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Number of Recent Sexual Partners among Blood Donors in Brazil: Associations with Donor Demographics, Donation Characteristics and Infectious Disease Markers

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Abstract

BACKGROUND—Brazilian blood centers ask candidate blood donors about the number of sexual partners in the last 12 months. Candidates who report a number over the limit are deferred. We studied the implications of this practice on blood safety.

STUDY DESIGN AND METHODS—We analyzed demographic characteristics, number of heterosexual partners, and disease marker rates among 689,868 donations from three Brazilian Centers between July 2007 and December 2009. Donors were grouped based on maximum number of partners allowed in the last 12 months for each center. Chi-square and logistic regression analysis were conducted to examine associations between demographic characteristics, number of sex partners, and individual and overall positive markers rates for HIV, HTLV-1/2, HBV, HCV, and syphilis.

RESULTS—First-time, younger and more educated donors were associated with a higher number of recent sexual partners, as was male gender in São Paulo and Recife ($p < 0.001$). Serologic markers for HIV, syphilis and overall were associated with multiple partners in São Paulo and Recife ($p<0.001$), but not in Belo Horizonte ($p= 0.05, 0.94, 0.75$, respectively). In logistic regression analysis, number of recent sexual partners were associated with positive serologic markers (AOR=1.2–1.5) especially HIV (AOR=1.0–4.4).

CONCLUSIONS—Number of recent heterosexual partners was associated with HIV positivity and overall rates of serological markers of sexually transmitted infections. The association was not consistent across centers, making it difficult to define the best cut-off value. These findings

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suggest the use of recent heterosexual contacts as a potentially important deferral criterion to improve blood safety in Brazil.

Introduction

Transfusion medicine has undergone many changes in the past few decades, largely because of the threat of blood borne diseases. Deferring high risk donors and expanded laboratory tests for infectious agents have dramatically decreased the rates of transfusion-transmitted infections.[1] The predonation interview aims to protect both donors and recipients.[2,3] Moreover, for infectious diseases for which we do not routinely test, donor selection is the only safeguard for the blood supply. However, if deferral criteria are too rigid, safe donors could be excluded and the availability of blood in the supply compromised. A balance between rational screening criteria and blood safety is therefore important to maintain the blood supply while mitigating the risk for transfusion transmitted diseases.

The development of rational deferral criteria depends on regional, geographic, social, cultural, psychological and economic characteristics, and should be based on analysis of country specific data. The Uniform Donor History Questionnaire applied in the United States contains more than 40 questions, with nearly 20% of them focused on sexual behavior.[4] Similarly, in Brazil the Ministry of Health promulgated a protocol, in line with regional and international rules, that must be followed. The protocol includes a number of questions and suggested eligibility criteria based on sexual activity. However, there is no standardized national policy stipulating eligibility of candidates according to the number of sexual partners, except for man who had sex with another man (MSM). MSM are eligible if they have not had a sexual partner in the last 12 months.[5]

Although not mandatory, Brazilian blood banks ask donors specific questions regarding the number of heterosexual sexual partners in the last twelve months during predonation interviews. Criteria for the acceptable number of recent sex partners at different blood centers are variable. In the Brazilian and international literature there is no consensus on the utility of deferring candidate donors based on recent heterosexual activity criteria or the number of heterosexual partners in a defined time period.[6,7] The purpose of this study was to evaluate the associations between number of sexual partners, donor and donation characteristics, and the prevalence of positive serologic tests in accepted donors at three regionally distinct blood centers in Brazil.

Material and Methods

Overall study design and setting

The International Retrovirus Epidemiology Donor Study-II (REDS) in Brazil includes three blood centers: 1) Fundação Pró-Sangue (FPS– São Paulo, São Paulo); 2) Fundação Hemominas (FH-MG-Belo Horizonte, Minas Gerais); and 3) Fundação Hemope (FH-Recife, Pernambuco). The first two are in the Southeastern part of Brazil and the third in the Northeast. Donor and donation data from each center are captured in a single data warehouse in São Paulo and then transferred to a coordinating center in the United States. Demographic information and serologic test data on all blood donations are collected, prepared and transferred electronically to the coordinating Center (Westat, Rockville, MD) for compilation and analysis.[8]

We conducted a cross-sectional study to examine the association between self-reported number of heterosexual sexual partners, in demographic and donation data, and serologic results for HIV, HTLV-1/2, HBV, HCV and syphilis at three REDS-II blood centers in Brazil, from July 2007 through December 2009.

