Fear of blood draw and total draw time combine to predict vasovagal reactions among whole blood donors

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BACKGROUND: Fear of blood draws is a predictor of vasovagal reaction risk among whole blood donors, and this relationship is particularly evident among less experienced donors. This study examines the combined effect of donor fear and total blood draw time on vasovagal reactions.

STUDY DESIGN AND METHODS: After successfully completing the blood donor health screening, 2730 whole blood donors attending high school drives were asked about their fear of having blood drawn. Donor reports of fear versus no fear were combined with total blood draw time to predict phlebotomist ratings of donor vasovagal reactions.

RESULTS: Both fear and draw time were significant predictors of vasovagal reactions, with observed reaction rates of 31.2% for fearful donors whose blood draw lasted 10 minutes or more versus 5.0% for nonfearful donors whose draw lasted less than 6 minutes. Binomial regression analyses revealed that fear remained a significant predictor of reaction rates across all blood draw intervals examined (odds ratio, 2.8-4.1; all $p < 0.001$) and that these effects were maintained after controlling for donor sex, weight, estimated blood volume, pulse rate, and donation status.

CONCLUSION: This report shows that both fear and blood draw time increase vasovagal reaction rates, and the two are additive. These findings suggest that fearful donors should be the focus of special attention to reduce their distress before donation as well as careful observation throughout the draw.

Although blood donor fear has long been recognized as a risk factor for syncopal and presyncopal (e.g., faint, dizzy, weak, nausea) reactions,[1-5] to date formal assessment of donor fear has not been considered a part of standard operating procedures during blood collections. Nonetheless, cross-sectional and longitudinal studies have demonstrated that such reactions can be predicted by both anticipatory anxiety (i.e., predonation apprehension about future exposure to donation-related stimuli) as well as day-of-donation fear (i.e., concerns about stimuli in the immediate environment such as needles and blood).[6-10] For example, Meade and colleagues[11] conducted a prospective assessment of donor anxiety 1 week before scheduled donation and demonstrated that concerns regarding blood and injury predicted vasovagal symptoms at subsequent donation. Labus and colleagues[12] found a similar relationship when donor fear of blood, injection, and injury stimuli were assessed upon arrival at the donation site. Together, these studies indicate that anticipatory anxiety does not dissuade all prospective donors and that individual differences in level of fear expressed on the day of donation can be a valuable predictor of vasovagal reactions.

Of course, assessment of donor fear would be counterproductive if exposure to such questions immediately before donation actually increased the frequency of reactions. To assess this issue, France and colleagues[13] compared vasovagal reactions among community blood

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donors who either did or did not respond to a question about fear of blood draws (i.e., "How afraid are you of having blood drawn from your arm?") immediately after their predonation health screening. Results confirmed that fear predicted symptoms and demonstrated that simply being asked about fear was not associated with a greater likelihood of reactions. One limitation of this study was that the sample was composed of predominantly experienced donors who tend to report less fear and who may be less sensitive to fear questions. A second limitation was a reliance on donor self-reports of reactions. France and colleagues[7] addressed these limitations in a follow-up study by examining the relationship between responses to the fear question and phlebotomist ratings of donor reactions among high school donors. While this study confirmed that exposure to the fear question did not affect donor reaction rates, the odds of a vasovagal reaction was 2.6 times greater (95% confidence interval [CI], 2.00-3.37) among fearful versus nonfearful donors and 5.9 times greater (95% CI, 2.02-17.38) among those who reported that they were "extremely afraid" compared to "not at all afraid." These odds ratios (ORs) compare favorably to other significant predictors of vasovagal reactions reported in large-scale donor studies, including age (OR, 2.7-3.0 for 16-18 years vs. 20+ years),[14-16] sex (OR, 1.2-1.9 for female vs. male),[14-16] donor status (OR, 1.9-2.6 for first-time donors vs. experienced donors),[14-16] weight (OR, 2.2 for <120 lb vs. >200 lb),[14] body mass index (OR, 2.5 for <18.5 vs. >25-30),[15] pulse rate (OR, 1.3 for >90 vs. <65),[15] and estimated blood volume (OR, 2.5-2.9 for <3.5 L vs. >4.8 L).[14,15] Importantly, a 1-year follow-up of these high school donors revealed that both predonation fear and the experience of vasovagal reactions reduced retention, with only 33% of fearful reactors attempting a subsequent donation compared to 57% of nonfearful donors without a reaction.[17] Path analyses indicated that reactions served as a mediator of the negative effect of predonation fear on repeat donation attempts. In sum, individuals who experience anxiety in anticipation of blood donation and/or fear during exposure to the donation environment are at greater risk for vasovagal symptoms. Not surprisingly, these fears are more intense among first-time donors[7,12] and therefore are likely to account for at least some of the variance in higher reaction rates observed in novice donors.

