

## Individual, contextual and network characteristics of blood donors and non-donors: a systematic review of recent literature

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**Background.** The ageing population and recent migration flows may negatively affect the blood supply in the long term, increasing the importance of targeted recruitment and retention strategies to address donors. This review sought to identify individual, network and contextual characteristics related to blood donor status and behaviour, to systematically discuss differences between study results, and to identify possible factors to target in recruitment and retention efforts.

**Methods.** The systematic review was conducted in accordance with a predefined PROSPERO protocol (CRD42016039591). After quality assessments by multiple independent raters, a final set of 66 peer-reviewed papers, published between October 2009 and January 2017, were included for review.

**Results.** Individual and contextual characteristics of blood donor status and behaviour were categorised into five main lines of research: donor demographics, motivations and barriers, adverse reactions and deferral, contextual factors, and blood centre factors. Results on donor demographics, motivations and barriers, and contextual factors were inconclusive, differing between studies, countries, and sample characteristics. Adverse reactions and deferral were negatively related to blood donor behaviour. Blood centre factors play an important role in donor management, e.g., providing information, reminders, and (non-)monetary rewards. No studies were found on network characteristics of (non-)donors.

**Discussion.** Although individual and contextual characteristics strongly relate to blood donor status and behaviour, mechanisms underlying these relations have not been studied sufficiently. We want to stress the importance of longitudinal studies in donor behaviour, exploring the role of life events and network characteristics within blood donor careers. Increased understanding of donor behaviour will assist policy makers of blood collection agencies, with the ultimate goal of safeguarding a sufficient and matching blood supply.

**Keywords:** blood donor behaviour, individual characteristics, contextual characteristics, donor career, systematic review.

### Introduction

In the Netherlands, approximately 2.5% of the population are registered as whole blood or plasma donors and account for 721,000 donations per year, providing about 25 whole blood units per 1,000 inhabitants. However, the number of donors in the Netherlands has been decreasing from more than 400,000 donors in 2010 to about 340,000 donors in 2015<sup>1</sup>. Although this does not pose a short-term threat to the blood supply, due to an even larger decrease in blood demand influenced by advanced surgery techniques and a more restrictive transfusion policy<sup>2-4</sup>, certain demographic developments may negatively affect the blood supply in the long term.

First, men in their 50s and 60s are overrepresented in the Dutch donor pool<sup>5</sup>. Within one to two decades, these men will no longer be eligible to donate and a new generation of blood donors needs to be available. However, recruiting and retaining young donors is difficult<sup>6</sup>.

Second, due to recent migration flows, the diversity of the population is growing and with it, the diversity of patients in need of specific blood and tissue types. Consequently, new and more donors with specific characteristics (e.g., male, ethnic minority) need to be recruited to safeguard a sufficient and matching blood supply.

The Netherlands is not the only country facing these developments<sup>7</sup>. Hence, recruitment and retention of

blood donors is an important study topic. Over the last 40 years, researchers have studied donor behaviour, trying to characterise the "typical blood donor"<sup>8-10</sup>. However, findings are inconclusive, with results changing over time and varying within and between countries.

This systematic review provides an overview of the great variety of results on characteristics of blood donor status (e.g., first-time, novice, experienced) and behaviour (e.g., donation frequency, return behaviour). We update previous systematic reviews<sup>11,12</sup> and extend them by exploring the role of external factors in donating blood. For example, through studies showing how contextual and blood centre factors are related to willingness to donate and actual donor behaviour<sup>13,14</sup>.

Furthermore, we try to shed light on donor careers. If human behaviour were static, all donors who ever started donating would continue to do so for the rest of their lives. In contrast, after people sign up as donor, some do not return after their first donation, while others continue to give blood until their maximum eligible age. These individual behavioural sequences and corresponding donor statuses are what we define as donor careers. We explore how donor careers play a role in previous study results.

From a practical perspective, this review is helpful in assisting policy makers of blood collection agencies. By presenting and comparing recent findings, blood collection agencies can design and implement evidence-based recruitment and retention campaigns to address (non-)donors in the most effective ways, convince first-time donors to become regular donors, and to guarantee a safe and sufficient blood supply in the future.

The main goal of this systematic review is to answer the following question: what individual, contextual and network characteristics are related to blood donor status and blood donor behaviour, and do these relationships change over time?

## Methods

This review is conducted in accordance with a predefined PROSPERO protocol (CRD42016039591)<sup>15</sup>. For this review we searched for studies on individual, network and contextual characteristics of blood donor status and behaviour.

### Literature search

Studies matching our search terms were collected using Google Scholar, PubMed, ScienceDirect, and Web of Science. Core keywords of the search were: (blood) AND (donor OR donation) AND (motivation OR attitude OR behaviour OR recruitment OR retention OR altruism OR centre OR network OR life event). To make sure we collected all possible relevant literature for review, we conducted a manual search in some of

the most relevant journals on prosocial behaviour and blood transfusion published between October 2009 and January 2017 (e.g., *Transfusion*, *Vox Sanguinis*, *Voluntary and Nonprofit Sector Quarterly*).

We built on and extended two earlier systematic reviews<sup>11,12</sup> and included studies published after October 2009, the last month of inclusion in one of these comparable reviews<sup>11</sup>, to provide an up-to-date review without replicating former systematic analyses. We decided not to shift our inclusion date further to February 2012 (last month of inclusion in the most recent systematic review)<sup>12</sup> because this would have required us to exclude 20 relevant papers related to blood donor status and behaviour, not discussed in either of the former reviews.

Additional details on the search strategy and review process can be found in the PROSPERO protocol<sup>15</sup>.

### Study selection

As a first step in the study selection process, papers that matched our search terms were assessed on title and abstract, based on six inclusion criteria: (i) published in English, German or Dutch; (ii) published in a peer-reviewed journal; (iii) published after October 2009; (iv) conducted in a Western country; (v) used quantitative methods; and (vi) used blood donor status or blood donor behaviour as an outcome measure. Of the 399 studies retrieved, 307 were rated as clearly ineligible.

Thereafter, two reviewers (TWP, EFK) independently read and evaluated the full text of the 88 remaining studies. Again, the selection was based on the six inclusion criteria. Disagreements on inclusion of specific studies were resolved by discussion. As a result of this critical evaluation, another 26 studies were excluded from review.

