



# Seroprevalence and Risk Factors Associated with Human Immunodeficiency Virus Infection Type 1 in Donors of the National Blood Transfusion Center of Libreville (Gabon)

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors CM designed the study and designed it with TN and JF. The supervision was provided by authors TN and JF. Author CM wrote the article. All authors have edited the article. All authors read and approved the final manuscript.*

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## **ABSTRACT**

**Background:** Transmission of HIV through blood transfusion remains a public health problem, particularly in countries in Sub-Saharan Africa. However, no study has determined the epidemiological data regarding HIV-1 infection in Gabonese blood donors. The objective of this study is to assess the seroprevalence of HIV-1 and the risk factors associated with infection in donors from the National Blood Transfusion Center in Libreville (Gabon).

**Methods:** A cross-sectional study carried out from June to August 2020 in 3669 persons donating blood at the National Blood Transfusion Center (NBTC). The ELISA technique (Evolis®, BioRad),

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the chemiluminescence technique (Cobas® e601, Roche), and the SD Bioline® HIV 1/2 test (Standard Diagnostics, Inc) were used for the detection of anti-HIV-1/2 antibodies and P24 antigen in donor plasma. Data were analyzed using SPSS software version 21.0, with  $p < .05$  considered statistically significant.

**Results:** The seropositivity rate HIV-1 was 0.8% (30/3669) (95% CI: 0.5; 1.1). The study was composed of 79.4% men and 20.6% women. The most representative age group was of 25-34 years with 54.5%. The seropositivity of men, women, and unrelated voluntary donors was 0.7%, 1.2%, and 1.0%, respectively. The risk factors such as the first blood donation (Adjusted Odds Ratio (AOR) = 0.1 [0.0 ;0.4],  $P = .002$ ), multiple sexual partners (AOR = 6.2 [2.2;17.2],  $P = .001$ ), primary educational level (AOR = 10.1 [1.4;75],  $P = .024$ ), and dental care (AOR = 3.6 [1.2;11],  $P = .024$ ) were significantly associated with HIV infection. About 0.14% of the patients had co-infection.

**Conclusion:** In the Gabonese context, about one out of a hundred blood donors are HIV-infected. These carriers of HIV infection in the blood banks are mainly new donors with multiple sexual partners, limited education, and poor dental care.

**Keywords:** HIV-1; seroprevalence; risk factors; blood donors; Gabon's NBTC.

## 1. INTRODUCTION

The infectious risk associated with donating blood remains a real public health problem where the prevalence rates of the main transfusion-transmissible infections (hepatitis B, hepatitis C, human immunodeficiency virus, and syphilis) are among the highest in the world [1]. Blood transfusion is a therapeutic intervention that makes it possible to reabsorb a deficiency in labile blood products (LBP) in many patients by saving their lives in certain circumstances (accidents, anemia, surgical interventions, etc.) [2]. But it is also a transmission route for infections transmitted by transfusion.

However, in developed countries, the risk of transmission has been reduced over the last decade thanks to the implementation of strategies aimed at improving blood safety [3]. In Canada, the introduction of techniques to search for HIV nucleic acid in blood banks has considerably reduced the risk of transmission of the human immunodeficiency virus (HIV), which is today 1 in 21.4 millions of donations [4].

In Sub-Saharan Africa (SSA), the demand for blood bags is very high, especially among pregnant women and children. This is why it is necessary to strengthen strategies for screening pathogens in blood banks to ensure a blood supply free of viruses. These resource-limited countries are faced with this problem because they are still unable to obtain techniques based on nucleic acid research, but also because of low coverage of 4th generation screening tests (Ab/Ag, p24) in blood banks [5]. Without forgetting also the lack of information on rapid screening tests used by almost all blood banks in these countries of Sub-Saharan Africa for the

screening of TTIs thus promoting a high risk of transmission of TTIs [6-7].