Consistent with our findings, Ditto and colleagues[8] previously reported that although blood donors acknowledged a number of blood and injury-related fears (e.g., needles, blood, mutilation), self-reported fear of having blood drawn was the specific fear measure that best predicted subjective and objective measures of vasovagal reactions. This research team also observed that the intensity of vasovagal reactions was positively related to perceived blood loss.[18] Specifically, despite equivalent blood loss during a standard 450-mL blood collection, donors who rated their perceived blood loss as greater 1) were more likely to receive phlebotomist-initiated treatment for vasovagal symptoms and 2) reported more intense vasovagal reactions. The latter effect was true even for those who did not receive any phlebotomist intervention, suggesting that higher symptom ratings were not merely a response to receiving treatment.

Interestingly, fear of losing too much blood is one possible contributor to higher reaction rates as a function of blood draw time. Newman and colleagues[19] analyzed blood collection records for more than 100,000 first-time donors and observed that vasovagal reaction rates increased steadily with draw time, approximately doubling for both male and female donors when comparing 4- and 9-minute phlebotomies. A similar relationship was subsequently noted in a sample of more than 5 million whole blood donors, with reaction rates approximately doubling when comparing phlebotomies lasting 4 to 8 minutes against those lasting 9 to 13 minutes.[20] Of course, fear is only one of many potential contributors to increased reaction rates as longer blood draws may be associated with a variety of donor differences that have been related to increased risk of vasovagal reactions (e.g., sex, age, donor status, blood volume). Indeed, as noted, female donors are more likely to experience vasovagal reactions[14-16] and also have mean draw times that are approximately 1 minute longer than male donors.[21] Longer phlebotomies may also be associated with increased physical discomfort or pain related to prolonged needle exposure and donor ratings of needle pain have been related to increased risk for vasovagal reactions.[22,23] Finally, physical and psychological factors may combine to determine risk as suggested by the observation that higher levels of donor anxiety contribute to greater needle pain.[22]

In sum, findings from existing studies suggest that vasovagal reactions may increase as a function of both fear and length of blood draw, but this combination of variables has yet to be examined in the same sample of donors. To address this novel question we conducted a reanalysis of existing data from a previously reported investigation of the relationship between donor fear and risk for vasovagal reactions.[7,17]

MATERIALS AND METHODS

For this study we focused our analyses on 2730 whole blood donors who successfully passed the donor health screening at high school blood drives conducted by the Community Blood Center of Greater Kansas City. Donor variables collected during the health screen included age, sex, number of prior donations, height, weight, blood pressure, and pulse rate. Using the self-reported height and weight values, estimated blood volume was computed according to the gender-specific equations described by Nadler and colleagues.[24] After the health screen, donors were asked to

TABLE 1. Phlebotomist-rated donor reaction codes

None	Mild	Moderate	Severe
	• Pallor (skin color change) • Feeling faint, lightheaded, dizzy, sweating • Hyperventilating (rapid breathing), may complain of fingers tingling • Pale, nauseated, stomach cramping	In addition to all or some of the mild signs and symptoms: • Momentary loss of consciousness ≤ 45 sec • Vomiting and/or incontinence	In addition to all or some of the signs and symptoms for mild/moderate reaction: • Tetany spasms • Convulsions • Confusion • Loss of consciousness >45 sec • Recovery from mild or moderate symptoms lasting >30 min

