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Factors associated with psychological and physiological stress reactions to blood donation: a systematic review of the literature

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Introduction

Blood donation is generally seen as a safe, voluntary and socially useful activity, based on the altruism of donors¹. A number of positive effects of blood donation are described in scientific literature, such as feelings of satisfaction, feelings of being more alert and feeling better in general². However, the majority of the literature concerning blood donation describes adverse events, such as fatigue, vasovagal symptoms, fainting and bruises²⁻⁵. In addition to the discomfort experienced by the donor, these might also impede blood donation in the future. Studies report that up to 10 to 20% of donors experience such adverse events^{6,7}. For a blood supply organisation, it is crucial to maintain the donor pool in order to be able to deliver an optimal supply of blood. This can be achieved by recruiting new donors and retaining existing ones. Either way, negative donor experiences should be kept to a minimum.

In blood donor research, several studies have investigated the occurrence of adverse events, retention, or the interaction between adverse events and retention. For instance, Bravo *et al.* investigated factors associated with fainting and donating blood and showed that vasovagal reactions are more common during or after phlebotomy than during registration⁸. Newman *et al.* showed that donors who experienced an adverse event were less likely to return to the blood centre⁹. In line with this, Veldhuizen *et al.* showed a strong association between reporting a vasovagal reaction and stopping donating, especially among men⁶. Adverse events may upset the donors, causing increased anxiety. However, despite some indications that anxiety is increased before and during donating blood¹⁰, it remains largely unclear what factors are associated with such a stress reaction.

Stress reactions are quite common phenomena^{11,12}. Various factors, known as stressors or stress stimuli, can induce a stress reaction. Although any situation and any object may elicit a stress reaction, the resulting stress experience may differ between individuals and circumstances¹². After being confronted with a stressor, a psychological stress reaction occurs, which can consist of higher levels of anxiety, irritation, fear,

worry, tension or anger¹³. At the same time, physiological stress reactions take place, such as increases in the levels of cortisol and (nor-)adrenaline¹⁴, a decrease in heart rate variability¹⁵, and negative changes in blood coagulation parameters¹⁶. As mentioned earlier, blood donation does not always elicit positive feelings, but can be accompanied by anxiety-eliciting factors as well⁸⁻¹⁷. These factors (stressors) may induce a stress reaction.

The relation between blood donation on the one hand, and anxiety and stress reactions on the other remains largely unclear. Although stress reactions (e.g. anxiety) do seem to be present, the factors capable of inducing or enhancing these reactions (i.e. stressors) are largely unidentified. The aim of this study was, therefore, to perform a systematic review of the literature in order to evaluate existing knowledge on the following research question: what factors are associated with psychological and physiological stress reactions in blood donors in a blood donation setting? We hypothesised that both physiological (e.g. increased levels of adrenaline or cortisol) and psychological (e.g. increased levels of anxiety or fear) stress reactions take place in a blood donation setting. We also hypothesised that a greater stress reaction would be associated with factors such as donation-related adverse events, e.g. bruises or fainting, as opposed to not experiencing such an event. Knowing and identifying potential stressors could help to optimise the donation experience for the donor.

Materials and methods

Information sources and search

One author (MH) prepared the search strategy in collaboration with two librarians. The strategy was discussed and adjustments were made resulting in consensus among all three individuals. The search strategy was then applied to the electronic databases PubMed (1948- June 26th, 2013), EMBASE (1980- June 26th, 2013) and PsycINFO (1806- June 26th, 2013). Keywords differed per database, but generally included: (i) terms related to blood donor (e.g. blood dono*) and blood donation (e.g. blood dona*); (ii) terms associated with psychological and physiological stress

reactions, e.g. stress, distress, anguish, anxious, coping, avoidance, attention, arousal, emotion, fear, anxiety, nervous, worry, tension, irritation, cortisol, (nor-)adrenaline, heart rate (variability), respiration rate, blood pressure, pulse pressure, galvanic skin response, electrodermal activity, catecholamine, glucocorticoids, autonomic nervous system, orthosympathetic, (para-)sympathetic, HPA axis, thrombocyte, blood platelets, blood coagulation, prothrombin, platelet aggregation, platelet activation; and (iii) both specific and non-specific terms used to relate possible contextual factors (stressors) to stress reactions, e.g. faint(-ing/-ness), dizziness, orthostasis, lightheaded(-ness), weak(-ness), fatigue, adverse event, (pre-)syncope, vasovagal, haemorrhage, haematoma, contusion, bruise, nausea, sickness, deferral, phlebotomy, venipuncture, (risk) factor, determinant, marker, symptom, sign, precursor, effect and relation.