As a final step, we conducted a quality control of the 66 studies included using a combination of four open-access critical appraisal tools for quantitative research: Critical Appraisal Skills Programme (CASP UK)<sup>16</sup>, Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)<sup>17</sup>, Standard Quality Assessment Criteria (Qualsyst)<sup>18</sup>, and the Critical Review Form<sup>19</sup>. These tools have been designed by epidemiologists, methodologists, and statisticians to improve both the quality of reporting on individual studies and the critical evaluation of study reports. Each appraisal tool has its own strengths and focus, but none of them incorporated a rating scale of all study characteristics relevant to our review. We, therefore, combined questions from each appraisal tool to carefully rate the included studies and all of the subparts (see Appendix A, Table I for the individual scores on these items for each study included and Appendix B, Table II for the items of the developed review form).

The quality of all studies was assessed by one rater (TWP), while four other raters (E-MM, RB, WdK, EFK) divided the studies among them. Weighted Cohen's kappa ( $\kappa_w$ ) showed a moderate to good agreement between the raters,  $\kappa_w=0.608$  (95% confidence interval: 0.384-0.832),  $p<0.000$ . Major disagreements on the inclusion of specific papers were resolved by discussion to define the final set of 66 included studies (Figure 1).

## Results

Most of the reviewed studies stem from Northern Europe ( $n=25$ ) and North America ( $n=24$ ), while the remainder were conducted in Southern Europe, Australia and New Zealand. The characteristics of these studies varied, with sample sizes ranging from 190 to 2.1 million, consisting of a minimum of 24% to a maximum of 80% male participants. Study designs and methods also differed, including field experiments, randomised controlled trials and descriptive studies based on registry data (Appendix C, Table III). We systematically summarise and discuss the studies' results, classified into two main categories: individual and contextual characteristics of donor status and behaviour (Figure 2).

### Individual characteristics

#### Donor demographics

More than half ( $n=35$ ) of the studies reported on socio-demographic characteristics of donors and non-donors, including sex, age, race and ethnicity, religion, education, employment, income, and demographic transitions.

The results on sex differences among donors and non-donors are mixed. Nine of the 21 studies reported that men were more likely to be donors than women<sup>20-28</sup>, ten studies reported the opposite<sup>5,7,29-36</sup>, while two found no sex differences<sup>37,38</sup>. After a first donation, men were more likely to return than women<sup>23,32,33,39-42</sup>. One study showed that this relationship was present in the short term (6-month follow-up)<sup>7</sup>, while another study only found a long-term difference (25-month follow-up)<sup>43</sup>. Men donated more frequently<sup>6,7,21,31-33,44,45</sup> and were more often multigallon donors (more than 10 lifetime donations) compared to women<sup>46</sup>.

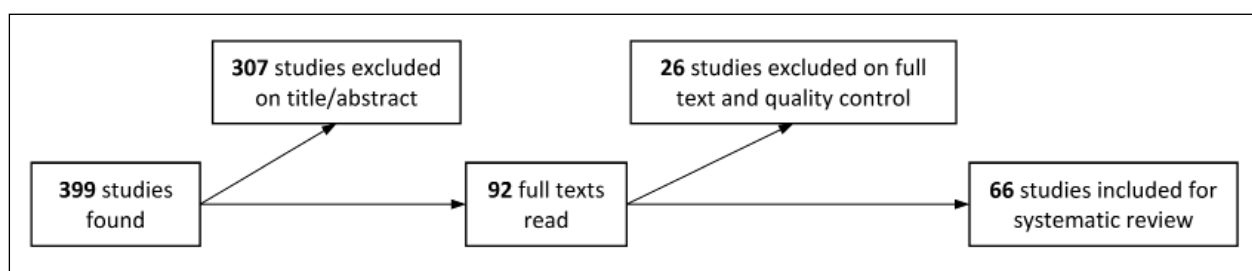
Studies on the relationship between age and donor status and behaviour also showed mixed results. Two studies indicated that the likelihood of donating increased with age<sup>30,47</sup>, while three others stated that younger people were more likely to donate<sup>31,37,38</sup>. Four studies found a non-linear association, with older people being more likely to donate until a certain age, after which the propensity decreased<sup>5,7,25,28</sup>. One study found no relationship between age and blood donation<sup>20</sup>. Younger people were more likely to be first-time donors than older people<sup>23,41,42</sup> and repeat donors were older than first-time donors<sup>7,41,42</sup>. The return rate of older donors was higher than that of younger donors<sup>6,40,43</sup>. In the United States, where the minimum eligible donor age is 16, the highest return rates were found for donors between the age of 16 and 18<sup>43</sup>. Older people were more likely to be frequent givers and multigallon donors, compared to younger people<sup>6,21,30,31</sup>.

Interactions between sex and age varied greatly in seven studies, but not in a systematic pattern<sup>7,21,23,32,33,48,49</sup>.