provide a written response to the question "How afraid are you of having blood drawn from your arm?" Possible responses to the question included 1 = "not at all afraid," 2 = "somewhat afraid," 3 = "moderately afraid," 4 = "very afraid," and 5 = "extremely afraid." Responses to the fear question were kept confidential, and hence phlebotomists were not aware of donor fear ratings. Other than the addition of this fear question, all donors were treated according to the standard operating procedures. Additional data obtained from the donor record included the phlebotomist-rated donor reaction code (i.e., none, mild, moderate, or severe—see Table 1) and the location where the donor reaction occurred, which included 88.4% in the donation chair, 8.7% after leaving the donation chair but still on site, and 2.9% after leaving the donation chair and off site (e.g., school classroom, hallway, or bathroom). The study protocol was reviewed and approved by the Ohio University Institutional Review Board.

Data reduction and statistical analysis

Given the distribution of donor reaction codes (i.e., none = 88.3%, mild = 10.4%, moderate = 0.5%, severe = 0.8%), this variable was recoded as a dichotomous variable (i.e., no reaction, n = 2402, 88.3%; reaction, n = 317, 11.7%). Similarly, the original distribution of blood draw fear ratings (i.e., no fear = 69.1%, somewhat afraid = 22.8%, moderately afraid = 6.1%, very afraid = 1.4%; extremely afraid = 0.6%) was recoded as a dichotomous variable (i.e., no fear, n = 1880, 69.1%; fear, n = 839, 30.9%). Finally, draw time was recoded into four interval groups to allow for computation of binomial logistic regression analyses and reporting of ORs for fear at specific draw time intervals (i.e., <6 min [n = 815, 30.0%], ≥6 to <8 min [n = 771, 28.4%], ≥8 to <10 min [n = 358, 13.2%], and ≥10 min [n = 775, 28.5%]). Phlebotomies that were completed in 3 minutes or less (n = 11) were excluded from the sample as they were considered to be potential arterial punctures; hence, the final sample for all analyses was 2719 donors. All statistical analyses were conducted with computer software (IBM SPSS Statistics 21.0, IBM Corp., Armonk, NY).

RESULTS

Donor characteristics

Because the blood drives were all located in high schools, not surprisingly as a group the donors were young (65.1% were either 17 or 18 years of age; mean, 27.0 years, SD, ±15.6), and most had had few prior donations (36.4% first-time donors, 18.5% second-time donors, and 14.1% third-time donors; mean, 5.1 prior donations; SD, ±12.9). At the same time, however, the mean values for age and prior donations are elevated by the presence of a significant proportion of older, more experienced donors in the sample (e.g., school teachers, staff). The sample was relatively evenly divided between female donors (54.9%) and male donors (45.1%), and the majority of donors in the sample self-identified as white (92%) and non-Hispanic (98%). Of the 2719 donors, 301 (11%) did not provide a complete donation. However, the proportion of incomplete donations did not differ significantly as a function of fear (i.e., no fear, 11.2%; fear, 10.7%; $\chi^2(1) = 0.14$, $p = 0.70$) or draw time interval (i.e., <6 min, 11.3%; ≥6 to <8 min, 9.5%; ≥8 to <10 min, 11.2%, ≥10 min, 12.4%; $\chi^2(3) = 3.41$, $p = 0.33$).

Effects of fear and draw time on reaction risk

As noted in Table 2, across all donors those who reported some fear of having blood drawn were significantly more likely than nonfearful donors to have a vasovagal reaction (21.7% vs. 7.2%, respectively; $\chi^2(1) = 118.61$, $p < 0.001$). A similar pattern was observed when the data were examined separately for those who provided a complete donation (i.e., 21.6% vs. 7.3%) and those who did not provide a complete donation (i.e., 22.2% vs. 6.2%). In addition, the overall proportion of reactions increased steadily as a function of draw time ($\chi^2(3) = 38.53$, $p < 0.001$), from a low of 7.7% among those whose blood draw was less than 6 minutes to a high of 16.9% among those whose blood draw lasted 10 minutes or more. A similar pattern of increasing proportions was observed across the draw time intervals when the data were examined separately for those who provided a complete donation (i.e., 7.9, 9.6,

TABLE 2. Percentage of vasovagal reactions observed as a function of donor fear and blood draw time*

Draw time (min)	No Fear	Fear	All donors
<6	5.0 (30/605)	15.7 (33/210)	7.7 (63/815)
≥6 to <8	6.4 (34/529)	16.1 (39/242)	9.5 (73/771)
≥8 to <10	8.5 (19/224)	23.1 (31/134)	14.0 (50/358)
≥10	10.0 (52/522)	31.2 (79/253)	16.9 (131/775)
All donors	7.2 (135/1880)	21.7 (182/839)	11.7 (317/2719)

* Data are reported as percent (number).