The National Blood Transfusion Center (NBTC) in Libreville (Gabon), needs to screen donated blood for blood-borne pathogens, namely HIV, hepatitis (C and B), and syphilis in order to reduce the risk of transmitting infections by transfusion. Testing for anti-HIV-1/2 antibodies and the P24 antigen is required. The practice of donating blood at the NBTC contributes daily to alleviate a deficit in labile blood products in patients who have undergone surgery, in pregnant women, and in children suffering from malaria. Monitoring the HIV-1 seroprevalence in blood donors in the sub-region in general and in particular at the Libreville NBTC contributes to securing blood donation, protecting recipient patients, and estimating the risk of infection (Risk factors such as non-responsible sexual behavior..) in these blood banks. But it is also necessary to investigate more on the genetic diversity of HIV-1 in order to improve the different strategies for screening the virus in blood banks. This may improve the virus-free blood supply in endemic and resource-limited countries.

The objective of this study is to determine the seropositivity of HIV-1 and the risk factors associated with HIV-1 infection in donors from the National Blood Transfusion Center in Libreville (Gabon).

## 2. MATERIALS AND METHODS

### 2.1 Study Design and Setting

A cross-sectional study was carried out at the NBTC living in Libreville Gabon during the

period from June to August 2020. The NBTC is Gabon's largest blood bank, providing its services in terms of labile blood products to almost all health structures in the city of Libreville. The NBTC ensures good practices in terms of safe blood transfusion and oversees the quality of labile blood products in the country.

For this study, all eligible donors based on the criteria (aged 18 to 55, in the absence of anemia, far from risky sexual behavior, in the absence of chronic diseases, ban for pregnant women, normal high blood pressure, etc.) established by the NBTC and who donated blood during the study period were included for the determination of HIV-1 prevalence.

But those who had agreed to complete the study questionnaire and being eligible for the selection criteria for the evaluation of risk factors associated with infection had been included.

## 2.2 Serological Analysis

A blood sample was taken in an EDTA tube for serological analysis from each donor. The techniques used for the detection of the P24 antigen and the anti-HIV 1 (groups M and O) and HIV-2 antibodies in the plasma of donors were the ELISA technique (Evolis®, BioRad), and the chemiluminescence technique (Cobas® 6000 e601, Roche). The SD Bioline® HIV 1/2, 3.0 test (Standard Diagnostics. Inc) was used for HIV typing. Serological analysis was performed according to the manufacturer's protocol.

## 2.3 Statistical Analysis

Data were verified, entered, and analyzed using SPSS software version 21.0 and EPI info 7.0. Descriptive data has been presented as frequencies and percentages. The chi-square test was used to compare seroprevalence rates of HIV-1 infection among blood donors by socio-demographic characteristics. Univariate and multivariate binary logistic regression models were used to identify risk factors associated with HIV infection. In multivariate, all independent variables were entered together using the simple entry method. The crude odds ratio (COR) and its 95% confidence interval (CI) were used to determine the strength of the association. The  $p < 0.05$  value was considered

statistically significant. The normality test was performed.

## 3. RESULTS

### 3.1 Socio-demographic Characteristics

A total of 3,690 donors were enrolled during the study period and 3669 were included in the study. But 21 were excluded for reasons of discrepancy in the results (neither positive nor negative, analysis not performed). The study was composed of 79.4% men and 20.6% women. The sex ratio M / F was 3:1. The most representative age group was that of 25-34 years with 54.5%. Family donors were more representative than volunteers, 76.5% and 23.5% respectively. Employees and students/pupils were the most representative, with a respective percentage of 55.5% and 28.9% (Table 1).

HIV-1 seroprevalence and risk factors associated with infection  
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A HIV-1 seroprevalence was 0.8% (30/3669) (95% CI : 0.5;1.1) with no significant difference between men (0.7%) and women (1.2%),  $P = .201$ . The age group that had a slightly high seroprevalence was between 25-34 years, a percentage of 1.1%. A positivity of 1.3% was found in new donors, which was significantly higher as compared to repeat donors (0.4%), (OR = 0.29 [95% CI : 0.13 ;0.65],  $P = .001$ ). The prevalence of family donors was 0.7% but without significant difference ( $P = .500$ ) with unrelated voluntary donors (Table 2). To assess the risk factors, the independent sample model was used. The risk factors that were significant associated with infection were multiple sexual partners (AOR = 6.2 [95% CI : 2.2;17.2],  $P = .001$ ), primary educational level (AOR = 10.1 [95% CI : 1.4;75],  $P = .024$ ) because the lower the level, the higher the risk) and dental care (AOR = 3.6 [95% CI : 1.2;11],  $P = .024$ ) (Table 3).