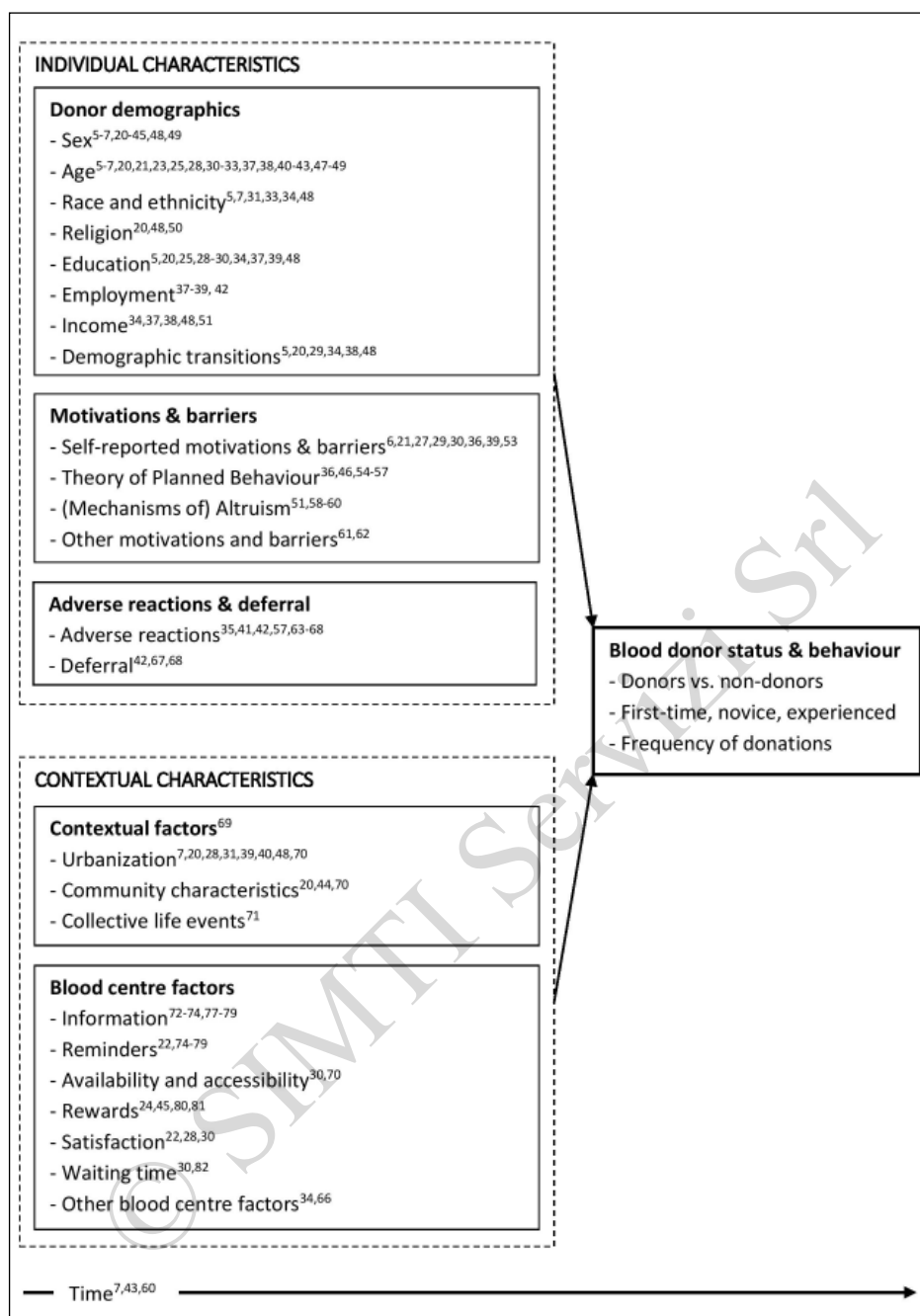
Regarding race and ethnicity, six studies from the United States, Great Britain and the Netherlands found higher rates of donors among (non-Hispanic) whites from the United States, and people with a British or Dutch ethnic background, respectively, compared to other race and ethnic groups<sup>5,7,31,33,34,48</sup>. Besides, (non-Hispanic) whites donated more frequently and were more likely to return than African-Americans, Asians, and Hispanics<sup>31,33</sup>.

Three studies examined the relation between religion and donor status. No relation was found in Spain<sup>20</sup>, while only limited evidence (positive relation for Catholic men aged 35-44) was found in the United States<sup>48</sup>. In contrast, another study from the United States found a positive relation for both organisational and subjective dimensions of religion (respectively church attendance and involvement in religious groups, and importance of faith in daily life)<sup>50</sup>.

With regard to education, five studies found higher education to be related to a higher propensity to donate<sup>5,20,30,39,48</sup>. Five others found an inverted U-shape relationship<sup>25,28,29,34,37</sup>, while one study found no relationship between education and donation<sup>38</sup>. Men with medium or higher education were more likely to have



**Figure 1** - Overview of the inclusion and exclusion process during and after the systematic search.



**Figure 2** - Categorisation of the 66 included papers among the two main categories (individual and contextual characteristics), and associated subtopics.

donated blood compared to men with a lower educational level, which did not hold for women<sup>47</sup>.

In two studies, donors did not differ from non-donors in terms of their employment status<sup>37,38</sup>, while one study showed that unemployed people were more likely to be non-donors<sup>39</sup>. Regarding donor status, Gemelli *et al.*<sup>42</sup> showed that first-time donors were more likely to be students than returning donors, while the group of returning donors had higher numbers of retired people,

professionals and tradespeople compared to the group of first-time donors.

Two studies found no relationship between personal income and donating<sup>38,51</sup>, one study found a negative relationship<sup>34</sup>, and two others concluded that people with a high (family) income were more likely to be donors than people with a low (family) income<sup>37,48</sup>.

Among donors in the Netherlands, the proportion of those either married or never married was larger

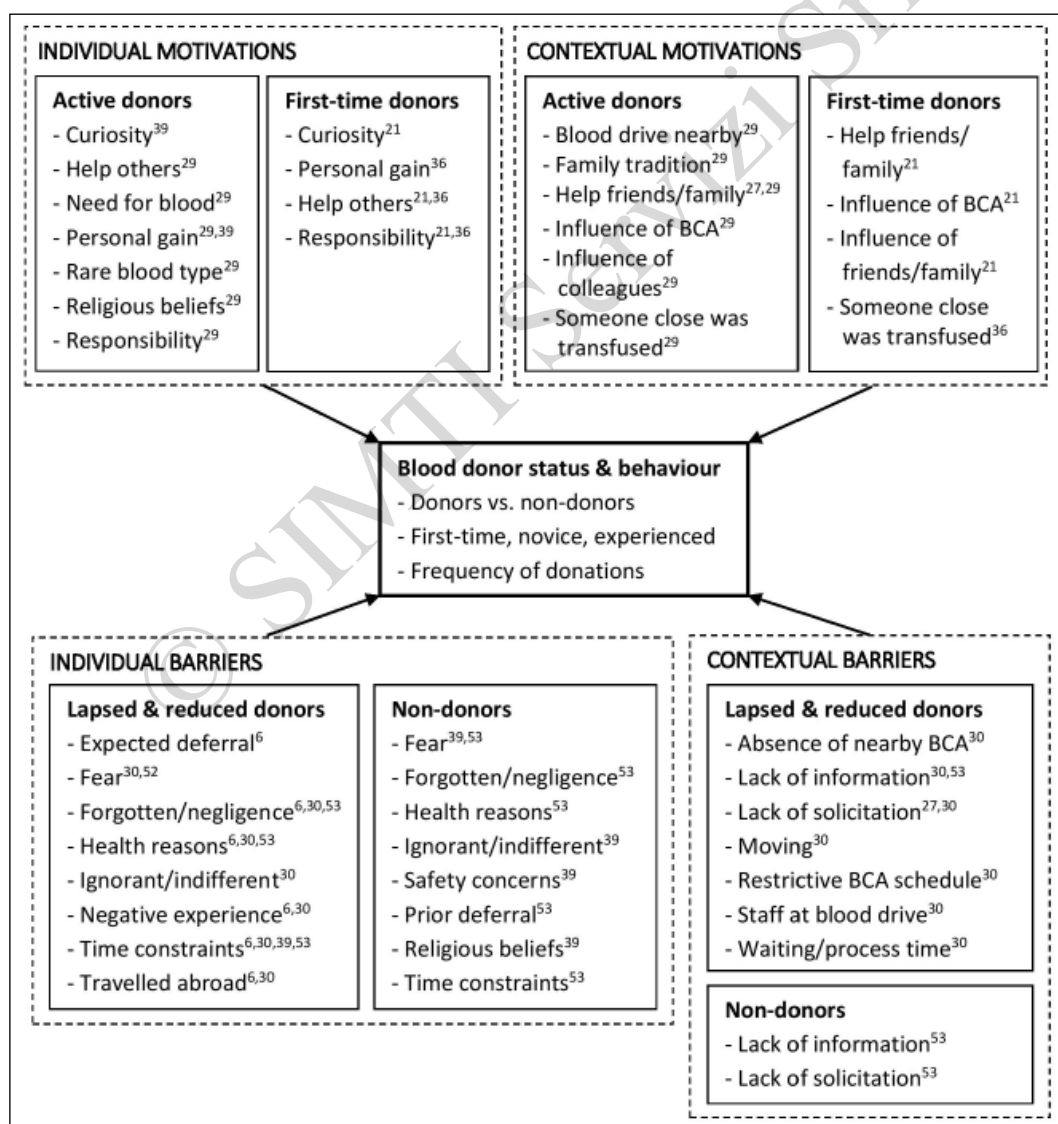
than in the general population<sup>5</sup>. Married people were also more likely to be donors in Canada<sup>29</sup>. In contrast, being married lowered the chance of being a donor in Germany and the United States<sup>34,38</sup>. In Spain, people who were divorced or widowed had a 50 percent higher chance of donating blood<sup>20</sup>. Gillum and Masters<sup>48</sup> found that being married was positively related to the likelihood of being a donor for men, but not for women. Having children lowered the chance of being a donor<sup>38</sup>.