13.8, and 17.1%) and those who did not provide a complete donation (i.e., 6.5, 8.2, 15.0, and 15.6%).

To examine the effect of fear on reaction rates as a function of draw time interval, binomial logistic regression analyses were conducted for each of the four draw time intervals. Results of these analyses revealed significantly higher odds of having a reaction among fearful versus nonfearful donors at all draw time intervals, including less than 6 minutes (OR, 3.5; 95% CI, 2.1-6.0; $p < 0.001$), 6 to 8 minutes (OR, 2.8; 95% CI, 1.7-4.6; $p < 0.001$), 8 to 10 minutes (OR, 3.3; 95% CI, 1.7-6.0; $p < 0.001$), and 10 minutes or more (OR, 4.1; 95% CI, 2.8-6.1; $p < 0.001$). To examine the relationship between fear and reactions after controlling for other potential predictors, the binomial regression analyses were repeated using simultaneous forced entry of fear, sex, weight, estimated blood volume, pulse rate, and donor status. Results of these analyses revealed that fear remained a significant predictor for each draw time interval (all $p \leq 0.001$) with ORs that were similar to those observed in the analyses without covariates (<6 min—OR, 3.1; 95% CI, 1.8-5.4; 6 to 8 min—OR, 2.5; 95% CI, 1.4-4.3; 8 to 10 min—OR, 3.4; 95% CI, 1.7-6.6; ≥10 min—OR, 2.9; 95% CI, 1.9-4.5). We then conducted a series of forward-entry binomial regression analyses using fear, sex, weight, estimated blood volume, pulse rate, and donor status as potential predictors of vasovagal reactions at each blood draw time interval. Results of these analyses indicated that fear was the first variable to enter into the model at each interval, indicating that it was the single best predictor of reactions. With fear in the model, donor weight was also entered as a significant predictor of reactions for the 6- to 8-minute interval (OR, 0.99; 95% CI, 0.982-0.997) and the 10-minutes-or-more interval (OR, 0.98; 95% CI, 0.978-0.991). Finally, pulse rate entered as a significant predictor after fear and weight for the 10-minutes-or-more interval (OR, 1.02; 95% CI, 1.004-1.041). The remaining potential predictors (i.e., sex, estimated blood volume, and donor status) did not enter into any of the final models as they were not significantly related to reactions with the other predictors entered in the model.

Effect of fear on blood draw time

To examine the effects of fear on blood draw times, an analysis of variance was conducted using between-subject variables of fear (fear, no fear), sex (female, male), and donor status (first-time donor, experienced donor). Results of this analysis revealed significant effects of sex ($F(1,2710) = 27.7$, $p < 0.001$), donor status, ($F(1,2710) = 61.2$, $p < 0.001$), and sex by donor status ($F(1,2710) = 35.5$, $p < 0.001$), but no significant main effects or interactions involving fear. Similar results were obtained when age and estimated blood volume were included in the analysis as covariates. Follow-up analyses of the sex-by-donor status interaction revealed no significant difference in blood draw times between male and female first-time donors ($p = 0.62$), but significantly longer draw times for experienced males versus experienced females ($p < 0.001$). In sum, these analyses reflect the fact that the mean draw time was not significantly different for those with and without fear.

