td>80.5</td>
</tr>
<tr>
<td>≥16 years</td>
<td>113</td>
<td>86.3</td>
</tr>
<tr>
<td><strong>Virologically controlled</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>210</td>
<td>86.6</td>
</tr>
<tr>
<td>No</td>
<td>15</td>
<td>61.7</td>
</tr>
<tr>
<td><strong>CD4 count (cells/mm³)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;500</td>
<td>82</td>
<td>71.7</td>
</tr>
<tr>
<td>&gt;500</td>
<td>143</td>
<td>91.2</td>
</tr>
</tbody>
</table>

*Weighted percentage.

**Final multivariate model constructed by stepwise regressions using backward elimination until all the covariates in the univariate analysis had a p-value <0.10.

PRR: prevalence rate ratio; CI: confidence interval; aPRR: adjusted prevalence rate ratio; IDU: intravenous drug users; SSA: Sub-Saharan Africa; CMU: health insurance for the disadvantaged; AME: health insurance for undocumented foreigners; GP: general practitioner; BMI: body mass index.
Figure 1. Factors associated with being up-to-date with breast cancer screening in the HIV-infected population (black triangle markers) and in the general population (grey dot markers) in Poisson multivariate regression models*

<table>
<thead>
<tr>
<th>Factor</th>
<th>HIV-infected population</th>
<th>General population</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (reference: 50-55 years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55-65 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-75 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cohabiting couple (reference: Yes)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Educational level (reference: High)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low/Intermediate</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Annual visit to a GP (reference: Yes)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Regular visits to a gynaecologist (reference: Yes)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BMI (reference: Normal weight)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tobacco smoking (reference: Non-smoker)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smoker</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Final multivariate model constructed by stepwise regressions using backward elimination until all the covariates in the univariate analysis had a p-value <0.10. The model included both the HIV-infected and the general population samples and an interaction term between each covariate and the study population.

**P-value of the interaction term between each category of the covariates and the study population in the final multivariate model, which included both the HIV-infected sample and general population sample.

GP: general practitioner; aPRR: adjusted prevalence rate ratio; BMI: body mass index.
Table 3. Factors associated with being up-to-date with cervical cancer screening according to the general population guidelines among the HIV-infected women aged 25-65 years in Poisson regression models (N=740)

<table>
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<th>Multivariate analysis***</th>
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<td>%*</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
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<tr>
<td>25-35 years</td>
<td>129</td>
<td>89.9</td>
</tr>
<tr>
<td>35-55 years</td>
<td>516</td>
<td>90.1</td>
</tr>
<tr>
<td>55-65 years</td>
<td>95</td>
<td>80.8</td>
</tr>
<tr>
<td><strong>Socio-epidemiological group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDU</td>
<td>103</td>
<td>83.5</td>
</tr>
<tr>
<td>SSA migrants</td>
<td>334</td>
<td>88.2</td>
</tr>
<tr>
<td>Non-IDU non-African women</td>
<td>303</td>
<td>91.6</td>
</tr>
<tr>
<td><strong>Cohabiting couple</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>445</td>
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<tr>
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<td>295</td>
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<td><strong>Living with children &lt;14 years old</strong></td>
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<tr>
<td>Unemployed</td>
<td>131</td>
<td>90.0</td>
</tr>
<tr>
<td>Disability/Other inactive women</td>
<td>232</td>
<td>86.2</td>
</tr>
<tr>
<td>Retired</td>
<td>36</td>
<td>83.3</td>
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<tr>
<td><strong>Income</strong></td>
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<tr>
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<tr>
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<td></td>
</tr>
<tr>
<td>Standard</td>
<td>536</td>
<td>90.6</td>
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<td>CMU/AME or other</td>
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<td><strong>Supplementary health insurance</strong></td>
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<td>627</td>
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<td>557</td>
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<tr>
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<tr>
<td><strong>BMI</strong></td>
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<tr>
<td>Underweight</td>
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<td>85.9</td>
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<tr>
<td>Obese</td>
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<td>92.4</td>
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<td><strong>Alcohol consumption</strong></td>
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<td></td>
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<tr>
<td>None</td>
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<tr>
<td>Moderate</td>
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<td>Risky</td>
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<td>90.2</td>
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<tr>
<td><strong>Tobacco smoking</strong></td>
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<tr>
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<tr>
<td>Current smoker</td>
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</tr>
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<td>&lt;8 years</td>
<td>255</td>
<td>90.0</td>
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<tr>
<td>8-16 years</td>
<td>232</td>
<td>85.9</td>
</tr>
<tr>
<td>≥16 years</td>
<td>253</td>
<td>90.8</td>
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<td><strong>Virologically controlled</strong></td>
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<td><strong>CD4 count (cells/mm³)</strong></td>
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<td>200-350</td>
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<td>94.6</td>
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<tr>
<td>&gt;500</td>
<td>441</td>
<td>89.4</td>
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</table>

*Weighted percentage.