### Motivations and barriers

Motivations and barriers to donating blood have been widely studied, mainly along three lines of research: self-reported motivations and barriers, the Theory of Planned Behaviour (TPB)<sup>52</sup>, and (mechanisms of) altruism.

Five studies examined self-reported motivations<sup>21,27,29,36,39</sup>, and five investigated self-reported barriers to donate blood<sup>6,27,30,39,53</sup> (Figure 3). Certain motivations to donate differed between members of socio-demographic groups<sup>21,29</sup>. Members of socio-demographic groups who are more likely to go through life events that might affect blood donation (e.g., studying, pregnancy) were more likely to cite motivations and barriers to donate associated with these events<sup>29,30,53</sup>.

Six studies used the TPB to predict donor behaviour. Only the intention to donate was robustly correlated with donor behaviour. Other variables in the TPB model (self-efficacy, subjective and moral norm, affective and cognitive attitude, and role identity) explained little if any variance when intention was included<sup>54-56</sup>.



**Figure 3** - Overview of the self-reported individual and contextual motivations and barriers to donate blood, differentiated by donor group.

Dutch donors were marked by high levels of intention, attitudes and self-efficacy<sup>36</sup>. Multigallon donors scored higher on self-efficacy, affective attitude and self-identity than occasional donors<sup>46</sup>. Affective attitude was positively related to return behaviour, while pressure to donate showed a negative relationship. Higher levels of self-efficacy, cognitive attitudes, affective attitudes and subjective norms were associated with lower levels of dropout<sup>57</sup>.

In studying altruism as a motivation to donating blood, Bolle and Otto<sup>51</sup> found no difference in the level of altruism between donors and non-donors (i.e., total amount of money donated to a charitable cause after filling in an online questionnaire served as a measure of their level of altruism). Evans and Ferguson<sup>58</sup> proposed a refinement of the general altruism concept, arguing that there are five theoretically distinct dimensions of altruism: impure altruism, kinship, self-regarding motives, reluctant altruism, and egalitarian warm-glow. Donors consistently scored higher than non-donors on feelings of warm-glow and reluctant altruism, but not on other forms of altruism<sup>59</sup>.

Regarding the donor career, cognitive and behavioural motives (e.g., intentions, self-efficacy and habit formation) showed associations in all stages of the donor career. For first-time and novice donors, reluctant altruism was a distinguishing factor, while experienced donors were marked by warm-glow and pure altruism. Impure altruism was higher among first-time donors than novice and experienced donors<sup>60</sup>.

No differences in levels of susceptibility to social influence between donors and non-donors appeared in one study<sup>61</sup>. Among participants who were aware of the need for blood, those who were asked to give blood were more likely to donate in the upcoming blood drive than those who were not asked to make an active decision<sup>62</sup>.

### **Adverse reactions and deferral**

As the self-reported barriers indicated, negative donation experiences and deferral might be reasons to lapse or stop donating<sup>6,30,53</sup>. Nine studies explored the role of adverse reactions (e.g., fainting, needle reactions) and deferral (e.g., low haemoglobin, travelling abroad) on donor status and behaviour.

Donors who experienced an adverse reaction showed lower return rates than donors who did not experience an adverse event<sup>42,57,63</sup>. This stopping risk increased with the severity of the reaction<sup>64,65</sup> and had a higher impact on first-time donors than repeat donors<sup>41,64-66</sup>. One study found that vasovagal reactions and fatigue, but not needle reactions, were negatively related to return rates<sup>35</sup>. Mixed results were found on the relationship between both age<sup>64,65</sup> and sex<sup>35,41,57,64</sup>, and return rates after an adverse reaction.

Donors who were temporarily deferred were less likely to return (especially for first-time donors and longer deferral periods) and had lower donation frequencies after deferral<sup>42,67,68</sup>. Age and education were positively related to return after deferral<sup>67</sup>.

### **Contextual characteristics**

Besides individual characteristics, context also plays a role in blood donor behaviour. For example, it was found that children raised in a "blood donor family" were more likely to become donors themselves<sup>69</sup>. Here we discuss contextual characteristics by differentiating between person-related factors (i.e., urbanisation, community characteristics, collective life events) and blood centre factors.

#### **Person-related factors**

In Spain and the United States, no differences were found in likelihood to donate between people from rural and urban areas<sup>20,48</sup>. In contrast, German municipalities with a larger population reported lower donation rates<sup>70</sup>. Although there were no differences in donation frequency between urban and rural areas in the United Kingdom, people from London donated less than those in other regions<sup>7</sup>. In contrast, Canadian, Greek and Serbian donors from metropolitan areas either showed higher propensities to donate<sup>28</sup>, or higher donation frequencies<sup>31,39</sup> than donors from non-metropolitan areas. In Switzerland, living in an urban area was associated with higher chances of becoming an inactive donor<sup>40</sup>.

