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Vasovagal reactions in whole blood donors at three REDS-II blood centers in Brazil

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BACKGROUND: In Brazil little is known about adverse reactions during donation and the donor characteristics that may be associated with such events. Donors are offered snacks and fluids before donating and are required to consume a light meal after donation. For these reasons the frequency of reactions may be different than those observed in other countries.

STUDY DESIGN AND METHODS: A cross-sectional study was conducted of eligible whole blood donors at three large blood centers located in Brazil between July 2007 and December 2009. Vasovagal reactions (VVRs) along with donor demographic and biometric data were collected. Reactions were defined as any presyncopal or syncopal event during the donation process. Multivariable logistic regression was performed to identify predictors of VVRs.

RESULTS: Of 724,861 donor presentations, 16,129 (2.2%) VVRs were recorded. Rates varied substantially between the three centers: 53, 290, and 381 per 10,000 donations in Recife, São Paulo, and Belo Horizonte, respectively. Although the reaction rates varied, the donor characteristics associated with VVRs were similar (younger age [18-29 years], replacement donors, first-time donors, low estimated blood volume [EBV]). In multivariable analysis controlling for differences between the donor populations in each city younger age, first-time donor status, and lower EBV were the factors most associated with reactions.

CONCLUSION: Factors associated with VVRs in other locations are also evident in Brazil. The difference in VVR rates between the three centers might be due to different procedures for identifying and reporting the reactions. Potential interventions to reduce the risk of reactions in Brazil should be considered.

Blood donation is recognized as an extremely safe procedure;[1,2] however, vasovagal (presyncopal and syncopal) reactions during or after donation increase the potential for donor injury. The prevalence of the vasovagal reactions (VVRs) varies by country,[1-8] and by many other factors such as age, sex, donation history (first-time vs. repeat), body mass index (BMI), estimated blood volume (EBV) of donors,[1,2] and type of donation (i.e., allogeneic or autologous whole blood donation, plamaspheresis, plateletpheresis, and multicomponent donations[4] including double-red-blood-cell collections[9]). Fortunately, the majority of adverse events are minor in severity,[8,10] but occasionally VVRs of higher severity occur.[11]

In Brazil, a country with a population of about 190 million,[12] the total annual allogeneic blood collection is approximately 3 million units, or 21 blood donations per

ABBREVIATIONS: BMI = body mass index; EBV = estimated blood volume; VVR(s) = vasovagal reaction(s); WBV = whole blood viscosity.

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1000 inhabitants.[13] Specific procedures are defined for donor recruitment, deferral criteria, laboratory tests, proper handling, and related component preparation procedures. The regulations are similar to those in place in the United States[14] and Europe,[15] and internationally accepted procedures and guidelines are used as reference in the development of Brazilian regulatory and practice guidelines.[16] In Brazil little is known about VVRs associated with blood donation, including the rates, severity, and characteristics of blood donors who have adverse reactions and variability of the VVRs between blood centers. We report on the rates and risk factors for VVRs in Brazil.

MATERIALS AND METHODS

Overall study design

The NHLBI International REDS-II study in Brazil started in 2007 and is composed of three major public blood banks. Two of them are in the southeast (Fundação Pro-Sangue, São Paulo and Fundação Hemominas, Belo Horizonte, Minas Gerais),[17] while the third is in the northeast (Fundação Hemope, Recife, Pernambuco). This study is a retrospective cross-sectional study of all allogeneic donors who donated blood between July 2007 and December 2009 at the three REDS-II international blood sites in Brazil.

Measures

Data originate from standard procedures in place to capture information over the course of blood donation. In accord with Federal guidelines, it is mandatory to check vital signs before donation.[18] Each blood donor must meet acceptability criteria before being subjected to phlebotomy. These criteria include age between 18 and 65 years, minimum weight 50 kg (110 lb), and being in good general health. The acceptable vital signs at each center are provided (Table 1) and are generally similar throughout Brazil. A questionnaire concerning the medical history is completed for every potential blood donor by a physician in Recife and Belo Horizonte and by a trained nurse in São Paulo.