Study subjects, procedures and deferral criteria

Records of voluntary allogeneic whole blood and platelet donations were extracted and analyzed. Demographic characteristics evaluated were gender, age, ethnicity, donor status (First time vs. repeat), education level, and donor type (Replacement vs. Community). Paying donors is forbidden in Brazil. Volunteer donors can give either at the request of or on behalf of a specific donor to replace units in the overall supply (defined as replacement donations) or to the general blood supply (defined as community donations). Replacement donors are generally recruited among friends and relatives of hospitalized patients and community donors through media campaigns. Donation is allowed for persons 18 to 65 years of age. The predonation screening consists of blood pressure, pulse and temperature, hematocrit check, medical history and sexual risk behavior interview. The interviews are private, face-to-face and performed by physicians or trained nurses and technologists under medical supervision, according to Standard Operational Procedures of each institution. All the answers are recorded at the time of the interview on a computer and audits are performed routinely to monitor conformity with procedures. In São Paulo and Recife, the question about sexual partners during predonation interview is: “How many sexual partners have you had in the last 12 months?” In Belo Horizonte, it is: “Have you had more than one sexual partner in the last 12 months? (If yes,) How many?”

The current criteria to defer donors are more than 6, 3 and 2 heterosexual partners in the past 12 months in São Paulo, Recife and Belo Horizonte, respectively.

Laboratory methods

Serologic results of each donation were recorded, including two EIA results for hepatitis B surface antigen (HBsAg), one result of antibodies to hepatitis B core antigen (anti-HBc), two EIA results for hepatitis C virus (anti-HCV), anti-HIV-1/2, and Human T-cell lymphotropic virus (HTLV-1/2), and one screening result of syphilis. Laboratory screening was performed in the three Blood Centers using kits approved by the Brazilian Ministry of Health. Each having sensitivity higher than 99% as described in the manufacturer's package insert information. The kits used in each center were not necessarily the same. However, in the case of a reactive or borderline result for HCV, HTLV-1/2, HBsAg, testing was repeated at the Serology Division of FPS, with a second EIA kit that was not utilized by any of the three centers using previously reported procedures.[9,10] For each donation an overall positive marker result was defined as any one of the following scenarios: dual EIA reactive result for HBsAg, HCV, HTLV-1/2, or HIV, or a reactive result for syphilis or anti-HBc screening.

Statistical analysis

Chi-square statistics were used to compare demographic characteristics, first time vs. repeat donor status, community vs. replacement donation type, individual and overall positive marker rates and specific markers associated with sexual transmission (HIV, syphilis and HB anti-core) by number of sex partners within each center. Since each center used a different cutoff number of sex partners to defer donors, and preliminary analysis suggested that the individual and overall positive marker rates were different by center and number of sex partners, we created a 10-level categorical variable to examine positive marker differences by center and number of sex partners. The 10 levels represent the following groups defined by number of sex partners and center: 0–1, 2, 3, 4–5, and 6 in São Paulo, 0–1, 2, and 3 in Recife, 0–1 and 2 in Belo Horizonte. Logistic regression analysis predicting positive marker rates (HIV, syphilis, anti-core, and overall) by this 10-level variable was conducted, adjusting for demographic variables, first time vs. repeat donor status, and community vs. replacement donation type. The 0–1 sex partner group in São Paulo was the largest group and had the lowest positive marker rate and was therefore used as the reference group. All São Paulo sex partner categories were compared to 0–1 partners in São Paulo. For

Recife and Belo Horizonte, 0–1 partners were compared to 0–1 partners from São Paulo. In addition, higher number partner categories were also compared with each 0–1 partner category within the same center.