In a German study, communities with a higher percentage of people aged 30 and above, a lower percentage of non-German inhabitants and a lower percentage of unemployed people had higher donor rates<sup>70</sup>. There were no differences in propensity to donate between people living in low, middle or high-income regions<sup>20,70</sup>. In Canada, communities with a higher proportion of singles and a lower proportion of children had higher annual donation rates. In contrast, communities with a higher proportion of educated people and higher immigrant rates had lower annual donation rates<sup>44</sup>.

As mentioned before, different motivations might be important for people in deciding to donate blood. One way these motivations can be triggered is by the occurrence of a life event. One study examined the effect of a collective, traumatic life event on donor behaviour<sup>71</sup>. In the weeks after the terror attacks on September 11<sup>th</sup> 2001, the number of first-time donors was almost three times higher than in September 2000. However, the return rate of these first-time donors did not differ. Women and older people were more likely to become loyal donors compared to men and younger people.

### **Blood centre factors**

Blood collection agencies play an important role in donor management, for example by providing information about donating blood, reminding donors about their next donation opportunity, and offering monetary or symbolic rewards.

The effectiveness of information and reminders provided by blood collection agencies was tested in seven experimental studies. People who read a short educational brochure on blood donation (e.g., information on the need for blood and the donation process) were more likely to sign up for an upcoming blood drive compared to people who read a standard blood bank brochure or a brochure unrelated to blood donation<sup>72</sup>. This effect was also present when donation-anxiety was heightened (i.e., in the presence of a mobile blood collection unit)<sup>73</sup>.

Both first-time and active donors who were reminded to donate by telephone were more likely to donate than (first-time) donors who were not reminded<sup>22,74</sup>. Overall, men and older people were most likely to donate after a call<sup>75</sup>. First-time donors were especially likely to donate when they received both an informational brochure and a telephone call reminder<sup>76</sup>. Among repeat donors, the combination of a telephone call and an email reminder had a positive effect on return rates of men, but not women<sup>77</sup>.

Moreover, not only the presence and content of the promotional and educational material of the blood collection agency matters, the framing of this material might also influence donor behaviour<sup>78,79</sup>. First, Moussaoui *et al.*<sup>79</sup> found that the return rate of lapsed donors did not vary when they received a donation invitation framed with a "save lives" message or a neutral invitation. Chou and Murnighan<sup>78</sup> even found that donors were more likely to donate at an upcoming blood drive when they received a loss-framed message (i.e., "help prevent someone from dying!"), than a gain-framed message (i.e., "help save someone's life!").

Canadian donors mentioned absence of a nearby blood drive as an important reason for reduced donation frequencies<sup>30</sup>. Within German communities, there was a relationship between available donation sites and donation rates for mobile sites but not for fixed sites<sup>70</sup>. The relationship had an inverted U-shape, with the positive association decreasing as the number of sessions rose.

The effects of monetary rewards have been tested in experimental settings. When Italian donors were rewarded with a day's paid leave, employed donors made, on average, one donation extra per year (most likely on Mondays and Fridays to extend their weekends) compared to self-employed or unemployed donors<sup>24</sup>. Donation frequencies increased with the monetary value

of incentives offered. Furthermore, donors, especially younger ones, were more likely to donate in places where higher rewards were offered<sup>80</sup>.

Regarding non-monetary rewards, the number of donors and frequency of donations in the United States increased when symbolic incentives were offered (e.g., t-shirts, coupons, mugs) and when their perceived value increased. If another donation site close to the donors' standard centre offered an incentive, donors were more likely to move to that centre and adjust their timing to receive the incentive<sup>81</sup>. When comparing the influence of private and public symbolic rewards (respectively receiving a medal and being mentioned in the local newspaper) on donation frequency in Italy, Lacetera and Macis<sup>45</sup> found that donors only increased their frequency when the thresholds for the public rewards were within reach. There was no decrease in donation frequency after these quotas were reached.

First-time donors satisfied with the overall donation experience were more likely to return to donate than those who were (moderately) unsatisfied<sup>22</sup>. However, only 1% of lapsed donors reported that dissatisfaction with the personnel was a barrier to donating<sup>30</sup>. Satisfaction with medical personnel was lower for younger donors<sup>28</sup>.

For men, but not for women, increased waiting time at the donation site decreased return rates<sup>82</sup>. Among active donors, 28% reduced their donation frequency because of waiting time, while 23% of the donors mentioned it as a reason for lapsing<sup>30</sup>.

There might be several other ways in which blood collection agencies can influence donor behaviour. A post-donation telephone interview (e.g., identifying motivations, making a donation plan) increased the likelihood of a subsequent donation, but not the donation frequency<sup>34</sup>. Van Dongen *et al.*<sup>66</sup> also showed the importance of donation planning, as for the third donation decision only planning failure was a significant predictor of non-return behaviour.

## **Discussion**

### **Essential findings**

The goal of this review was to identify individual, network and contextual characteristics that relate to blood donor status and behaviour, and to systematically discuss differences between study results. We found empirical evidence on five main lines of research: donor demographics, motivations and barriers, adverse reactions and deferral, contextual factors, and blood centre factors.

Demographic characteristics are strongly related to donor status and behaviour. However, the results vary considerably between studies, countries, and sample characteristics. There is no general profile in terms of certain socio-demographic features that is characteristic

of first-time, loyal, frequent, or non-donors. Individual (non-)donor behaviour cannot be fully understood without taking into account the widely ranging cultural and historical contexts on national and regional levels. Previous research has suggested that donor profiles vary between blood collection regimes because donors are recruited using different strategies<sup>83</sup>.

Self-reported barriers were quite consistent between studies. However, barriers to donate blood varied between members of different socio-demographic groups. Regarding motivations, we can conclude that blood donation is not just a purely altruistic act. Motivations to donate blood are dynamic and multidimensional, and include both self- and other-regarding motives. These findings have implications for blood collection agencies, as more tailored recruitment and retention campaigns might be able to address barriers and motivations for (non-)donors from specific socio-demographic groups more effectively.

Adverse reactions and deferral are negatively related to donor behaviour, especially for first-time donors. There might be a relation with donors' age and sex, but these results are inconclusive and understudied.

Regarding contextual factors, we cannot draw any strong conclusions. Results on urbanisation and community characteristics are mixed, with no clear differences to be found between or within countries. Furthermore, we recognise culture as an important contextual factor<sup>84,85</sup>, but none of the studies investigated its role in relation to blood donor status or behaviour.