Both free text words (limited by title and abstract) and index terms were used to capture the topic of interest. The reference lists of the identified articles were checked for additional articles. Full details of the search strategies are available from the authors.

Study selection

Two inclusion statements were formulated and applied to title, abstract and whole text: (i) the article contained primary research outcomes in healthy blood donors; and (ii) the study examined the effect of a potential factor on a stress reaction. If an article did not fulfil both statements, it was excluded. The retrieved references were selected by title and abstract by one reviewer (MH) based on the inclusion criteria. To check reproducibility, a random selection of the retrieved records was taken and screened by a second reviewer (IV). The results of this selection, including cases of doubt, were discussed (by MH and IV) until consensus was reached. After data extraction, inclusion of the remaining articles, based on the inclusion criteria, was discussed by all Authors.

Data extraction

The following data were extracted from the articles included: author, year of publication, country, description of the study population (sample size, age, gender, number of prior donations), donation type (whole blood, plasma), timing of the measurement of the stress reaction (before/during/after donation), stress reactions, stressors and main results.

Quality description

A quality description of the studies was performed by using items from guidelines on reporting and evaluating studies (i.e. the STROBE Statement¹⁸, the Cochrane criteria¹⁹ and guidelines for reviewing

aetiological research²⁰), and relevant items as reported in earlier review studies from our department, investigating stress in humans^{21,22}. For each study, two authors (JS and MH) independently judged whether or not the study described details about its participants, the methods and the results.

The details required concerning the participants were the population from which the participants were drawn and the main characteristics of the study population (age, gender, number of donations), if applicable per study group. For the methods, details were required of a seemingly valid assessment method (e.g. timing of the measurements, name and reference of assessment instrument used) for both factors and stress reactions and a description of the appropriate statistics was necessary. The key results had to be summarised with reference to the study objectives.

Disagreement between the reviewers was discussed until consensus was reached. The main objective of the quality description was to assess whether all items considered relevant to our review were measured, analysed and described.

Results

Number of hits

After combining the identified articles from the different sources and excluding duplicates, the search strategy provided a total of 2,913 publications. The majority of the citations were excluded on the basis of title or abstract by the first author (MH). This step was replicated in a random sample (30%) by a second reviewer (IV) to check reproducibility. Differences and cases of doubt (<3%) were discussed until consensus was reached. The remaining articles (n=22) were fully extracted. Finally, ten studies were included in this review, based on the inclusion criteria applied on the full text and discussed by all authors. A flow diagram of the inclusion strategy is presented in Figure 1.

Quality description

Details from the quality assessment of the ten studies included are shown in Table I. All studies described the population from which the participants were taken. However, two studies did not present sufficient information about the donors' characteristics. In four studies, insufficient details were available on the measurement of the stress reaction or the stressor. In these studies, although the stressor and reaction were measured, the timing of the measurements and/or the name and/or details of the assessment instrument were not presented.

Study descriptives

Detailed descriptives of the ten studies included can be found in Table II. The ten studies were