Results

There were 689,868 complete records of approved candidates for whole blood and apheresis donations at the three REDS-II centers in Brazil from July 1, 2007 through December 31, 2009. Overall, a total of 332,692 (48.2%) donors were from São Paulo, 187,924 (27.3%) from Recife and 169,252 (24.6%) from Belo Horizonte. The majority of donors were male, with 208,866 (62.8%) in São Paulo, 155,563 (82.8%) in Recife, and 107,760 (63.7%) in Belo Horizonte. The number of sexual partners was not routinely registered at time of donation before REDS-II started in Brazil. After the program launched, there were some difficult to standardized data collection. Hence there were 71,191 (9.4%) donations not included in analysis because of missing information on the new included questions such as number of sexual partners, educational level, etc, mainly in Recife. However, on inquiry to centers we reasoned these were missing at random.

Table 1 presents the distribution of the blood donors by center according to self-reported number of heterosexual partners and donor and donation characteristics, including serological marker rates. The great majority of donors reported 0–1 sexual partners in the year before donation (Table 1). Demographic characteristics associated with higher number of sexual partners were male gender ($p<0.001$ for São Paulo and Recife), younger age ($p<0.001$), black race (<0.001 for São Paulo only) first-time donation status ($p<0.001$) and higher levels of education ($p<0.001$). Donor type, i.e. community or replacement, was not associated with the number of sexual partners.

The overall reactive serologic markers for HIV, HTLV-1/2, HBV, HCV and syphilis was 3.2% in Recife, 1.6% in São Paulo and 2.1% in Belo Horizonte (Table 2). Overall, Recife had higher rates than Belo Horizonte, which had higher rates than São Paulo with regard to HIV, syphilis, HB anti-core, HBsAg, and overall markers. However, São Paulo had the highest HCV rates among the three centers, and Recife had higher HTLV rates than both São Paulo and Minas. There was also a decreasing trend in HIV rates, but increasing trend in syphilis, HB anti-core, HCV, HTLV, and overall marker rates, associated with increasing age.

Serologic markers, HIV and syphilis in particular, were associated with a higher number of sexual partners in São Paulo and Recife ($p<0.001$), but not in Belo Horizonte ($p=0.75$, 0.05, 0.94 for overall, HIV, and syphilis respectively). Figure 1 displays the HIV, syphilis, HB anti-core, and overall marker rates by center and number of partners. There is a clear trend in HIV dual EIA reactive rates associated with higher numbers of recent partners in all three centers. Such a trend for syphilis, HB anti-core, and overall markers is also observed in São Paulo and Recife, but not in Belo Horizonte.

In logistic regression analyses, the number of sexual partners was associated with positive serologic markers after adjusting for demographic characteristics, first time vs. repeat donor status, and donation type, with adjusted odds ratios (AORs) varying from 1.2 for overall markers in Recife (2 vs. 0–1 partners) to 4.4 for HIV in Recife (3 vs. 0–1 partners). The trend in the association between higher marker rates and higher number of partners was still significant for HIV in São Paulo. As shown in Table 3, in São Paulo, compared with the largest subgroup of donors with 0–1 sexual partners, donors with 2, 3, 4–5, and 6 partners there were 1.3, 1.4, 1.5, and 1.2 times more likely, respectively, to have an overall positive serological result. For HIV, the corresponding AORs were 1.9, 2.3, 3.7, and 4.3, respectively. The elevated AORs were statistically significant except for 6 partners.

However, few donors reported 6 partners (n=382, 0.11% of São Paulo donations) and the serologic marker rates for 6 partners were statistically equivalent to the rates for 4–5 partners (p=0.88, 0.44, 0.55, 0.55 for HIV, syphilis, HB anti-core, and overall respectively). In Recife, 2 and 3 sexual partners were also significantly associated with more serological markers of infection. Donors with 2 recent partners were 1.2 times and those with 3 recent partners were 1.4 times more likely to have positive serological results when compared to 0–1 partners in Recife. Donors with 3 partners were 4.4 times more likely to be dual EIA reactive for HIV when compared with those with 0–1 partners. However, in Belo Horizonte, no significant difference was found between 2 and 0–1 sexual partners (AOR 0.9, 95% CI, 0.6–1.4), although for HIV the AOR was borderline significant (AOR=3.14 95%CI- 0.99–9.96). Across the three centers, when donors with 0–1 sexual partners in Recife and Belo Horizonte were compared with those in São Paulo, Recife donors were more likely to have a positive serologic marker (AOR = 1.9 for the overall positive marker; AOR = 1.7 for HIV; AOR = 2.9 for syphilis; AOR = 1.5 for HB anti-core) and Belo Horizonte donors also displayed a moderately higher association with positive markers (AOR = 1.2 for the overall positive marker; AOR = 1.8 for syphilis; AOR = 1.1 for HB anti-core).