The Federal guidelines also recommend that no blood should be collected from candidates who are fasting and the blood center should offer a small snack before donation. After the donation, it is obligatory to supply adequate oral hydration and a light meal or snacks. There are small differences in the donor intake procedures at the blood centers. In São Paulo and Recife, the prospective blood donor goes to the registration, then vital signs and anemia testing, and if the blood donor is approved he or she goes to the donation area. In Belo Horizonte after acceptance for donation, donors go to the snack area and then to the donation area. Restrictions are also in place indicating that no blood should be collected from candidates who ate a large meal, rich in fatty foods, or consumed alcohol within 4 hours before donation. Of note, there is no height restriction for blood donation in Brazil, and weight is usually self-reported.

A trained technician performs the phlebotomy in a separate room in the blood bank while the donor is in a semisupine position. The total volume of blood to be collected should not exceed 8 mL/kg for women and 9 mL/kg for men. The allowed donation volume is 450 ± 50 mL, which may be increased by 30 mL to perform laboratory tests required by law and technical internal guidelines. Table 1 shows the criteria for blood donation at each REDS-II Brazil blood center. After the blood collection, the blood donor remains seated for about 10 minutes and if she or he feels well, a light meal and refreshments are served at the canteen under attention of a trained technician for 15 minutes or more.

Only allogeneic whole blood donations were included in this analysis. Whole blood donation represents 98% of all of the donations in the REDS-II Brazil data set. Estimated blood volume (EBV) was calculated based on the formula of Nadler and colleagues[19] based on sex, height, and weight. Of note, height and weight are self-reported in

TABLE 1. Criteria for blood donation at each REDS-II Brazil blood center

Criterion	Recife	Belo Horizonte	São Paulo
Age (years)	18 ≤ age ≤ 65	18 ≤ age ≤ 65	18 ≤ age ≤ 65
Weight	≥50 kg or 110 lb	≥50 kg or 110 lb	≥50 kg or 110 lb
Pulse	60 ≤ pulse ≤ 100 bpm	60 ≤ pulse ≤ 100 bpm	60 ≤ pulse ≤ 100 bpm
Blood pressure (BP) (mmHg)			
Systolic	100 ≤ BP ≤ 160	100 ≤ BP ≤ 180	100 ≤ BP ≤ 180
Diastolic	60 ≤ BP ≤ 100	60 ≤ BP ≤ 90	60 ≤ BP ≤ 90
Hct or Hb			
Male	Hb: ≤13 g/dL	Hb: ≤13 g/dL 39 ≤ Hct ≤ 55	39 ≤ Hct ≤ 54
Female	Hb: ≤12.5 g/dL	Hb: ≤12.5 g/dL 38 ≤ Hct ≤ 54	38 ≤ Hct ≤ 50
Collection volume (mL)	450 mL	450 mL†	450 mL*

* São Paulo: males ≥ 50 kg = 450 mL; females ≥ 50 to ≤57 kg = 400 mL; females ≥ 57 kg = 450 mL.
† Belo Horizonte: males ≥ 50 kg = 450 mL; females ≥ 50 to ≤55 kg = 410 mL; females > 55 kg = 450 mL.

all three blood centers. VVRs are reported on nonstandardized forms; however, all forms capture specific symptoms of the reaction, monitoring of vital signs, and medical interventions received. Vasovagal adverse reactions were classified into three categories of severity: mild grade for presyncopal VVRs such as pallor, sweating, anxiety; moderate grade for hypotension, vomiting, and transient loss of consciousness; and severe grade for loss of consciousness associated with other signs and symptoms such as recurrent vomiting, prolonged pulse and/or blood pressure recovery times, incontinence, and convulsions, among other signs and symptoms. Only VVRs that occurred during or immediately after blood donation, while the blood donors still were at the blood center premises are included in this analysis. Needle-related injuries were excluded.