Blood collection agencies play an important role in blood donor behaviour. Providing information and reminders were effective ways of boosting attendance rates. Experimental studies on (non-)monetary rewards also showed promising results. However, since all studies were performed in two USA and Italian cities by the same research group, more research is needed to draw conclusions on the generalisability of the results. Some other blood centre factors play a role as well (e.g., decreasing waiting time, planning future donations), but too few studies have investigated these factors to conclude on their effectiveness.

No studies were found on network characteristics of donors and non-donors. Although some studies included parental and partner status<sup>5,20,38,48</sup>, these relations could not be attributed exclusively to (social) networks, but also represent demographic transitions.

### Limitations

Systematic reviews are limited by the quality of the available studies and, more specifically, the representativeness and comparability of findings. Several of the studies included in this review failed to describe basic characteristics of the sample (e.g., mean

age, percentage of men and women), while others relied on non-random samples of university studies, making it difficult to generalise the study results and draw reliable conclusions.

With regard to comparability, a variety of concepts were used to study the same topic (e.g., community characteristics, self-reported barriers), while others used different definitions of donor status, making it difficult to compare findings across studies. In order to enable international comparisons, we would recommend the use of DOMAINE definitions<sup>86</sup> to characterise groups of donors and their behaviour.

### Future research

Despite the limitations, this review can serve as a basis for future research. First, we want to emphasise the importance of donor careers. Most research on donor behaviour and motivations used cross-sectional methods without taking into account that people and their behaviour might change. However, Ferguson *et al.*<sup>60</sup> showed how altruistic motives to donate blood differed between first-time, novice and experienced donors. We encourage the use of dynamic approaches and methods, following individual donors across several years to investigate motivational changes.

Moreover, if behaviour and motivations change over time, it will be interesting to explore how, when and why these changes take place. One possibility might be the occurrence of a life event. Collective events seem to have an effect on donating blood for the first time<sup>71</sup>, but based on self-reported barriers<sup>30,53</sup>, we can assume that individual events have effects as well. For example, health-related events might increase the awareness of need for blood or feelings of social responsibility, making it more likely that a person starts donating or increases the frequency of donating. Other life events can influence the network characteristics of donors (e.g., moving to another city), which affect the propensity to donate due to decreased network influences.

Second, it would be worthwhile to further explore network characteristics to discover how family ties and peer pressure influence individual donor behaviour. Bani and Strepparava<sup>21</sup> found that around 22% of the respondents were influenced by family and friends in their decision to donate, while Pedersen *et al.*<sup>69</sup> suggested that familial and heritable influences could be even stronger, extending beyond the donors' own awareness.

Finally, we suggest paying attention to the broader level of contextual and blood centre factors. These are important from a practical point of view because they can be influenced by blood collection agencies (e.g., providing information and reminders proved to have a positive influence on donor behaviour). Current research can be improved by modelling blood centre factors in



hierarchical ("multilevel") models to investigate the role of contextual characteristics (e.g., regional differences within countries) in these blood collection agency strategies. They can also be tested in field experiments, which allow for stronger causal inferences.

In summary, this systematic review has provided an overview of the recent literature on individual and contextual characteristics related to blood donor status and behaviour. If the great diversity of the results have one thing in common, it is that blood donor behaviour cannot be understood from one set of (non-) donor characteristics, as we have already stressed the importance of cultural and historical contexts in individual behaviour. Research on donor behaviour should try to explore the interrelationships between the individual, contextual, and network levels (e.g., multilevel designs and longitudinal studies), which could help us to better understand donor behaviour, and further assist blood collection agencies in designing tailored recruitment and retention strategies. We hope that this will contribute to safeguarding a sufficient and matching blood supply in the future.

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**Appendix A**

**Table I** - Quality assessment of the studies included for systematic review (n=66).

Study	Study clearly addresses focused issue?	Study design appropriate to address aims?	Factors and outcomes described in objectives?	Study population recruited in an acceptable way?	Variables accurately measured?	Analyses justified and appropriate?	Results detailed and reliable?	Impact of the research discussed?	Total*
Abásolo (2014)	†	+	+	+	+	+	o	o	7
Atsma (2011)	+	+	+	+	+	o	+	o	7
Bani (2011)	+	+	+	o	o	o	+	o	6
Beyerlein (2016)	+	+	+	+	o	o	+	+	7
Bolle (2010)	+	o	+	-	-	o	+	+	5
Bruhin (2015)	+	+	o	+	+	o	+	+	7
Charbonneau (2015)	+	+	+	+	o	+	+	+	7.5
Charbonneau (2016)	+	+	+	+	o	+	+	+	7.5
Chou (2013)	+	+	+	o	o	o	+	+	6.5
Cimaroli (2012)	+	+	+	+	+	+	+	o	7.5
Conner (2012)	+	+	+	+	+	o	+	+	7.5
Craig (2015)	+	+	+	o	o	o	+	o	5.5
Custer (2011)	+	+	+	o	o	+	o	o	6
Custer (2012)	+	+	+	+	o	+	o	+	7
Duboz (2010)	+	+	+	+	+	+	o	+	7.5
Eder (2012)	+	+	+	o	+	o	o	o	6
Evans (2014)	o	+	+	o	+	+	+	o	6.5
Ferguson (2012a)	+	+	+	+	+	+	+	o	7.5
Ferguson (2012b)	+	+	+	-	+	-	o	+	5.5
France (2014)	+	o	+	o	o	o	o	o	5
France (2010)	+	o	+	-	+	o	o	o	5
Garrett Whitney (2010)	+	+	+	+	o	o	+	+	7
Gemelli (2017)	+	+	o	+	+	+	+	o	7
Germain (2016)	o	+	+	+	o	o	+	+	6.5
Gillum (2010)	+	+	+	+	o	o	+	+	7
Godin (2011)	+	+	+	+	+	o	+	+	7.5
Griffin (2014)	+	o	o	-	o	o	o	+	4.5
Hillgrove (2011)	+	+	+	+	+	o	+	+	7.5
Holdershaw (2011)	+	+	o	o	+	o	o	+	5.5
James (2014)	+	+	+	+	+	o	+	+	7.5
Jóhannsdóttir (2016)	+	+	+	+	o	+	o	+	7
Kalargirou (2014)	+	o	+	o	+	o	o	o	5.5
Lacetera (2010)	+	+	+	o	+	o	+	o	6.5
Lacetera (2013)	+	+	+	+	+	o	+	o	6.5
Lacetera (2012)	+	+	+	+	+	o	+	o	6.5
Lacetera (2014)	+	+	+	+	+	o	+	o	6.5
Lattimore (2015)	+	+	+	+	+	o	+	+	7.5
Martín-Santana (2013)	o	+	o	-	+	o	o	+	5
Masser ... & Hunder (2016)	+	+	+	+	+	o	+	+	7.5

\*Total score for the corresponding study; +: 1 point; o: ½ point; -: 0 points. Scores range from 0 (very high risk of bias) to 8 (very low risk of bias).  
 †+: low risk of bias; o: medium risk of bias; -: high risk of bias.