It is interesting to note in Table 3, that in the multivariate model first-time donors, male (AOR=2.28, 95%CI 1.74–2.99), race (AOR Black =1.61, 95%CI1.16–2.24) and AOR mixed race = 1.39, 95%CI 1.09–1.77) and community donors (replacement AOR = 0.72 [95%CI -0.57–0.90]) remain significantly associated with HIV infection. However these ORs were all lower than those for donors with 4 sexual partners in São Paulo (AOR=3.65, 95%CI 1.69–7.89) and 3 sexual partners in Recife (AOR=4.43, 95% CI 2.16–9.09), and 2 sexual partners in Belo Horizonte (AOR=3.14, 95% CI 0.99–9.96), although the OR in Belo Horizonte is borderline significant.

Discussion

We found an association between higher number of heterosexual partners in the past year and higher rates of infectious disease markers, and in particular HIV infection, among eligible blood donors in Brazil. This suggests that screening for number of recent partners, as performed routinely with different cut-off criteria in the different blood centers in Brazil, potentially contributes to enhancing blood safety. In addition, we found that blood donors who had more sexual partners in the last 12 months are more likely to be male and younger, consistent with broader epidemiological data indicating increased risk for sexually transmitted diseases.

There are relevant economic, cultural, and social differences between Brazil and other countries that can impact blood safety. First, NAT is not performed routinely in the whole country.[5] Second, HIV incidence and estimated residual transfusion risk are approximately 10 times higher in first time donors in Brazil when compared to US and European first time donors.[11] Third, educational brochures have not been shown to be efficacious with respect to increasing donor self-deferral or disclosure of behavioral risk.[12] Finally, Confidential Unit Exclusion has been shown to have no benefit in the reduction of positive serologic tests among donors.[10] In this context, one could advocate that the association between number of recent heterosexual partners and positive serologic markers is evident and, deferring donors with higher number of sexual partners remains an important contributor to blood safety in Brazil. The association between HIV and the number of sexual partners observed in São Paulo and Recife are particularly disturbing. Remarkably, the association of HIV and 4–5 sexual partners showed the highest AOR among all studied variables.

Although centers have included a question about number of sexual partners routinely in Brazil, no one has previously analyzed the effect of this measure on blood supply either at

individual centers or across centers. The number of allowed sexual partners in candidate donors is different in each site, and the number of self-reported partners is also different. If we had considered only donors with 0–2 partners (i.e., ≤2 partners was the criterion for acceptance at all centers), São Paulo would have almost 7% of the donors with two partners while Belo Horizonte and Recife would have less than 1%. This could be due to regional differences in sexual activity but is probably also related to other aspects of the donor selection and interview process. For example, there are other questions used during donor screening that are more stringent in not allowing donors with more than 0–1 partner to donate in Belo Horizonte and Recife as compared to São Paulo. All centers defer donors if they indicate that they had "casual" sexual partners, but the meaning of "casual" differs: for São Paulo and Recife it is someone the donor had not met before; in Belo Horizonte it is someone who had been a sexual partner for less than one year. These questions may directly affect the total number of sexual partners in accepted donors, and probably explain why two sexual partners in Belo Horizonte have the same rate of infectious marker as 0–1 in São Paulo. Lending further support to the impact of blood center practices, Di Lorenzo Oliveira et al., reported that one third of first time and almost 20% of repeat donors in Minas Gerais State were temporally deferred because they disclosed risk behaviors associated with sexual transmitted disease.[13] In contrast at FPS in São Paulo and Hemope in Recife the overall rates of deferral for risk behaviors are 9% and 10% respectively.[14]