Statistical analysis

Unadjusted rates of reaction were calculated as the proportion of reactions out of all whole blood donation attempts overall and according to blood center and also donor demographic and biometric characteristics. Reaction rates and rates by severity category are expressed per 10,000 donations. Multivariable logistic regression analysis was performed to identify the predictors of VVRs associated with whole blood donation. All reactions were grouped into a single indicator variable for logistic regression analysis. Due to colinearity between EBV and BMI and separately between systolic and diastolic blood pressure, the logistic regression included only one of each pair. The decision of what to include was based on clinical considerations, since statistically the effects were indistinguishable. Results are reported as adjusted odds ratios (AORs) with associated 95% confidence intervals (95% CIs). The p values shown in Table 4 test common OR or center-specific OR for each characteristic in the model. Analyses were conducted using computer software (SAS/STAT, Version 9.2, SAS Institute, Inc., Cary, NC; and Excel, Version 2010, Microsoft, Inc., Redmond, WA).

RESULTS

A total of 724,861 allogeneic whole blood donations were attempted from July 2007 to December 2009 at the three centers, with 331,316 (45%) in São Paulo, 258,109 (36%) in Recife, and 135,436 (18.5%) in Belo Horizonte; 16,129 blood donors (2.2%) experienced VVRs (Table 2). Nearly 95% of VVRs were classified as mild, while 4.6% were moderate and 0.9% severe. Fifty-four percent of donors with reactions were male and 46% were female. Overall, the age group of 18 to 29 years old represented 42% of blood donors yet these young donors experienced 64% of VVRs.

Seventy percent of donors were male and 30% were female. However, only 54% of donors with reactions were male, while 46% were female. Therefore, females were more likely to experience VVRs with 339 reactions per 10,000 presentations compared to 172 reactions per 10,000 for males (Table 2), yielding a crude OR of 2.0 (95% CI, 1.9-2.1).

Replacement donors (who gave blood for their friends or relatives) had slightly higher rates of VVRs compared to community donors (233 and 217 per 10,000, respectively). High VVR rates were evident in first-time donors (428 per 10,000), donors aged 18 to 20 years (464 per 10,000), and donors with lower EBV (457 per 10,000) or underweight BMI (483 per 10,000). High pulse (>90 bpm) and low pulse (<65 bpm) were positively associated with the VVR (329 per 10,000 and 254 per 10,000 vs. 204 per 10,000 for those with pulse 65-90 bpm). Reaction rates were higher for donors with lower blood pressures (whether diastolic or systolic).

Importantly, the rates of VVR varied among the centers: Belo Horizonte had the highest rates of VVRs (381 per 10,000) followed by São Paulo (290 per 10,000) and Recife (53 per 100,000; Table 3). Reaction rates according to demographic characteristics at each center also demonstrated notable differences (Table 3). For example, reaction rates by race/ethnicity categories are highly variable. In Belo Horizonte donors with self-reported Asian race had reaction rates of 574 per 10,000 whereas the rate observed in Asian donors in Recife was 9 per 10,000. The rate in Belo Horizonte was the highest for any race/ethnicity category, while it was the lowest for any category in Recife.

Multivariable logistic regression analysis confirmed that VVRs in Brazil are highly associated with specific donor characteristics (Table 4). Independent predictors of VVRs include younger age, with donors 18 to 20 and donors 21 to 24 years of age having odds of reactions approximately threefold higher than for donors aged 41 to 65 (AOR 3.08, 95% CI 2.89-3.28; and AOR 2.80, 95% CI 2.64-2.97, respectively). First-time blood donors also had higher odds of reactions compared to repeat donors (AOR 2.49, 95% CI 2.41-2.58). Lower EBVs were associated with higher odds of reactions across the three blood centers. When compared to donors with EBVs of 5000 mL or more, donors with EBV of less than 3500 mL were 1.8 to 2.6 times more likely to have a VVR depending on the center, and other categories of EBV were also associated with the risk of reactions. Race/ethnicities other than white had significantly lower odds of reactions. Analysis of the odds of VVRs by center showed that donors in Recife had a lower odds of donors having documented reactions (AOR 0.21, 95% CI 0.20-0.22) compared to São Paulo, but Belo Horizonte was not significantly different than São Paulo. An unexpected finding was the association between increasing hematocrit (Hct) level and the odds of