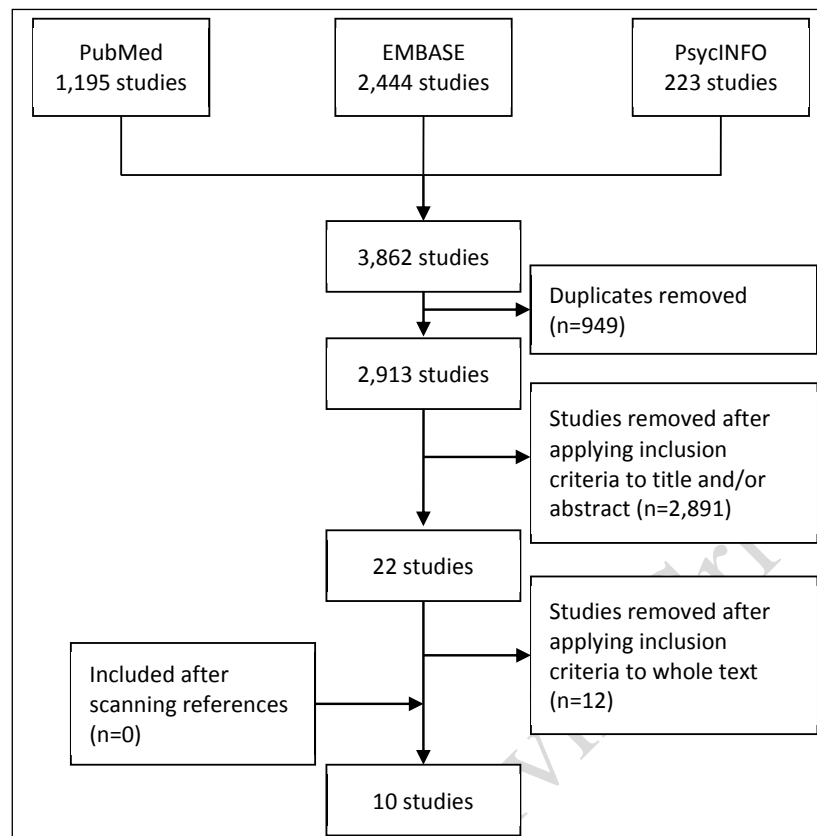


Figure 1 - Flow chart of studies included and excluded at the different stages of the review process.

Table I - Quality description.

Author, year	Participants		Measurements			Results
	Population	Main characteristics	Factor	Stress reaction	Statistics	Summary key results
Kaloupek, 1984 ²⁷	+	+	+	+	+	+
Kaloupek, 1985 ²⁸	+	+	+	+	+	+
Basler, 1987 ²⁶	+	-	+	-	+	+
Breckler, 1993 ³⁰	+	+	+	+	+	+
Bellitti, 1994 ³¹	+	+	+	-	+	+
Ferguson, 1997 ²³	+	+	+	+	+	+
Ulrich, 2003 ²⁴	+	+/-	+/-	+	+	+
Byrne, 2005 ²⁹	+	+	+	+	-	+
Ditto, 2006 ¹⁰	+	+	+	+	+	+
Hanson, 2009 ²⁵	+	+	+	-	+	+

+: described in the article; +/-: described adequately, although not in full detail; -: not described in the article.

published between 1984 and 2009. Seven studies were observational, one study described itself as being quasi-experimental²³, one as being a field experiment²⁴, and one study was originally set up as a randomised clinical trial²⁵. Because the control group of this last-mentioned study was well described, this study was included and the results presented are those of the control group. Only an early study by Basler *et al.* used participants undergoing a cell-separation as a

subgroup, the rest of the studies were based solely on (whole) blood donation²⁶.

Both physiological and psychological stress reactions were assessed in a blood donation setting. Psychological reactions were assessed in nine out of the ten articles^{10,23-30}. Three of these studies combined physiological measurements with psychological parameters^{24,28,29}. One study focused only on the physiological stress reaction³¹. The results are shown in Table III.

Table II - Study descriptives.