Another possible explanation for different proportions of self-reported number of recent sexual partners among centers is the fact that repeat donors are already aware of cut-off limits to be accepted at the center where they give blood. Thus, some repeat donors may omit accurate information about their sexual behavior to avoid being deferred. For example in Recife where 3 partners is the maximum number accepted, for HIV the AOR of 2 vs 0–1 and 3 vs 0–1 were 1.00 (95%CI 0.41–2.45) and 4.43 (95%CI 2.16–9.09), suggesting that there are people with more than 3 partners saying that they had only 3 sexual partners. In São Paulo the corresponding increase in risk from 2 to 3 sexual partner is 1.87 (95%CI 1.15–3.04 and 2.28 (95%CI 1.11–4.69).

Another interesting aspect of the analysis is that although São Paulo had less restrictive deferral criteria, the overall infectious marker rate was higher in Recife and Belo Horizonte. There are two possible explanations. First the prevalence in the general population is higher in those regions; however there are no reports comparing rates of infectious markers in the three general populations of each region. Another explanation is that we used overall reactivity to markers including syphilis and HB anti-core, and those markers were not confirmed. Differences in the laboratory procedures could produce differences in the overall prevalence.

Another striking finding of this study is the strong age cohort effect evident in the risk of serological markers of infection. While older age donors would be expected to have cumulatively higher rates of infection than younger donors, the differences observed here are remarkable, mainly when we evaluate EIA tests for syphilis and HB anti-core. Number of sexual partners in the past years does not seem to correlate well with those markers, probably because they are more associated with lifetime number of sexual partners. Even after adjusting for other factors, there were very large monotonic differences evident. Part of these results may be attributable to age cohort effects reflecting reduced prevalence of HBV and syphilis infection in younger ages of the general population in Brazil. In contrast, HIV positivity was higher among younger donors, reflecting the increased risk of exposure of this population to HIV infection.

The Donor Health Questionnaire in Brazil has 40 or more questions and, operationally, to withdraw the question about number of sexual partners would reduce the time the donor and

staff spend in the qualification process. Considering that the pre-donation interview in Brazil is face-to-face, some candidates may not feel comfortable disclosing sexual behaviors and may not honestly answer questions related to stigmatizing or socially sensitive behaviors[15] or even may not understand the meaning of various sex-related screening questions as described for students in US and Canadian blood donors[16,17]. Another possible source of inaccuracy would be the donor's recall about number of sexual partners in the last 12 months. Furthermore, face-to-face pre-donation interviews are often conducted mechanically by the staff who repeat questions over and over, in a flat tone of voice, which could make it difficult for a donor to focus his/her attention for a long time.[18] This study did not seek to address these particular issues related to donor screening practices. However, it is possible that these issues have led to the misclassification of self-reported number of sexual partners in the previous year by some donors.

There are other disadvantages that must be taken into account when blood donors are deferred based only on number of recent sexual partners. A balance must be struck in donor eligibility that meets the simultaneous goals of achieving the safest blood supply possible while still ensuring that an adequate quantity of blood in the supply is available to meet transfusion needs. Younger and more educated donors have shown higher return[19,20] and depending on the infection lower serological marker yield rates and represent an opportunity to increase the blood supply. Consequently, to mitigate the loss of young and more educated donors because of higher number of sexual partners, blood centers will either need to recruit first time donors who present higher risks of reactive serologic markers or figure out more successful ways to maximize return rates in lower risk repeat donors.

We recognize potential limitations in our study. The cut-offs for deferring a donor based on number of partners, donors' characteristics and, prevalence of serologic markers are different among the centers. Thus, comparing the numbers of sexual partners among centers may be confounded by geographic differences in the epidemiology of each infection. However, data from three blood centers located in different geographic regions are more representative of the Brazilian population and strengthen the generalizability of the findings. Another potential source of bias is that we evaluated only eligible donors. These donors were submitted to a predonation screening that comprises not only sexual risk behavior, but also other risks for transfusion transmitted diseases. It would be very valuable to determine if donors who are deferred for having too many heterosexual partners at each of the centers have even higher rates of infectious markers. A study of deferred donors at blood centers in Brazil will soon be completed and may be able to provide currently unavailable data on this topic. The lack of standard confirmatory tests on all donations, such as HIV Western Blot and HCV RIBA, to confirm screening tests is another limitation (such testing is only performed in Brazil on donors who return for retesting and counseling); however to enhance the accuracy of the results, we performed validated confirmatory algorithms using second EIA tests for each agent, different from the screening test and performed in a single reference laboratory, as described elsewhere[12,13].