TABLE 2. Reaction rate by demographic characteristics*

Characteristic	No reactions	Reactions	Rate of reaction (per 10,000 donations)
Reaction grade			
Mild		15,239 (94.5)	210
Moderate		745 (4.6)	10
Severe		145 (0.9)	2
Overall	708,732 (100.0)	16,129 (100.0)	222
Sex			
Female	212,812 (30.0)	7,466 (46.3)	339
Male	495,920 (70.0)	8,663 (53.7)	172
Age (years)			
18-20	59,282 (8.4)	2,887 (17.9)	464
21-24	99,642 (14.1)	3,793 (23.5)	367
25-29	138,077 (19.5)	3,703 (23.0)	261
30-40	229,513 (32.4)	3,946 (24.5)	169
41-65	182,079 (25.7)	1,800 (11.1)	98
Missing	139 (0.0)	0 (0.0)	
Donor type			
Community	455,505 (64.3)	10,092 (62.6)	217
Replacement	253,227 (35.7)	6,037 (37.4)	233
Donation history			
First-time	223,405 (31.5)	9,996 (62.0)	428
Repeat	485,327 (68.5)	6,133 (38.0)	125
Race/ethnicity			
Black	74,054 (10.4)	1,142 (7.1)	152
Mixed	297,053 (41.9)	5,299 (32.8)	175
White	274,620 (38.7)	8,059 (50.0)	285
Asian	7,160 (1.0)	202 (1.2)	274
Indigenous	2,034 (0.3)	70 (0.4)	333
Missing	53,811 (7.6)	1,357 (8.4)	
EBV (mL)			
<3500	30,780 (4.3)	1,474 (9.1)	457
3500-3999	80,164 (11.3)	3,117 (19.3)	374
4000-4499	101,218 (14.3)	2,834 (17.6)	272
4500-4999	154,046 (21.7)	3,201 (19.8)	204
≥5000	231,606 (32.7)	3,543 (22.0)	150
Missing	110,918 (15.6)	1,960 (12.2)	
BMI			
Underweight	4,355 (0.6)	221 (1.4)	483
Normal	263,008 (37.1)	8,264 (51.2)	305
Overweight	233,043 (32.9)	4,299 (26.6)	181
Obese	77,962 (11.0)	1,140 (7.1)	144
Severely obese	19,446 (2.7)	245 (1.5)	125
Missing	110,918 (15.7)	1,960 (12.2)	
Pulse (bpm)			
<65	62,001 (8.8)	1,614 (10.0)	254
65-90	479,472 (67.6)	9,993 (62.0)	204
>90	66,552 (9.4)	2,262 (14.0)	329
Missing	100,707 (14.2)	2,260 (14.0)	
Diastolic BP (mmHg)			
<60	24,858 (3.5)	808 (5.0)	315
60-100	534,884 (75.5)	12,144 (75.3)	222
>100	56,190 (7.9)	921 (5.7)	161
Missing	92,800 (13.1)	2,256 (14.0)	
Systolic BP (mmHg)			
<100	781 (0.1)	41 (0.2)	499
100-160	546,536 (77.1)	12,526 (77.7)	224
>160	68,889 (9.7)	1,315 (8.2)	188
Missing	92,526 (13.1)	2,247 (13.9)	
Blood center			
Recife	256,752 (36.2)	1,357 (8.4)	53
Belo Horizonte	130,283 (18.4)	5,153 (32.0)	381
São Paulo	321,697 (45.4)	9,619 (59.6)	290
Hct (g/dL)†			
38-39	55,638 (12.4)	1,989 (13.7)	345
40-41	77,003 (17.2)	2,706 (18.7)	340
42-43	86,854 (19.4)	2,691 (18.6)	301
44-45	88,444 (19.8)	2,681 (18.5)	294
≥46	138,969 (31.1)	4,424 (30.5)	309

* Data are reported as n (%).