DISCUSSION

The results of this study indicated that vasovagal reaction rates increased as a function of blood draw time, approximately doubling in frequency when comparing draw times that last more than 10 minutes against draw times lasting less than 6 minutes. These findings are highly consistent with those previously reported by Newman and colleagues,[19,20] including a confirmation of their report of a doubling of reactions rates when comparing the longest and shortest phlebotomies.[20] What is novel about the current findings is the demonstration that these draw time effects combine with the known effects of blood donor fear to further enhance the prediction of reaction risk. Specifically, in this study fear of blood draws predicted an approximate threefold increase in the odds of experiencing a vasovagal reaction at each draw duration level examined, and these effects persisted after controlling for donor sex, weight, estimated blood volume, pulse rate, and first-time donation status. The lowest proportion of reactions (5.0%) was observed among donors who reported no fear and had the shortest draw times, whereas the highest proportion of reactions (31.2%) was observed among fearful donors with the longest draw times. Although these findings reflect relatively stable ORs across draw time intervals, indicating an additive effect of fear and draw time, it is interesting to note that the difference in the overall proportion of fearful versus nonfearful reactors grows larger with longer draw times. That is, for draw times under 6 minutes fear was associated with 10.7%

more vasovagal reactions (i.e., 5.0% among nonfearful donors vs. 15.7% among fearful donors) whereas for draw times over 10 minutes fear was associated with 21.2% more reactions (i.e., 10.0% among nonfearful donors vs. 31.2% among fearful donors).

Possible explanations for the growing proportion of fearful reactors as blood draw time increases include longer exposures to threatening stimuli, increased chance of needle manipulation and potential manipulation-related injury, and changes in cognitions during the donation process. During the early phase of the phlebotomy, all donors are exposed to a similar set of potentially threatening stimuli (e.g., needles, pain, blood). With longer phlebotomies there is simply more time to be exposed to these stimuli and hence possibly greater opportunity to react. Longer draw times can also be associated with needle adjustments due to reductions in blood flow. This is important as a now classic study of syncopal responses to orthostatic stress in pilots demonstrated that the experience of needle adjustments was associated with an increased risk of vasovagal reactions, particularly if such adjustments elicited discomfort or pain.[23] Such adjustments may also increase the risk of needle-related injury. For example, Bravo[25] reported that, relative to whole blood donations lasting 7 minutes, the odds of a needle injury increase threefold when the blood draw lasted 20 to 24 minutes and fourfold when it lasted 25 to 30 minutes. Further, donors in this sample who experienced a needle-related injury had a 17-fold increase in their odds of having a vasovagal reaction. Finally, with longer blood draw times there is also more opportunity for fearful donors to perceive or generate new threats such as concern about the volume of blood being withdrawn. While this may seem like an irrational concern given that the volume of blood collected is standardized for all donors, it is nonetheless consistent with the recent findings of Ditto and colleagues[18] that vasovagal reactions were higher among donors who reported a greater perceived blood loss. Unfortunately, we did not assess donor thoughts and feelings during the donation process and therefore this explanation is merely speculative. Accordingly, future studies should include repeated assessment of donor sensations, thoughts, and feelings throughout the donation process.

Regardless of the nature of the psychological processes that may be contributing to the observed findings, they have clear practical implications. Screening for fearful donors should be conducted as part of the health screening process, particularly among younger and less experienced donor populations. Those who self-identify as fearful should then be the focus of special attention to reduce their distress before donation. They should also receive more careful observation during their donation, particularly if their draw runs longer than average. Finally, greater precautions should also be considered to mitigate the risk of delayed reactions after fearful donors leave the donation chair.

Several approaches might be considered to reduce the risk of vasovagal reactions related to draw time and donor fear. With respect to draw times, the use of flow rate pumps to increase the speed of collections or smaller bags to reduce donation volume are both technically feasible solutions that have been used in other parts of the world.[26] While these approaches are unlikely to be implemented in the United States any time soon, special attention may be offered to help reduce distress among fearful donors. Based on the current findings one simple educational intervention may be to provide fearful donors with accurate information about normal variability in blood draw times and reassurance that total amount of blood withdrawn does not vary across donors. Other strategies might also be employed to help manage anxiety throughout the donation (e.g., distraction). Although a targeted intervention approach has yet to be applied to fearful donors, this advice is consistent with the lessons learned from our studies on the provision of education and donation coping strategies to prospective donors. Specifically, our educational materials 1) acknowledge common donor concerns about fear, pain, and syncopal reactions; 2) give accurate and reassuring normative information regarding actual donor reports of pain and syncope; and 3) provide empirically validated strategies that can be used in the donation setting to help cope with common donor concerns (e.g., applied muscle tensing to avert syncopal symptoms). When delivered as brochures,[27-29] videos,[30] or Web-based interventions,[31] these coping materials have been shown to improve donation attitudes, reduce donation-related anxiety, and increase confidence in one's ability to cope with the donation process. Given the success of these materials in bolstering prospective blood donors, future studies are needed to test specific interventions to combat the cognitive, emotional, and physiologic reactions that may contribute to increased risk for vasovagal reactions among fearful donors.