*Continued on next page*

**Table I** - Quality assessment of the studies included for systematic review (n=66). (continued from previous page)

Study	Study clearly addresses focused issue?	Study design appropriate to address aims?	Factors and outcomes described in objectives?	Study population recruited in an acceptable way?	Variables accurately measured?	Analyses justified and appropriate?	Results detailed and reliable?	Impact of the research discussed?	Total*
Masser ... & Smith (2016)	+	+	+	0	+	0	+	+	7
Misje (2010)	+	+	+	+	+	0	+	+	7.5
Moussaoui (2016)	0	+	0	0	+	+	+	+	6.5
Notari (2009)	+	+	0	0	+	0	+	0	6
Papagiannis (2016)	+	+	+	+	-	0	+	+	6.5
Pedersen (2016)	0	+	+	+	+	0	0	0	6
Politou (2015)	+	0	0	0	0	-	-	0	3.5
Prados Madrona (2014)	+	0	+	+	+	0	0	+	6.5
Priller (2011)	-	+	0	-	-	0	0	-	2.5
Shaz (2011)	0	+	+	0	0	0	0	0	5
Shehu (2015)	0	+	0	+	0	+	0	+	6
Sinclair (2010)	0	+	0	+	+	0	+	0	6
Stutzer (2011)	0	+	0	+	+	+	+	+	7
Tran (2010)	+	+	+	+	+	+	0	+	7.5
Van Dongen (2013)	+	+	+	+	+	+	+	+	8
Van Dongen (2014)	+	+	+	+	-	+	+	+	7
Vavic (2012)	0	+	0	0	0	0	0	0	4.5
Veldhuizen (2012)	+	+	+	+	+	0	+	+	7.5
Veldhuizen (2013)	+	+	+	0	+	0	+	+	7
Volken (2013)	+	0	0	0	+	0	0	0	5
Volken (2015)	+	+	+	+	+	0	+	0	7
Warfel (2012)	+	0	+	-	+	0	+	0	6.5
Weidmann (2012)	+	+	0	+	+	0	+	+	7
Wevers (2014a)	+	0	+	+	+	0	0	+	6.5
Wevers (2014b)	+	+	+	+	+	0	+	+	7.5
White (2016)	+	0	+	-	+	0	+	0	5.5
Wiersum (2016)	+	+	0	+	+	0	+	+	7

\*Total score for the corresponding study; +: 1 point; 0: ½ point; -: 0 points. Scores range from 0 (very high risk of bias) to 8 (very low risk of bias).  
†+: low risk of bias; 0: medium risk of bias; -: high risk of bias.

## Appendix B

**Table II** - Overview of the items used in the newly developed review form.

	Main questions	Sub questions	Appraisal tool
<b>Introduction</b>	Did the study address a clearly focused issue?		CASP UK
		Specific objectives described? Research population described in the objectives?	STROBE, QualSyst CASP UK
<b>Methods</b>	Study design appropriate to address the study aims?		QualSyst, CRF
	Factors and outcomes described in the objectives?		STROBE
	Study population recruited in an acceptable way?		CASP UK, QualSyst
		Research population representative of a defined population? Setting and location described? Periods of recruitment described? Eligibility criteria described?	CASP UK STROBE STROBE STROBE
	Were variables accurately measured?		CASP UK, QualSyst
		Factors and outcomes well defined? Outcomes and factors measured by validated measures?	CASP UK, QualSyst CASP UK, QualSyst
	Statistical analyses described, justified and appropriate?		CASP UK, QualSyst
		All statistical methods described? Correct statistical method used to answer the research question? Relevant confounders taken into account? Explained how the sample size was calculated and justified?	STROBE CASP UK, QualSyst, CRF CASP UK STROBE, CRF
<b>Results</b>	Results reported in sufficient detail and reliable?		CASP UK, QualSyst
		Response rate of the study population described? Results reported in terms of statistical significance?	STROBE CRF
<b>Conclusion/ Discussion</b>	Was the impact of the research discussed?		CASP UK, STROBE, QualSyst, CRF
		Implications for practice and further research described?	CASP UK, CRF
		Results compared with those of other studies?	CRF
		Conclusions supported by the results? Can the results be applied to the local population?	QualSyst CASP UK, STROBE

CASP UK: Critical Appraisal Skills Programme<sup>16</sup>; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology<sup>17</sup>; QualSyst: Standard Quality Assessment Criteria<sup>18</sup>; CRF: Critical Review Form<sup>19</sup>.

## Appendix C

Table III - Overview and characteristics of the studies included for systematic review (n=66).