† Quantitative Hct data are unknown for more than 95% of the records at Recife blood center.

VVRs in São Paulo and in Belo Horizonte (AOR 0.69 [95% CI 0.63-0.75] in São Paulo and AOR = 0.77 [95% CI 0.69-0.85] in Belo Horizonte) for donors with Hct values between 38 and 39 when compared to donors with Hct levels of 46 or higher. We could not evaluate this relationship in Recife because Hct and/or hemoglobin (Hb) values were not available in the analysis data set.

DISCUSSION

The aims of this study were to assess the frequency of and factors associated with VVRs in allogeneic whole blood donors in Brazil. The frequency of donation-related adverse events has not previously been reported in the peer-reviewed literature for Brazil. This is the largest and first multicenter study to assess risk factors for donor adverse reactions. Results of our analysis show that 2.3% of all whole blood donations were complicated by a documented VVR, which is higher than rates reported in the general donor population in Italy,[3-5] India,[20,21] Greece,[6] and Denmark,[22] but similar to findings from the United States.[1,23-25]

Our study shows that young age, low EBV, and first-time blood donor status are the major factors associated with increased reaction rates, consistent with previous studies.[2,5,10,20,23] Like other authors[24,26,27] we found a low incidence of serious reactions and no evidence of severe events such as myocardium infarction or thrombophlebitis, which represent truly rare adverse complications of blood donation. Many studies[1,2,9,23,25,28,29] have observed that first-time donors were more likely to experience VVRs. We confirmed that replacement blood donors presented a slightly higher likelihood of adverse reaction, consistent with the finding of others.[5,6] Synergistic psychological mechanisms might be driving these findings. A first-time donation is associated with anxiety in inexperienced donors relative to repeat donors who are familiar with the donation process.[30] Moreover, donations from replacement donors may include an extra layer of

TABLE 3. Reaction rate by blood center and demographic characteristics

Characteristic	Recife (per 10,000 donations)	Belo Horizonte (per 10,000 donations)	São Paulo (per 10,000 donations)
Reaction grade			
Mild	48	355	277
Moderate	1	23	12
Severe	4	2	1
Overall	53	380	290
Sex			
Female	100	550	348
Male	42	285	256
Age (years)			
18-20	104	743	661
21-24	80	576	491
25-29	67	408	336
30-40	39	278	224
41-65	27	186	126
Donor type			
Community	44	350	272
Replacement	61	402	387
Donation history			
First-time	110	630	554
Repeat	29	222	167
Race/ethnicity			
Black	34	235	174
Mixed	51	354	240
White	57	437	344
Asian	9	574	294
Indigenous	178	429	286
EBV (mL)			
<3500	183	709	459
3500-3999	113	614	384
4000-4499	79	416	330
4500-4999	50	326	276
≥5000	34	242	213
BMI			
Underweight	198	541	562
Normal	81	450	365
Overweight	43	321	237
Obese	38	293	199
Severely obese	34	253	169
Pulse (bpm)			
<65	73	364	248
65-90	55	415	281
>90	57	478	356
Diastolic BP (mmHg)			
<60	94	502	336
60-100	54	403	302
>100	34	261	196
Systolic BP (mmHg)			
<100	0	640	574
100-160	56	410	304
>160	30	294	219
Hct (g/dL)*			
38-39		458	290
40-41		428	304
42-43		371	273
44-45		327	282
≥46		337	299

* Quantitative Hct data are unknown for over 95% of the records at Recife blood center.

anxiety due to desire to provide blood for a friend or relative in need of transfusion,[6] whereas community donors come to donate blood to help anonymously individuals with no specific emotional connection with the recipient other than "helping society."[31]