In conclusion, our data show the complexity of using questions related to the number of heterosexual partners in blood banks. The number of self reported recent heterosexual partners in donors from three Brazilian blood centers was associated with positive serologic markers, mainly with HIV. The association was not consistent across the centers, reflecting other factors such as regional differences in the prevalence of sexually transmitted infections in the general population of Brazil. Before implementation of number of heterosexual partners deferral policies within each country, studies should be carried on to evaluate the impact on blood bank practice. The challenge for blood banks is to evaluate if screening donors for the number of sexual partner can be translated into a decrease in the residual risk of transfusion transmitted infections without jeopardizing the blood availability.

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Abbreviations

AOR	adjusted odds ratio
EIA	enzyme immunoassay
FPS	Fundação Pró-Sangue, Hemocentro de São Paulo
HBV	hepatitis B virus
Hemope	Hemocentro de Pernambuco
MSM	man who had sex with another man
REDS	International Retrovirus Epidemiology Donor Study

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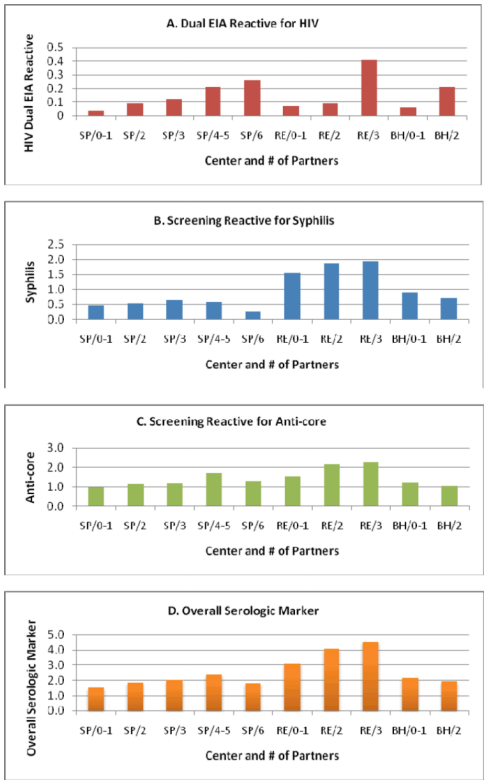

Figure 1.

Infectious disease markers by center and number of sexual partners. A. Dual EIA reactive for HIV; B. Screening reactive for syphilis; C. Screening reactive for HB Anticore; D. Overall serologic marker (defined as dual EIA reactive for HIV, HBsAg, HCV, or HTLV, or screening reactive for anticore or syphilis).

SP= São Paulo, RE=Recife; BH=Belo Horizonte

Table 1

Distribution of Demographic Characteristics and confirmatory serologic markers by Number of Sexual Partners (%)