Although this sample provides an initial demonstration of the relationships between fear, draw time, and risk for reactions, some caution is required when drawing conclusions due to a number of limitations. Perhaps most importantly, this study should be replicated with larger samples of blood donors. Whereas our findings demonstrated that fear predicted reactions across blood draw intervals after statistically controlling for other known predictors, larger samples will allow for a careful examination of these relationships within specific subgroups of donors defined by characteristics such as age, sex, donor status, race/ethnicity, and estimated blood volume. Each of these factors are independently related to risk for vasovagal reactions; hence it is important to understand the extent to which fear may or may not contribute to additional risk within these subgroups. Larger samples will also allow an

assessment of the potential influence of fear versus other factors at different phases of the donation process (i.e., registration, phlebotomy, on site after phlebotomy, off site). Although such analyses were not possible in this study given the relatively small proportion of reactions that occurred after donors left the donation cot, it is clear from prior studies that some donor characteristics such as age and first-time donation status are associated with increased risk for reactions across all phases of the donation process whereas others such as estimated blood volume become important once the phlebotomy has begun.[32] A more fine-grained analysis of the role of fear at different phases of the donation process may help to identify when fear is interacting with other known predictors and to highlight when fear-mitigating interventions should ideally be implemented. Other limitations that should be addressed in future studies include coding and analysis of needle manipulation, needle-related injury, and donor pain to determine the extent to which reactions related to fear and increasing draw time may be associated with greater physical or psychological stress. Finally, because the reaction coding system used by the phlebotomists in this study may include adverse events that were not vasovagal in nature, future studies would benefit from a more fine-grained analysis of the association between fear, draw time, and different types of adverse reactions.

In sum, in this sample fear was the best predictor of vasovagal reactions at each draw time interval. Further, when fear was present in the prediction models many of the previously reported predictors of reactions (e.g., age, sex, donor status, estimated blood volume) were no longer significant. Accordingly, we believe that these data are extremely valuable in that they point toward an important predictor of vasovagal reactions that is not routinely measured during blood collections, may be stronger than other known predictors of vasovagal reactions, and can be addressed without disqualifying or otherwise excluding potential donors. Further studies are needed to replicate and extend these findings among larger and more diverse samples of blood donors.

CONFLICT OF INTEREST

The authors have disclosed no conflicts of interest.