Unadjusted analyses indicated a higher rate of VVRs among females, as reported in other studies.[1,9,20,26,29] However, after adjusting for other risk factors, female sex was not a significant predictor of VVRs in our multivariable analysis. Of note, we used Nadler's sex-specific formulas to calculate EBV that may have inherently controlled for any potential sex effect. However, there are also other factors related to differences in the allowed collection volume between males and females that may be relevant. Brazilian blood bank regulations[18] limit the donation amount to 450 ± 50 mL, which may be increased by 30 mL to perform laboratory tests. Combining the minimum weight requirement of 50 kg (110 lb) for blood donation and blood volume requirement results in an allowed maximum blood loss per donation of 430 mL for a 50-kg female and 480 mL for a 50-kg male donor, representing 18 and 14% smaller draw volumes, respectively, than allowed in the United States.[14] The standards in Brazil are similar to the 450-mL standard volume collected in Europe.[15,32] Given these factors we expected that we might find VVR rates similar to those in Europe, but our study shows that the Brazilian rate of VVRs is higher when compared to reports from Europe.[3,5,32]

Our study has demonstrated an unexpected (and unreported) effect related to increasing Hct and higher likelihood of adverse reactions. One hypothesis that might explain this finding relates to whole blood viscosity (WBV).[33] It has been shown that Hct is one of the principal determinants of WBV. Hct has the greatest effect on WBV during high-velocity blood flow; for instance, a 10% increase in Hct typically increases viscosity at high shear rates (arterial flow) by about 20%.[34] WBV is also a key determinant of the overall work load on the heart and perfusion of tissues. In addition, there is also a relationship between WBV and blood pressure. If WBV increases then total peripheral resistance will increase, thereby reducing blood flow. Conversely, when WBV decreases, blood flow and perfusion will increase.[35] These physiological considerations might explain the relation-

TABLE 4. OR from multivariable logistic regression analysis showing predictors of reaction in blood donors in Brazil*

Characteristic	All Centers—OR (95% CI)		
	Recife‡	Belo Horizonte	São Paulo
Sex	p < 0.0001	p < 0.0001	p < 0.0001
Female	1.36 (1.17, 1.60)	1.49 (1.36, 1.62)	0.86 (0.79, 0.92)
Male	1.0	1.0	1.0
EBV (mL)	p < 0.0001	p < 0.0001	p < 0.0001
<3500	2.61 (1.98-3.44)	1.77 (1.48-1.98)	2.12 (1.92-2.35)
3500-3999	1.83 (1.45-2.31)	1.56 (1.38-1.76)	1.89 (1.74-2.06)
4000-4499	1.78 (1.48-2.13)	1.34 (1.20-1.50)	1.61 (1.50-1.74)
4500-4999	1.36 (1.16-1.61)	1.27 (1.15-1.41)	1.29 (1.21-1.36)
≥5000	1.0	1.0	1.0
Hct (g/dL)		p = 0.0002	p < 0.0001
38-39		0.77 (0.69-0.85)	0.69 (0.63-0.75)
40-41		0.85 (0.77-0.94)	0.81 (0.75-0.87)
42-43		0.87 (0.79-0.96)	0.80 (0.75-0.86)
44-45		0.90 (0.82-0.98)	0.93 (0.87-0.98)
≥46		1.0	1.0
Blood center†		p < 0.0001	
Recife		0.21 (0.20-0.22)	
Belo Horizonte		1.38 (1.32-1.45)	
São Paulo		1.0	
Age (years)		p < 0.0001	
18-20		3.08 (2.89-3.28)	
21-24		2.80 (2.64-2.97)	
25-29		2.27 (2.14-2.41)	
30-40		1.70 (1.61-1.80)	
41-65		1.0	
Donor type		p < 0.0001	
Community		1.0	
Replacement		1.09 (1.05-1.13)	
Donation history		p < 0.0001	
First-time		2.49 (2.41-2.58)	
Repeat		1.0	
Race/ethnicity		p < 0.0001	
Black		0.51 (0.48-0.54)	
Mixed		0.73 (0.70-0.76)	
White		1.0	
Asian		0.75 (0.65-0.87)	
Indigenous		0.81 (0.64-1.03)	
Pulse (bpm)		p < 0.0001	
<65		0.77 (0.72-0.83)	
65-90		0.85 (0.81-0.89)	
>90		1.0	
Diastolic BP (mmHg)		p < 0.0001	
<60		1.11 (1.00-1.23)	
60-100		1.17 (1.09-1.26)	
>100		1.0	