Demographic Characteristic	Number of Sex Partners									
	Recife			São Paulo					Belo Horizonte	
	0–1	2	3	0–1	2	3	4–5	6	0–1	2
Total # of donations	180,135	5,840	1,949	300,926	21,508	6,553	3,323	382	167,855	1,397
% within each center	95.9	3.1	1	90.5	6.5	2	1	0.1	99.2	0.8
Gender*										
Male	95.4	3.4	1.2	88.6	7.3	2.6	1.4	0.2	99.2	0.8
Female	98.3	1.5	0.2	93.6	5.1	1.0	0.3	0.01	99.2	0.8
Age†										
<25	93.8	4.3	2.0	83.2	10.2	3.9	2.4	0.3	98.4	1.6
25–34	95.8	3.2	1.1	89.5	7.3	2.2	1.0	0.1	99.2	0.8
35–44	96.7	2.6	0.6	93.8	4.7	1.1	0.4	0.03	99.7	0.3
45–54	97.3	2.3	0.5	96.0	3.1	0.6	0.6	0.04	99.8	0.2
>55	97.6	2.0	0.4	97.3	2.0	0.5	0.5	0.02	99.8	0.2
Race‡										
Black	95.8	3.3	0.9	89.2	7.2	2.2	1.2	0.1	99.2	0.8
Mixture	95.9	3.1	1.0	90.6	6.5	1.9	0.9	0.1	99.3	0.7
White	95.7	3.1	1.2	90.6	6.3	2.0	1	0.1	99.0	1.0
Red or Yellow	96.1	2.9	1.0	89.8	6.9	2.3	0.9	0.09	99.0	1.0
Donor Status†										
First Time	94.1	4.1	1.7	86.9	8.1	3.0	1.8	0.2	98.6	1.4
Repeat	96.5	2.7	0.8	92.1	5.7	1.5	0.7	0.07	99.4	0.6
Education†,										
< 8 year	96.9	2.5	0.6	94.1	4.2	1.2	0.5	0.05	99.4	0.6
Complete 8 year	96.0	3.2	0.8	92.1	5.4	1.5	0.9	0.1	99.4	0.6
11 year	95.5	3.3	1.2	89.4	7.1	2.2	1.1	0.1	99.0	1.0
College and above	95.9	2.9	1.3	90.4	6.7	2.0	0.9	0.09	98.9	1.1

* p<0.001 for all centers, except Belo Horizonte;

† p< 0.001 for all variables;

‡ p<0.001 for São Paulo and Belo Horizonte, p=0.03 for Recife

Table 2

Serological Markers by Center and by Demographic Characteristics (%)

	HIV	Syphilis	HB anti-core	HBsAg	HCV	HTLV	Overall Marker*
Overall	0.06	0.87	1.20	0.08	0.09	0.04	2.15
Center							
Recife	0.08	1.55	1.55	0.12	0.07	0.06	3.18
Belo Horizonte	0.06	0.91	1.22	0.09	0.04	0.03	2.14
São Paulo	0.05	0.47	0.98	0.06	0.13	0.03	1.58
Age in Years							
<25	0.06	0.33	0.78	0.07	0.06	0.03	1.23
25–34	0.07	0.53	1.03	0.09	0.09	0.03	1.71
35–44	0.06	1.01	1.38	0.09	0.09	0.05	2.47
45–54	0.03	2.01	1.75	0.08	0.14	0.07	3.71
>55	0.03	2.57	2.17	0.06	0.15	0.05	4.50
Gender							
Female	0.03	0.68	1.22	0.07	0.12	0.07	2.02
Male	0.07	0.96	1.19	0.09	0.08	0.03	2.21
Education							
< 8 year	0.07	1.77	2.27	0.14	0.13	0.07	4.03
Complete 8 year	0.07	1.42	1.64	0.13	0.12	0.06	3.13
11 year	0.05	0.62	0.93	0.06	0.09	0.03	1.66
College and above	0.05	0.41	0.69	0.05	0.06	0.02	1.20
Race							
White	0.04	0.62	0.87	0.05	0.09	0.03	1.57
Black	0.07	1.03	1.50	0.13	0.10	0.06	2.60
Mixture	0.06	1.03	1.33	0.09	0.09	0.05	2.44
Other	0.03	0.37	1.00	0.11	0.06	0.06	1.45
Donor Status							
Repeat	0.04	0.56	0.23	0.02	0.02	0.01	0.86
First Time	0.09	1.58	3.40	0.23	0.27	0.12	5.12
Donation Type							
Community	0.05	0.58	0.84	0.06	0.08	0.03	1.52
Replacement	0.06	1.43	1.89	0.12	0.11	0.06	3.39

*Overall marker is defined by dual EIA reactive for HIV, HBsAg, HCV, or HTLV, or screen reactive for syphilis or anti-core.

**p< 0.001 for all variables except for the following: HIV by education levels, p = 0.06; Anti-core by gender, p = 0.30; HCV by race, p=0.50; HBsAg by age, p = 0.42.