### 3.2 Cases of Co-infection among Blood Donors

The study recorded 5 cases of co-infections with hepatitis C and syphilis. The overall prevalence was 0.14% (5/3669). There were 2 (0.05%) cases of HIV-HCV co-infection and 3 (0.08%) cases of HIV-Syphilis co-infection. The 5 cases of co-infection were new donors and

ranged in age from 18-24 to 25-34 years. The men were the most representative with 4 cases of co-infection against 1 case for the female sex, i.e., 0.11% and 0.03% respectively. No HIV-HBV co-infection was observed during the study period (Table 4).

#### 4. DISCUSSION

To ensure a pathogen-free blood supply, WHO recommends collecting blood from regular unpaid voluntary donors because they have a lower risk of TTIs (transfusion transmissible infection) compared to compensatory or family donors. TTIs are infections that can be viral,

bacterial, parasitic or prion which can be transmitted by blood transfusion. This cross-sectional study aimed to determine the seroprevalence and risk factors associated with HIV infection in blood donors at the National Blood Transfusion Center (NBTC) in Libreville (Gabon).

The HIV seroprevalence among NBTC blood donors was 3.4% in 2017 [8]. But it has dropped considerably between 2017 and 2020, going from 3.4% to 0.8%. This could be accounted for by the improvement in transfusion safety strategies at the level of the pre-donation phase

**Table 1. Socio-demographic data of donors from the NBTC in Libreville (Gabon)**

Variables		N (%)
Sex	Male	2913 (79.4)
	Female	756 (20.6)
Age (years)	18-24	635 (17.3)
	25-34	2000 (54.5)
	35- 44	796 (21.7)
	≥45	238 (6.5)
Occupation	Employees	2036 (55.5)
	Students-Pupils	1060 (28.9)
	Unemployed	573 (15.6)
Donation status	Former/ Regular	2033 (55.4)
	New	1636 (44.6)
Type of donor	Unrelated Volunteer	862 (23.5)
	Family	2807 (76.5)

*N : Number % : Percentage*

**Table 2. HIV seroprevalence among the different socio-demographic data of blood donors from the NBTC in Libreville (Gabon)**

Variables		HIV (Status)		Chi-2	OR	CI	P-value
		Negative N (%)	Positive N (%)				
Sex	All	3639 (99.2)	30 (0.8)			0.5; 1.1	
	Male (1)	2892 (99.3)	21 (0.7)	1.63	-	0.76; 3.54	.201
Age (years)	Female	747 (98.8)	9 (1.2)	-	1.66	-	-
	18-24 (1)	633 (99.7)	2 (0.3)	3.29	0.28	0.07;1.19	.100
	25-34	1978 (98.9)	22 (1.1)	-	-	-	-
	35-44	790 (99.2)	6 (0.8)	0.69	0.68	0.27; 1.68	.500
Occupation	≥45	238 (100)	0 (0)	2.64	-	-	.200
	Employees (1)	2021 (99.3)	15 (0.7)	-	-	-	-
	Students-Pupils	1051 (99.2)	9 (0.8)	0.11	1.15	0.5 ;2.64	.900
Donation status	Unemployed	567 (99.0)	6 (1.0)	0.54	1.43	0.55;3.7	.500
	Former (1)	2025 (99.6)	8 (0.4)	10.11	-	0.13 ;0.65	.001
Type of donor	New	1614 (98.7)	22 (1.3)	-	0.29	-	-
	Unrelated Volunteer	853 (99.0)	9 (1.0)	0.71	1.4	0.64 ; 3.07	.500
	Family (1)	2786 (99.3)	21 (0.7)	-	-	-	-

*HIV: Human Immunodeficiency Virus; OR: Odds Ratio; CI: 95% Confidence Interval (1): Reference Group; %: Percentage*

**Table 3. Risk factors associated with HIV-1 infection in blood donors by univariate and multivariate logistic regression model**