Author, year	Country	Study type (design)	Sample size (gender ^a)	Age (year, mean±SD ^b)	Donation type	Prior donations (mean±SD ^b)
Kaloupek, 1984 ²⁷	Canada	Observational	Exp 1: 43 (23M, 20F) Exp 2: replication study 1: 50 (23M, 27F), new part: 95 (55M, 40F)	Exp 1: 23.9±4.8 Exp 2: 24.0±4.7	Blood, 450 mL	Exp 1: 4.0±4.8 Exp 2: 2.7±3.9
Kaloupek, 1985 ²⁸	Canada	Observational	73 (36M, 37F)	23.4±5.3	Blood	20 FTD, 53 multi-time
Basler, 1987 ²⁶	Germany	Observational	Test group: 76 Control group: 45	Not specified	Test group: 76 used cell-separator of whom 33 were re-examined at a subsequent full- blood donation. Control group: 45 full-blood donors	Test group: 39 FTD, 8 second-time, 29 third-time. Control group: 45 full-blood, prior donations unknown, no experience with apheresis.
Breckler, 1993 ³⁰	Baltimore	Observational	210 (57% M)	Mean 22.9	Blood donation	45 FTD, 54 novice (1-2 donations), 67 experienced (3-8 donations), 42 veteran (≥9 donations). 85% in preceding year.
Bellitti, 1994 ³¹	Italy	Observational	20 (13M, 7F)	Range 25-45	Full blood (F: 5 mL/kg; M: 6 mL/kg)	Within subject comparison 1 st and 4 th donation
Ferguson, 1997 ²³	UK	Quasi- experimental	215 (75M, 137F, 3 not recorded)	Mean 23, range 18-57	Blood donation	4 groups; FTD, 1-2 times, 3 times, 4 or more times
Ulrich, 2003 ²⁴	Texas	Field experiment, 4 conditions (Nature, Urban, Television and No Television)	872 (591M, 281F). Nature n=198, Urban n=240, Television n=174, No Television n= 260.	Mean 40.4, range 17-70. Male: mean 40.9, female: mean 39.3	Whole blood, 1 pint	Not specified
Byrne, 2005 ²⁹	Canada	Observational	610 (263M, 347F)	22.4±7.2	Blood, 450 mL	3.6±7.3
Ditto, 2006 ¹⁰	Canada	Observational	671 (245M, 426F)	20.1±3.9	Blood donation	461 FTD, 210 second time
Hanson, 2009 ²⁵	Ohio	RCT, 2 groups: with (n=34) and without (n=31) social support	65 (31M, 34F)	22.3±7.4, range 18-57	Whole blood	Novice, 0-2 donations

^a M for male, F for female, as reported by paper; ^b If reported, unless stated otherwise; Exp: experiment; FTD: first time donor; RCT: randomised controlled trial.

Stress reactions

Psychological reactions that were assessed included levels of anxiety before, and/or during and/or after donation^{10,23,25-30}, stress²⁶, fear²⁴ and arousal²³. Pre-donation stress levels of anxiety or fear were found to be higher than post-donation levels in all studies^{23-26,29,30}. In addition, one study found higher anxiety levels during the actual donation compared to before or after the donation²⁵, and one study showed that stress levels immediately before venipuncture were higher²⁶. Two studies found a non-significant decrease in anxiety levels from before donation to during donation, whilst post-donation anxiety levels were not assessed²⁷⁻²⁸.

Physiological stress reactions were measured in four studies, which showed that heart rate was higher before donation than after donation^{24,31}, heart rate was higher before

donation than during donation²⁸, higher blood pressure before donation than after donation^{24,29,31} and/or higher pre-donation cortisol levels than post-donation ones, with a lower pre-donation cortisol in the fourth donation compared to the first donation³¹. In these cases, blood samples for cortisol assay were collected 15 minutes before and 30 minutes after initiation of the phlebotomy.

In one study anxiety ratings were associated with the likelihood that a donor would return¹⁰. In women only, a negative association between these two was shown, in which female donors who exhibited higher levels of anxiety were less likely to return.

Stressors

A number of different factors were associated with stress reactions in a blood donation setting. Except for

Table III - Factors associated with stress reactions, studied in blood donors.