Table 3

Adjusted Odds Ratios (95% CI) Predicting Serological Markers in Logistic Regression Analysis

Variables	HIV	Syphilis	HB anti-core	Overall Marker
Center by # of Partners *				
SP/0–1 partner	1	1	1	1
SP/2 partners †	1.87 (1.15–3.04)	1.45 (1.19–1.76)	1.21 (1.06–1.39)	1.32 (1.19–1.47)
SP/3 partners †	2.28 (1.11–4.69)	1.83 (1.34–2.50)	1.14 (0.91–1.43)	1.38 (1.15–1.65)
SP/4–5 partners †	3.65 (1.69–7.89)	1.63 (1.03–2.57)	1.53 (1.17–2.01)	1.53 (1.22–1.93)
SP/6 partners †	4.29 (0.60–30.93)	0.73 (0.10–5.23)	1.16 (0.48–2.82)	1.16 (0.54–2.46)
RE/ 0–1 vs. SP/0–1 partner	1.69 (1.29–2.22)	2.86 (2.66–3.07)	1.50 (1.41–1.59)	1.90 (1.82–1.99)
RE/2 vs. RE/0–1 partners †	1.00 (0.41–2.45)	1.21 (0.99–1.47)	1.19 (0.99–1.43)	1.18 (1.03–1.35)
RE/3 vs. RE/0–1 partners †	4.43 (2.16–9.09)	1.43 (1.02–1.99)	1.21 (0.89–1.65)	1.35 (1.08–1.68)
BH/0–1 vs. SP/0–1 partner	1.18 (0.86–1.62)	1.81 (1.67–1.97)	1.08 (1.01–1.16)	1.22 (1.16–1.29)
BH/2 vs. BH/0–1 partners †	3.14 (0.99–9.96)	0.98 (0.52–1.83)	0.73 (0.43–1.24)	0.89 (0.60–1.31)
Age in Years				
<25	1	1	1	1
25–34	1.51 (1.16–1.97)	2.21 (1.99–2.45)	2.22 (2.07–2.38)	2.15 (2.03–2.28)
35–44	1.45 (1.07–1.97)	4.47 (4.02–4.96)	3.72 (3.46–4.01)	3.69 (3.48–3.91)
45–54	0.63 (0.39–1.02)	9.67 (8.71-	5.14 (4.74–5.58)	6.11 (5.75–6.50)
>55	0.82 (0.39–1.72)	13.85 (12.23-	6.99 (6.27–7.80)	8.26 (7.61–8.95)
Gender				
Female	1	1	1	1
Male	2.28 (1.74–2.99)	1.29 (1.22–1.38)	1.21 (1.15–1.27)	1.20 (1.15–1.24)
Education				
11 year	1	1	1	1
< 8 year	1.35 (0.99–1.84)	1.48 (1.38–1.58)	1.58 (1.49–1.68)	1.51 (1.44–1.58)
Complete 8 year	1.24 (0.94–1.64)	1.41 (1.31–1.51)	1.36 (1.28–1.45)	1.37 (1.31–1.44)
College and above	1.21 (0.88–1.66)	0.61 (0.55–0.68)	0.71 (0.65–0.77)	0.68 (0.63–0.72)
Race				
White	1	1	1	1
Black	1.61 (1.16–2.24)	1.51 (1.38–1.64)	1.69 (1.57–1.82)	1.60 (1.51–1.69)
Mixture	1.39 (1.09–1.77)	1.26 (1.19–1.35)	1.36 (1.29–1.44)	1.32 (1.26–1.37)
Other	0.79 (0.25–2.49)	0.80 (0.57–1.12)	1.34 (1.09–1.65)	1.11 (0.93–1.32)
Donor Status				
Repeat	1	1	1	1
First Time	2.67 (2.15–3.30)	4.01 (3.79–4.24)	20.59 (19.26–22.00)	8.64 (8.31–8.99)
Donation Type				
Community	1	1	1	1

Variables	HIV	Syphilis	HB anti-core	Overall Marker
Replacement	0.72 (0.57–0.90)	1.23 (1.16–1.30)	0.99 (0.94–1.04)	1.08 (1.04–1.12)

*SP = São Paulo; RE = Recife; BH = Belo Horizonte

†Within-Center comparisons used 0–1 partner at each center as a reference group