Variables		Univariate analysis		Multivariate analysis	
		OR (CI 95%)	P-value	AOR (CI 95%)	P-value
Donation status	New (1)	0.2 (0.1 – 0.5)	0.001	0.1 (0 – 0.4)	.002
	Regular	-	-	-	-
Education level	Primary (1)	5.4 (1.1 - 27)	0.041	10.1 (1.4– 75)	.024
	Secondary	1.3 (0.6 - 3)	0.479	2.8 (1.0-8.2)	.062
	Superior	-	-	-	-
Marital status	Married	-	-	-	-
	Single (1)	0.9 (0.2 – 3.4)	0.859	0.9 (0.1 – 6.2)	.950
	Concubine	0.4 (0.1 – 1.9)	0.277	0.7 (0.1 – 4.9)	.743
History of HIV in family	Yes	0.3 (0.1 – 1.3)	0.098	0.5 (0.1- 3.1)	.458
	No	-	-	-	-
Multiple sexual partners	Yes	7.4 (3.1 – 17.8)	0.001	6.2 (2.2 – 17.2)	.001
	No	-	-	-	-
Excessive alcohol intake	Yes	0.5 (0.2 – 1.3)	0.170	0.4 (0.1 – 1.2)	.084
	No	-	-	-	-
Dental care	Yes	5.9 (2.5 – 13.7)	0.001	3.6 (1.2 – 11)	.024
	No	-	-	-	-
Have done a screening test	Yes	0.5 (0.2 – 1.1)	0.100	2.8 (0.7-11.5)	.115
	No	-	-	-	-

(1): Reference Group OR : Odds Ratio AOR : Adjusted Odds Ratio CI : 95% Confidence Interval

**Table 4. Seroprevalence of co-infection according to socio-demographic data**

Variables		Total	HIV-HCV co-infection		HIV-Syphilis co-infection	
			N	% (CI 95%)	N	% (CI 95%)
All		3669	2	0.05 (0 – 0.13)	3	0.08 (0 – 0.2)
Sex	Male	2913	1	0.03 (0 – 0.1)	3	0.1 (0 – 0.2)
	Female	756	1	0.13 (0 – 0.4)	0	-
Age (years)	18-24	635	1	0.16 (0 – 0.5)	3	0.5 (0 – 1.0)
	25-34	2000	1	0.05 (0 – 0.2)	0	-
	35-44	796	0	-	0	-
	≥45	238	0	-	0	-
Occupation	Employees	2036	0	-	1	0.05 (0 – 0.2)
	Students-Pupils	1060	0	-	2	0.2 (0 – 0.5)
	Unemployed	573	2	0.35 (0 – 0.8)	0	-
Donation status	Former/Regular	2033	0	-	0	-
	New	1636	2	0.12 (0 – 0.3)	3	0.18 (0 – 0.4)
Type of donor	Unrelated	862	1	0.12 (0 – 0.3)	2	0.23 (0 – 0.6)
	Volunteer	-	-	-	-	-
	Family	2807	1	0.04 (0 – 0.1)	1	0.04 (0 – 0.1)

HIV: Human Immunodeficiency Virus; HCV: Hepatitis C Virus; CI: 95% Confidence Interval N: Number %: Percentage

because the selection of donors is done rigorously, failing any donation participant who does not meet the selection criteria (no sex between men, no sex with multiple partners, no sex for money, no change of sex partners in the last 3 months, no chronic infections, no drug use injectables..) established by the NBTC. This seroprevalence was similar to that of studies

carried out in some developing countries such as Ethiopia (1.4%), Uganda (1.03%), Yemen (0.6%), Eritrea. (0.8%) Nigeria (1.1%), Kenya (1.15%) and South Africa (1.13%) [9-15]. This slight difference in seroprevalence could be due to the behavioral characteristics of study participants, geographic distribution, different procedures for selecting participants for