**Final multivariate model constructed by stepwise regressions using backward elimination until all the covariates in the univariate analysis had a p-value <0.10.

PRR: prevalence rate ratio; CI: confidence interval; aPRR: adjusted prevalence rate ratio; IDU: intravenous drug users; SSA: Sub-Saharan Africa; CMU: health insurance for the disadvantaged; AME: health insurance for undocumented foreigners; GP: general practitioner; BMI: body mass index.
Figure 2. Factors associated with being up-to-date with cervical cancer screening according to the general population guidelines in the HIV-infected population (black triangle markers) and in the general population (grey dot markers) in Poisson multivariate regression models*

<table>
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<tr>
<th>Factor</th>
<th>p-value</th>
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</tr>
<tr>
<td>25-35 years</td>
<td>0.03</td>
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<tr>
<td>55-65 years</td>
<td>0.72</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.98</td>
</tr>
<tr>
<td>Intermediate</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>Employment status (reference: Employed)</strong></td>
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</tr>
<tr>
<td>Unemployed</td>
<td>0.03</td>
</tr>
<tr>
<td>Disability/Other inactive women</td>
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<tr>
<td>Retired</td>
<td>0.97</td>
</tr>
<tr>
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<tr>
<td>Low</td>
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<tr>
<td><strong>Supplementary health insurance (reference: Yes)</strong></td>
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</tr>
<tr>
<td>No</td>
<td>0.77</td>
</tr>
<tr>
<td><strong>Regular visits to a gynaecologist (reference: Yes)</strong></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Final multivariate model constructed by stepwise regressions using backward elimination until all the covariates in the univariate analysis had a p-value <0.10. The model included both the HIV-infected and the general population samples and an interaction term between each covariate and the study population.

**P-value of the interaction term between each category of the covariates and the study population in the final multivariate model, which included both the HIV-infected sample and the general population sample.

aPRR: adjusted prevalence rate ratio.
Table 4. Factors associated with being up-to-date with cervical cancer screening according to the HIV-specific guidelines among the HIV-infected women aged 25-65 years in Poisson regression models (N=740)

<table>
<thead>
<tr>
<th>Age</th>
<th><strong>Univariate analysis</strong></th>
<th><strong>Multivariate analysis</strong></th>
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<tbody>
<tr>
<td></td>
<td>N</td>
<td>%*</td>
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<tr>
<td>25-35 years</td>
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<td>55-65 years</td>
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<tr>
<td>Socio-epidemiological group</td>
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<td>IDU</td>
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<td>SSA migrants</td>
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<td>Non-IDU non-African women</td>
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<td>Cohabiting couple</td>
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<td>Living with children &lt;14 years old</td>
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<tr>
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<tr>
<td>Yes</td>
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<tr>
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<td>83.1</td>
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<td>Disability/Other inactive women</td>
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<tr>
<td>Retired</td>
<td>36</td>
<td>74.4</td>
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<tr>
<td>Income</td>
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<tr>
<td>Low</td>
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<tr>
<td>High</td>
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<tr>
<td>Health insurance</td>
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<tr>
<td>Standard</td>
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<td>CMU/AME or other</td>
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<tr>
<td>Supplementary health insurance</td>
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<tr>
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<tr>
<td>Annual visit to a GP</td>
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<tr>
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<td>77.8</td>
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<td><strong>BMI</strong></td>
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<td>Moderate</td>
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<td>Current smoker</td>
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<td><strong>Time since HIV diagnosis</strong></td>
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<td>≥16 years</td>
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<td><strong>Virologically controlled</strong></td>
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<td><strong>CD4 count (cells/mm³)</strong></td>
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<tr>
<td>&gt;500</td>
<td>441</td>
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</tbody>
</table>

*Weighted percentage.
**Final multivariate model constructed by stepwise regressions using backward elimination until all the covariates in the univariate analysis had a p-value <0.10.

PRR: prevalence rate ratio; CI: confidence interval; aPRR: adjusted prevalence rate ratio; IDU: intravenous drug users; SSA: Sub-Saharan Africa; CMU: health insurance for the disadvantaged; AME: health insurance for undocumented foreigners; GP: general practitioner; BMI: body mass index.
Appendix

The ANRS-Vespa2 Study Group includes France Lert (INSERM UMR-S 1018) and Bruno Spire (INSERM UMR-S 912 / ORS PACA), scientific coordinators, Patrizia Carrieri (INSERM UMR-S 912 / ORS PACA), Rosemary Dray-Spira (INSERM UMR-S 1136), Christine Hamelin (INSERM UMR-S 1018), Nicolas Lorente (INSERM UMR-S 912 / ORS PACA), Marie Préau (INSERM UMR-S 912 / ORS PACA) and Marie Suzan-Monti (INSERM UMR-S 912 / ORS PACA) in the collaboration of Marion Mora (INSERM UMR-S 912 / ORS PACA).

List of participating hospitals and investigators