REFERENCES

1. Callahan R, Edelman EB, Smith MS, et al. Study of incidence and characteristics of blood donor "reactors". Transfusion 1963;3:76-82.
2. Graham DT, Kabler JD, Lunsford L. Vasovagal fainting: a diphasic response. Psychosom Med 1961;23:493-507.
3. Brown H, McCormack P. An analysis of vasomotor phenomena (faints) occurring in blood donors. Br Med J 1942;1:1-5.
4. Moloney WC, Lonnergan LR, McClintock JK. Syncope in blood donors. N Engl J Med 1946;234:114-8.
5. Ruetz PP, Johnson SA, Callahan R, et al. Fainting: a review of its mechanisms and a study in blood donors. Medicine (Baltimore) 1967;46:363-84.
6. Viar MA, Etzel EN, Ciesielski BG, et al. Disgust, anxiety, and vasovagal syncope sensations: a comparison of injection-fearful and nonfearful blood donors. J Anxiety Disord 2010; 24:941-5.
7. France CR, France JL, Himawan LK, et al. How afraid are you of having blood drawn from your arm? A simple fear question predicts vasovagal reactions without causing them among high school donors. Transfusion 2013;53: 315-21.
8. Ditto B, Gilchrist PT, Holly CD. Fear-related predictors of vasovagal symptoms during blood donation: it's in the blood. J Behav Med 2012;35:393-9.
9. Vossbeck-Elsebusch AN, Gerlach AL. The relation between disgust-sensitivity, blood-injection-injury fears and vasovagal symptoms in blood donors: disgust sensitivity cannot explain fainting or blood donation-related symptoms. J Behav Ther Exp Psychiatry 2012;43:607-13.
10. Olatunji BO, Etzel EN, Ciesielski BG. Vasovagal syncope and blood donor return: examination of the role of experience and affective expectancies. Behav Modif 2010;34: 164-74.
11. Meade MA, France CR, Peterson LM. Predicting vasovagal reactions in volunteer blood donors. J Psychosom Res 1996; 40:495-501.
12. Labus JS, France CR, Taylor BK. Vasovagal reactions in volunteer blood donors: analyzing the predictive power of the medical fears survey. Int J Behav Med 2000;7:62-72.
13. France CR, France JL, Kowalsky JM, et al. Assessment of donor fear enhances prediction of presyncopal symptoms among volunteer blood donors. Transfusion 2012;52:375-80.
14. Rios JA, Fang J, Tu Y, et al. The potential impact of selective donor deferrals based on estimated blood volume on vasovagal reactions and donor deferral rates. Transfusion 2010; 50:1265-75.
15. Wiltbank TB, Giordano GF, Kamel H, et al. Faint and prefaint reactions in whole-blood donors: an analysis of predonation measurements and their predictive value. Transfusion 2008; 48:1799-808.
16. Eder AF, Hillyer CD, Dy BA, et al. Adverse reactions to allogeneic whole blood donation by 16- and 17-year-olds. JAMA 2008;299:2279-86.
17. France CR, France JL, Carlson BW, et al. Fear of blood draws, vasovagal reactions, and retention among high school donors. Transfusion 2014;54:918-24.
18. Ditto B, Balegh S, Gilchrist PT, et al. Relation between perceived blood loss and vasovagal symptoms in blood donors. Clin Auton Res 2012;22:113-6.
19. Newman BH, Siegfried B, Buchanan L. Are vasovagal reaction rates in blood donors related to the duration of the phlebotomy? Transfusion 2008;48:568-9.

20. Newman BH, Siegfried B. Phlebotomy duration and vasovagal reaction rates in 5.4 million donations [abstract]. Transfusion 2013;53:110A.
21. Tomasulo P, Bravo M, Kamel H. Time course of vasovagal syncope with whole blood donation. ISBT Sci Ser 2010;5:52-8.
22. France CR, France JL, Wissel ME, et al. Donor anxiety, needle pain, and syncopal reactions combine to determine retention: a path analysis of two-year donor return data. Transfusion 2013;53:1992-2000.
23. Stevens PM. Cardiovascular dynamics during orthostasis and the influence of intravascular instrumentation. Am J Cardiol 1966;17:211-8.
24. Nadler SB, Hidalgo JU, Bloch T. Prediction of blood volume in normal human adults. Surgery 1962;51:224-32.
25. Bravo M. Are hemoglobin, cholesterol, mean arterial pressure and drawtime additional factors associated with donor vasovagal reactions and needle injuries? Paper presented at the 14th International Haemovigilance Seminar. Montreal, Quebec, Canada; 2012.
26. Newman BH. Management of young blood donors. Transfus Med Hemother 2014;41:284-95.
27. France CR, Montalva R, France JL, et al. Enhancing attitudes and intentions in prospective blood donors: evaluation of a new donor recruitment brochure. Transfusion 2008;48:526-30.
28. France CR, France JL, Kowalsky JM, et al. Education in donation coping strategies encourages individuals to give blood: further evaluation of a donor recruitment brochure. Transfusion 2010;50:85-91.
29. Masser B, France CR. An evaluation of a donation coping brochure with Australian non-donors. Transfus Apher Sci 2010;43:291-7.
30. France CR, France JL, Wissel ME, et al. Enhancing blood donation intentions using multimedia donor education materials. Transfusion 2011;51:1796-801.
31. France CR, France JL, Kowalsky JM, et al. A Web-based approach to blood donor preparation. Transfusion 2013;53:328-36.
32. Bravo M, Kamel H, Custer B, et al. Factors associated with fainting: before, during and after whole blood donation. Vox Sang 2011;101:303-12.