Factor studied (method)	Author, year	Psychological stress measurement	Physiological stress measurement	Details	Direction of association
Prior donations	Kaloupek, 1984 ²⁷	Anxiety (AT, AACL, ON)		PD: no groups	Negative
	Kaloupek, 1985 ²⁸	Anxiety (AT, AACL, ON, OTO)		PD: 0 or ≥1	Negative
	Basler, 1987 ²⁶	Anxiety (STAI-X1, self-constructed stress scale)		TD: pre-donation stress levels only. PD: TD; 0, 1, 2. WD: ?	Negative
	Breckler, 1993 ³⁰	Anxiety (MACL)		PD: 0, 1-2, 3-8, ≥9	Negative
	Bellitti, 1994 ³¹		Cortisol, blood pressure, heart rate	Experience only associated with cortisol. PD: 1, 4	Negative
	Ferguson, 1997 ²³	Anxiety (SACL, ALE)		PD: 0, 1-2, 3, ≥4	Negative
	Byrne, 2005 ²⁹	Anxiety (STAI)	Blood pressure	Experience only associated with anxiety. PD: no groups	Negative
Coping method (CS, CQ)	Kaloupek, 1984 ²⁷	Anxiety (AT, AACL, ON)		Avoidant coping	Negative
	Kaloupek, 1985 ²⁸	Anxiety (AT, AACL, ON, OTO)	Heart rate	Avoidant- and problem-focused coping; no associations for heart rate (except for FTD and problem-focused coping)	Negative
Donation type	Basler, 1987 ²⁶	Anxiety (STAI-X1, self-constructed stress scale)		TD only	Negative
Character traits (STAI-X2, FPI)	Basler, 1987 ²⁶	Anxiety (STAI-X1, self-constructed stress scale)		TD: habitual anxiety, negative expectations, extraversion	Positive
Television	Ulrich, 2003 ²⁴	Fear (ZIPERS)	Heart rate, blood pressure	Nature and no television (low-distraction), all measurements	Negative
Music	Ferguson, 1997 ²³	Anxiety (SACL)			None
		Appraisals (ALE)		Association vigilance coping and post-donation depressing appraisals	≤2 donations: positive; ≥3 donations: negative
Alexithymia (TAS)	Byrne, 2005 ²⁹	Anxiety (STAI)	Blood pressure	Alexithymia only associated to anxiety	Positive
Physical symptoms (BDRI, VAS, ON)	Hanson, 2009 ²⁵	Anxiety (STAI)		Assessed BDRI-4	Positive
	Ditto, 2006 ¹⁰	Anxiety (STAI)		Assessed BDRI, association also for VAS	Positive
Donation successfulness	Ditto, 2006 ¹⁰	Anxiety (STAI)		Only post-donation stress levels	Negative

AT: anxiety thermometer; AACL: Affective Adjective Checklist; ON: observation nurse; PD: number of Prior Donations; OTO: observation trained observer; STAI-X1 and STAI: Spielberger State Anxiety Scale, measuring situational anxiety; TD: thrombocytapheresis donation; WD: whole-blood donors; MACL: Mood Adjective Check List; SACL: Stress Arousal Check List; ALE: Appraisal of Life Events; CQ: Coping Question, to assess coping method, based on Billings and Moos; CS: Coping Scale, to assess coping, based on Billings and Moos; STAI-X2: Spielberger State Anxiety Scale, measuring habitual anxiety; FPI: questionnaire assessing extraversion, neuroticism and masculinity; ZIPERS: Zuckerman Inventory of Personal Reactions; TAS: Toronto Alexithymia Scale; BDRI: Blood Donation Reactions Inventory; BDRI-4: Abbreviated, 4-item version of the Blood Donation Reactions Inventory; VAS: Visual Analogue Scale to assess pain finger prick and venipuncture.

the number of prior donations -which was found to be relevant in seven out of ten articles^{23,29-31}- most factors were found in two studies at most.

Prior donations

A factor associated with stress reactions during blood donation was the number of prior donations. In seven studies, inexperienced donors showed significantly higher levels of stress-related reactions than more experienced donors^{23,26-31}. In the study

by Basler *et al.*, designed to assess differences in the donor strain between thrombocytapheresis and whole-blood donation, the authors found a significant negative association between stress and the number of prior donations for thrombocytapheresis donors only²⁶.

Psychological stressors

In total, five different psychological stressors were associated with stress reactions in a blood donation

setting, and included character traits, television, music, alexithymia and coping method^{23,24,26-29}. Coping methods, as studied by Kaloupek *et al.*, were considered as a trait that influences the stress reaction exhibited^{27,28}. The authors showed that subjects making use of an avoidant or a problem-focused coping method exhibited lower stress levels both before and during donation. In contrast, a behavioural or emotion-focused coping style was associated with increased anticipatory stress reactions. Furthermore, donors who had given more prior donations were shown to make more use of an avoidant or problem-focused coping method, which resulted in lower stress reactions. In inexperienced donors a strong association was found between emotion-focused coping and anticipatory stress reactions.

Basler *et al.* studied several character traits and found that increased levels of habitual anxiety, more negative expectations and more extraversion were associated with significantly higher levels of stress around donation²⁶. In a more recent study by Byrne *et al.*, higher levels of alexithymia - a person's inability to experience, express, or describe emotions- were significantly associated with higher pre-donation and post-donation levels of anxiety²⁹. Furthermore, they showed a significant association with a greater difference between pre- and post-donation systolic blood pressure and higher levels of alexithymia.