* p values for testing common ORs and for center-specific ORs (Sex, EBV, and Hct) of each characteristic are shown in table.
† Average center difference.
‡ Quantitative Hct data are unknown for more than 99% of the records at Recife blood center.

ship between higher Hct and adverse reaction events. High Hct may act to further restrict blood flow during vasovagal events. Further studies to evaluate the relationship between Hct and VVRs in blood donors are needed.

This study has several limitations. First, we lacked records regarding the onset time of VVRs and had limited access to some other data such as information on the occurrence of delayed reactions and the lack of Hct and/or Hb data for one of the centers. Consequently we could not examine all types of VVRs or factors associated with reactions that occurred after leaving the blood center. Second, weight and height were self-reported leading to the possibility of under- and overestimation of each value. Third, although moderate and severe reactions are relatively uncommon compared to mild reactions, establishing a clear distinction between the reaction severities is difficult since the classification is a subjective decision by blood center staff. Furthermore, adverse events are not recorded on standardized reporting forms across the three blood centers. Different forms and different center practices regarding the classification of signs and symptoms of VVRs may have been substantial contributors to differences in reaction rates across blood centers. For these reasons we did not conduct analyses that sought to determine if specific demographic characteristics may be associated with different reaction severities.

Evidence of remarkable differences in VVR rates at different blood centers is not unique to Brazil. Analyses conducted in the United States have reported similar large differences by center.[1,2,36,37] There are considerable regional demographic and cultural differences between the southeastern and northeastern parts of Brazil.[38,39] Demographics and blood center procedures may contribute to the difference seen between VVR rates observed at the REDS-II Brazil centers. Additional explanations include the possibility that VVRs may not have been recorded in Recife due to differences in standard operating procedures. Developing consistent reporting practices using common definitions across the Brazilian blood bank network would be the first step to understand that the differences in adverse reactions by center are significant as reported here.

Offering fluids and light snacks before starting the phlebotomy has been proposed as a method to decrease the development of VVRs among blood donors.[40,41] Yet, the provision of snacks and fluids before donation as a means of reducing VVRs does is not consistent with our findings, since VVRs are higher in Belo Horizonte despite the fact that the Belo Horizonte blood center requires that donors have fluids and a light snack before donation whereas this

is only a recommendation given to donors in São Paulo and Recife. This finding suggests that other variables such as emotional or psychological factors in association with the percentage of blood volume drawn may play an important role in the prevalence of VVR. It has been already described that donors who present adverse reactions tend to be hypochondriac, depressed, and overly concerned with their bodily functions and are more prone to feelings of uselessness and pessimism.[42,43] This psychological aspect might explain why phlebotomist skills are related to lower donor reaction rate, for instance, lower rates were observed when more attention was given to the donors and more talkative nurses had lower rates of blood donors reactions.[44] Syncope and presyncope are also related to blood or injury phobia; that is, the fear can be triggered by seeing blood, by sustaining an injury, or by receiving an injection or some other invasive medical procedure.[45-49] In summary, the interaction between psychosocial characteristics and biophysical characteristics and the impact of these factors mechanistically on vasovagal and other reactions has not been completely elucidated.[42,43]

Our results show that the risk factors for VVRs among the Brazilian blood donor population are similar to those observed in other countries,[2-4,6,7,32] even though blood donor eligibility and donation procedures are not the same. Overall, the Brazilian blood donor population is younger than the blood donor population in the United States[50,51] and Europe[52] and the highest rates of reaction VVRs were found within younger age donors. Efforts to reduce the risk of VVRs in donors in Brazil is important as part of donor vigilance and also may be increasingly important as blood centers in Brazil seek to convert young, first-time donors into long-term repeat blood donors.

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CONFLICT OF INTEREST

None.

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