donation, and screening strategy that differs from country to country. The seroprevalence was high in women than men, i.e., 1.2% and 0.7%. The risk of infection in women was 1.66 times (OR = 1.66) higher. The age group with a high seroprevalence was between 25-34 years or 1.1%. This explanation could be due to the sexual practice for money which would lead them to adopt risky sexual behaviors (multiplicity of sexual partners). Some studies in Ethiopia and Mali showed that women were 1.6 times more at risk (OR = 1.6) than men and the 25-34 age group was also at risk compared to other age groups [7-16]. And concerning the profession of the donor, it emerged that students/pupils and the unemployed had high seropositivity (0.8% and 1.0% respectively). This could be explained by the fact that students/pupils and the unemployed are among the youngest between the ages of 18 and 35 and who constitute the most sexually active donor population. Studies in some countries have also shown that this category of donors (students/pupils and the unemployed) are more at risk than other categories of donors [17,18]. The seroprevalence among new donors (1.3%) was significantly high ( $P = .001$ ). New donors were 0.29 times more at risk (OR = 0.29 Chi<sup>2</sup> = 10.11, [95% CI: 0.13;0.65]) than repeat donors. This category of donors (new donors) is more at risk. This could be explained by the concern to know their serological status for free in a blood bank after having consented to risky sex before. Some studies carried out in some countries like Pakistan, Cameroon, the Netherlands, the Central African Republic (CAR) and Nigeria have also shown that new donors have high seropositivity [17,19-22]. Sexual partner multiplicity was a risk factor that was statistically associated with HIV infection and significant ( $P = .001$ ). But this could be explained by the fact that the main route of transmission of HIV is sexual. And the multiplicity of sexual partners reinforces this association. In Africa, the transmission of this virus is more through the sexual route. This fact is confirmed by several studies carried out in Kenya, Ethiopia, and Indonesia where multiple sexual partners were significant associated with infection [11,23,24]. Dental care ( $P = .024$ ) was identified to be significant associated with HIV infection. This information shows that in dental practice there is still much to improve in terms of strategies related to good aseptic practice. In some developing countries, this problem is still present in dental surgeries such as Ethiopia where a study showed a significant association

between dental care and HIV infection [11]. Risk factors that were weakly significant associated with infection were marital status, family history of HIV, being previously tested, and binge drinking. This finding could be attributed to donor selection measures at the medical interview level. A low level of education was identified by the study as a significant ( $P = .024$ ) risk factor associated with HIV infection. However, it turns out that a weak acquisition of knowledge about HIV infection would encourage an increase in risky behavior among this category of people. This has been reported in some studies conducted in some countries such as Mali, Kenya, and Ethiopia where low education level was significant associated with HIV infection [16,25,26]. Donation status was one of the risk factors in our study. New donors also had a risk that was significant ( $P = .002$ ) associated with HIV infection. This could be accounted for by the ignorance of their serological status which would increase the seropositivity of this category of donors but this is not the case in a repeat donor who regularly donates blood and on the other hand, is informed of his serological status. In some studies conducted in Brazil, Kenya, and Malawi, new donors are significant associated with HIV infection [16,25,27]. Among seropositive donors, the study observed five (5) cases of co-infections only in new donors and with an overall prevalence of 0.14%. This observation could be explained by the different risk behaviors adopted by some people, such as unprotected sex with multiple partners, but also by tattoos and injecting drugs. These behaviors would promote co-infections in this category of people. This statement has been confirmed in some studies carried out in different countries namely Burkina Faso (0.06%) and Mali (0.09%) that co-infections were frequent among new donors [16,28].

Study limitations were based on the unavailability of results on the day the assays were run and also the failure of reagents from one of the analyzers during the first weeks of the study. The tests were based on serology including the p24 antigen to reduce the window period but there is still a risk of residual transmission of HIV-1 which could have been identified by NAT or by cohort analysis. The effect of genetic diversity in HIV-1 on residual risk remains to be determined.

## 5. CONCLUSION

Ultimately, the seropositivity of HIV infection among donors from the Libreville National Blood Transfusion Center was found to be low compared to previous studies conducted locally. Of note, in the Gabonese context, about one out of a hundred blood donors are HIV-infected. These carriers of HIV infection in the blood banks are mainly those with multiple sexual partners, with limited education, and with poor dental care. Therefore, the questionnaire on risk assessment of HIV infection among blood donors should consider these factors for exclusion, especially in the urban settings of Gabon.

## CONSENT AND ETHICAL APPROVAL

The study was approved by the general management of the NBTC and by the National Committee of Ethics for Research (NCER) of Gabon. The number of the ethics opinion certificate was N ° 0087/2019 / PR / SG / NCER. The informed consent form was signed by each study participant.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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