In a study assessing the influence of providing passive music, Ferguson *et al.* showed vigilance coping occurred when music was present, a form of distraction thought to decrease anxiety levels²³. However, the presence of music resulted in higher pre-donation levels of anxiety-provoking appraisals (rating the environment as anxiety-provoking) and higher post-donation levels of depressing appraisals (rating the environment as depressing) in less-experienced donors (≤ 2 donations). In more experienced donors (≥ 3 donations), the results were the reverse, with these donors showing lower levels of post-donation depressing appraisals. No effect was found for levels of anxiety. In a study assessing the effects of distraction on anxiety levels, Ulrich *et al.* showed that distraction in the form of different television programmes had an association with stress levels²⁴. Thereby, a group given low distraction (nature films on television or no television), showed lower stress reactions than a group with high distraction (urban environment on television).

Physiological stressors

Two physiological stressors were associated with stress reactions in a blood donation setting, namely physical symptoms and donation success^{10,25}. Physical symptoms, also called donor-related symptoms, were found to be associated with higher levels of stress

reactions^{10,25}. Symptoms were assessed using the Blood Donation Reaction Inventory, both the 11-item and the 4-item versions, assessing symptoms such as dizziness and light-headedness. Other measures were pain ratings of the venipuncture or fingerprick, and nurse reports. A significant negative correlation was found between post-donation anxiety and donation success¹⁰, which implies that donors experience more stress when their donation is unsuccessful.

Discussion

In this review, we identified factors associated with psychological and physiological stress reactions related to donating blood, extracted from ten studies. Psychological stress reactions, measured through questionnaires, consisted of increased pre-donation levels of anxiety, fear and arousal, which declined towards the end of the donation. Physiological stress reactions included higher pre-donation heart rate and blood pressure, as well as higher post-donation cortisol levels. Fewer prior donations and a number of psychological and physiological stressors were found to be associated with higher stress reactions. Psychological stressors associated with higher stress reactions included high-distraction television, habitual anxiety, negative expectations and extraversion. An avoidant and problem-focused coping method was associated with lower stress reactions, and expressed more by donors who had made more prior donations. Physiological stressors associated with a higher stress reaction included ratings of pain and physical symptoms, e.g. dizziness and light-headedness. Except for the number of prior donations, which was shown to be relevant in seven studies, each stressor was specified in no more than two articles.

As an indicator of psychological stress experienced by the donor, most studies assessed anxiety through the use of standardised questionnaires. Unfortunately, the small number of psychological stress reactions assessed might lead to a simplification of our knowledge, as for instance nervousness or tension was not measured. All psychological and nearly all physiological stress levels were found to be raised during registration, declining towards the end of the donation procedure. In addition, two studies showed anxiety peaking shortly before or after the venipuncture^{25,26}. Both psychological and physiological reactions imply a predominantly anticipatory stress reaction, while the physiological component might also be related to the physical efforts made by the donors, e.g. walking or cycling towards the donation centre. Although a number of associations are made between stress levels and hormonal parameters in the literature^{32,33}, we included only one blood donation-related study examining one of these parameters, i.e. serum cortisol³¹. In this study by Bellitti *et al.*, the

cortisol level prior to the fourth donation was lower than that prior to the first donation. However, cortisol levels in the first donation decreased during the donation while they stay at a constant level in the fourth donation. It can be speculated that the physiological stress responses (heart rate, blood pressure and cortisol) are mediated by a primarily physiologically driven mechanism, perhaps because of a response to hypovolaemia. However, in regard to the cortisol response, this does not seem likely since blood loss at a blood donation is relatively small (~500 mL) and the level of cortisol was measured shortly after the donation (30 minutes). Moreover, there was not a similar increase in pre-donation cortisol at the fourth donation as there had been at the first donation. With the exception of this study, cortisol has not been found to be associated with blood donations, and the influence of the increase in cortisol on the blood product is not yet clear. In a large systematic review, Thrall *et al.* showed the effects of psychological stress and physical activity on haemorrhology, coagulation, fibrinolysis and platelet reactivity¹⁶. Despite our sensitive search and the high number of hits, we were unable to find a study which assessed these parameters in a blood bank setting. In our view, this lack of findings is interesting since donation-induced stress might affect the final blood product.

Seven studies reported an association between an increased number of prior donations and lower stress reactions around a blood donation. This phenomenon might be explained by donor selection, with donors who show more reaction not returning to make subsequent donations⁴. Likewise, anxiety was shown to reduce return rates for female donors in this review¹⁰, and physical symptoms and donation successfulness were associated with increased stress reactions^{10,25}. This is also in line with findings in the literature, in which a study by France *et al.* showed that donors who react do not come back³⁴. Interestingly, Bellitti *et al.* found a reduction in cortisol levels from first to fourth donations, suggesting that a donation is not a stressful event in itself, and the stress exhibited might be related to the emotional component of a never-experienced-before event³¹. In conclusion, the above-mentioned finding might indicate that donors who do not experience major adverse events in the first few phlebotomies return, which, through a process of habituation, results in concomitant reduced stress levels.

A number of stressors were assessed in just two studies. While being noteworthy, their relevance and direction of association are therefore disputable. For instance, distraction in the form of television or music gave mixed results. Ferguson *et al.* found that the presence of music had no influence on experienced stress²³. However, music was shown to have the opposite effects on environmental appraisals for donors who had

made more than two, or two or less donations, being beneficial in the former situation, and detrimental in the latter one. In contrast, Ulrich *et al.* showed stress reactions were lower in a group exposed to low distraction compared to those in a group exposed to high-distraction²⁴. Unfortunately, Ulrich *et al.* did not present details of the number of prior donations, which might explain the different findings. The effects of coping method on the stress reaction were described in two studies, both conducted by Kaloupek *et al.*^{27,28} In their view, coping strategies are seen as "trait" measures and influence the way people react in general to stressors. They showed avoidant and problem-focused coping reduced anxiety around a blood donation. A number of character traits -alexithymia, habitual anxiety, negative expectations and extraversion- were also associated with higher stress reactions^{26,29}. Whilst the first three observations are not difficult to understand, the last one is. However, according to the authors, extraversion accounted for only a small part, and was therefore not considered relevant for practical intervention²⁶. The psychology of apheresis donors as well as the physiology of apheresis donations might differ from the psychology and physiology at whole blood donation, since apheresis is more time-consuming and often performed more regularly than a standard whole blood donation. This may point towards a greater commitment and more involvement from the plasma donor, as well as an increased self-esteem, which was also shown by Veldhuizen *et al.*³⁵ Veldhuizen *et al.* also showed that plasma donors had less (pre-donation) anxiety and had made significantly more prior donations than the whole blood group.

The findings in this review indicate that stress levels are increased at the start of the donation period, with inexperienced donors showing higher stress levels. Nurses and physicians dealing with donors should be aware of this phenomenon, and make efforts to comfort the donor at this point. Although people respond differently after confrontation with a stressor, such as a bruise or the insertion of a needle, low distraction television such as nature films might help donors who need to be distracted. Reducing the level of stress experienced by donors can be beneficial for donor retention.

Limitations

While the strength of this study is its systematic retrieval and description of the literature, this may also be a source of weakness. Our purpose was to perform a comprehensive search, including all possible factors which might be associated with stress reactions around a blood donation. Although we obtained a large number of citations, we cannot be sure that we did not miss relevant papers. We tried to deal with this problem by scanning

the references of included studies, which yielded no additional studies.

The comparability between the studies may also present a limitation. All studies originated in the USA or Europe. Although we have no indication that whole-blood donors were paid for donation, it is common in the USA to pay plasma donors, while this is not allowed in most European countries. Stress reactions between paid and unpaid donors might be different because of, for instance, motivational differences.

The number of studies in the field of stress reactions and stressors in blood donation is rather limited. Many issues, such as the relation between negative experience and stress reactions at future donations, or the relation between stress reactions and blood products, require further research. Based on the literature we reviewed in this study, we conclude that stress reactions appear to be present around blood donations. In particular, anxiety levels rise at the start of a donation. An increased number of prior donations is associated with a reduced level of stress reactions, while negative experiences are associated with increased stress levels. Physicians and nurses dealing with donors should be aware of this phenomenon, and make efforts to comfort the donor at this point.

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The Authors declare no conflicts of interest.

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