Study	Study characteristics					Characteristics of status and/or behaviour	
	Country*	Sample	Age	% male	Donor groups†	Individual characteristics‡	Contextual characteristics
Abásolo (2014)	ESP	1,211	45.8	48.0	D/ND	Age, sex, edu., rel., partner	Urbanisation, community
Atsma (2011)	NLD	15,076	46.3	47.3	D/POP	Age, sex, edu., ethn., partner	-
Bani (2011)	ITA	895	nr§	80.3	ND/RD/VD	Age, sex, mot.	-
Beyerlein (2016)	USA	1,589	47.1	51.2	D/ND	Rel., mot.	-
Bolle (2010)	GER	345	nr	nr	D/ND	Mot.	-
Bruhin (2015)	CHE	40,653	nr	nr	HFD/LFD	-	BC  : phone call
Charbonneau (2015)	CAN	795	39.5¶	42.0	D	Age, sex, edu., partner, mot.	-
Charbonneau (2016)	CAN	816	40.6¶	48.0	AD/LPD	Age, sex, edu., barrier	-
Chou (2013)	USA	3,534	nr	nr	D/ND	-	BC: brochure
Cimaroli (2012)	CAN	30,054	41.0	nr	FTD/RPTD	Age, sex	BC: accessibility, community
Conner (2012)	CAN	1,108	nr	nr	ED	Mot.	-
Craig (2015)	AUS	848	nr	nr	D	-	BC: waiting times
Custer (2011)	USA	505,623	nr	nr	FTD/RPTD	Deferral	-
Custer (2012)	USA	665,501	nr	nr	D	Adverse reaction	-
Duboz (2010)	FRA	1,186	39.2¶	46.8	LPD/ND	Barrier	-
Eder (2012)	USA	1,101,628	nr	nr	FTD/RPTD	Adverse reaction	-
Evans (2014)	GRB	414	20.1	38.0	D/ND	Mot.	-
Ferguson (2012a)	NLD	12,580	45.6	47.0	FTD/NVD/ED	Mot.	-
Ferguson (2012b)	USA	1,583	20.2¶	32.9¶	D/ND	Mot.	-
France (2014)	USA	1,715	17.3¶	44.3¶	FTD/ED	Mot., barrier, adverse reaction	-
France (2010)	USA	345	18.9	26.7	D/ND	-	BC: brochure
Garrett Whitney (2010)	USA	751,338	nr	54.0	FTD/RPTD	Sex	BC: phone call
Gemelli (2017)	AUS	90,867	48.1	51.4	NFD/EFD	Age, sex, adverse reaction, deferral	-
Germain (2016)	CAN	3,454	41.8	48.5	RPTD	-	BC: phone call, email
Gillum (2010)	USA	10,976	30.7¶	44.9	D/ND	Age, edu., ethn., inc., rel., partner	Urbanisation
Godin (2011)	CAN	1,541	30.0	45.0	FTD	-	BC: phone call
Griffin (2014)	AUS	345	nr	nr	D/ND	Mot.	-
Hillgrove (2011)	AUS	69,686	42.3¶	47.1¶	D	Deferral	-
Holdershaw (2011)	NZL	1,008	22.0	39.7	D/ND	Mot.	-
James (2014)	USA	402,692	37.3¶	44.3	FTD/RPTD	Age, sex, ethn.	Urbanisation, BC: accessibility
Jóhannsdóttir (2016)	ISL	27,406	nr	68.7	NWD/FTD/ND	Age, sex	-
Kalargirou (2014)	GRC	800	31.1¶	38.2	AD/PD/RPD/ND	Age, sex, edu., employ., mot.	Urbanisation
Lacetera (2010)	ITA	2,009	37.5	71	D	Sex, mot.	BC: rewards
Lacetera (2013)	ITA	3,177	38.8¶	71.6¶	D	Sex, mot.	BC: rewards

\* ISO ALPHA-3 code<sup>87</sup>.

† Abbreviations for donor groups: D: donor; AD: active donor; ED: experienced donor; FTD: first-time; GD: group donor; HFD: high frequency donor; NFD: new frequent donor; EFD: existing frequent donor; ID: individual donor; LFD: low frequency donor; LPD: lapsed donor; MD: multigallon donor; ND: non-donor; NVD: novice donor; NWD: new donor; OD: occasional donor; PD: previous donor; RD: regular donor; RPD: replacement donor; RPTD: repeat donor; VD: veteran donor; POP: general population; MZ: monozygotic twin; DZ: dizygotic twin.

‡ Abbreviations for individual characteristics: edu.: education; employ.: employment; ethn.: ethnicity; inc.: income; mot.: motivation; rel.: religion.

§ "nr" means that the specific value was not reported in the study. Eder *et al.*<sup>65</sup> and Notari *et al.*<sup>43</sup> both report age groups, but due to large ranges within these groups and the fact that the USA has no maximum eligible blood donation age, an accurate mean age could not be given; || BC refers to "blood centre factor"; ¶ exact mean age or percentage of men is not specified in the paper. Numbers computed from information available in the paper, such as distribution among age group.

Continued on next page.

**Table III** - Overview and characteristics of the studies included for systematic review (n=66). (continued from previous page)

Study	Study characteristics					Characteristics of status and/or behaviour	
	Country*	Sample	Age	% male	Donor groups†	Individual characteristics‡	Contextual characteristics
Lattimore (2015)	GBR	2,153,955	42.7¶	48.7	FTD/RPTD	Age, sex, ethn.	Urbanisation
Martin-Santana (2013)	ESP	1,015	27.5¶	46.8	D/ND	Age, sex, edu.	BC: rewards
Masser ... & Hunder (2016)	AUS	3,646	32.0	34.8	ND	-	BC: brochure, phone call
Masser ... & Smith (2016)	AUS	922	22.2	39.3	D/ND	-	BC: brochure
Misje (2010)	NOR	17,812	nr	53.0	FTD/RD	Sex	-
Moussaoui (2016)	CHE	1,022	36.3	47.9	LPD	-	BC: brochure
Notari (2009)	USA	1,173,694	nr	47.9	FTD	Age	-
Papagiannis (2016)	GRC	293	21.2	22.5	D/ND	Sex, mot.	BC: rewards
Pedersen (2016)	DNK	1,516	nr	32.0	MZ/DZ	Genetic factors	Contextual factors
Politou (2015)	GRC	1,362	34.7¶	71.1	ID/GD	Age, sex, mot., barrier	-
Prados Madrona (2014)	ESP	20,998	nr	52.3	D/ND	Age, sex	-
Priller (2011)	GER	16,963	nr	nr	D/ND	Age, sex, edu., employ., inc.	-
Shaz (2011)	USA	138,194	35.9¶	46.0	FTD/RPTD/ ND	Age, sex, ethn.	-
Shehu (2015)	GER	12,487	46.8	49.4	D/ND	Age, sex, edu., employ., inc., partner, parent	-
Sinclair (2010)	USA	215	31.1	40.9	D	Sex, edu., inc., ethn., partner	BC: post-donation interview
Stutzer (2011)	CHE	1,838	nr	nr	D/ND	Mot.	-
Tran (2010)	USA	4,594	34.9¶	36.6	FTD	-	Life events
Van Dongen (2013)	NLD	1,278	33.0	26.0	FTD	Sex, mot., adverse reaction	-
Van Dongen (2014)	NLD	1,018	35.9	31.6	D	Sex, mot., adverse reaction, deferral	BC: planning
Vavic (2012)	SRB	639	30.1¶	72.1	FTD/RPTD	Sex, age, edu.	BC: satisfaction, urbanisation
Veldhuizen (2012)	NLD	12,051	45.3	54.0	D	Mot., adverse reaction	-
Veldhuizen (2013)	NLD	2,964	34.3	30.8	D	Sex, mot.	-
Volken (2013)	GER/CHE	8,746	32.7¶	47.8	D/ND	Age, sex, edu.	-
Volken (2015)	CHE	17,430	33.5¶	50.0	D	Age, sex	Urbanisation
Warfel (2012)	USA	253	19.0¶	40.7	D/ND	Mot.	-
Weidmann (2012)	GER	1,519	nr	nr	D/ND	-	BC: mobile sites, community
Wevers (2014a)	NLD	4,901	42.2¶	52.3	RPTD/NRPTD	Age, sex, barrier, deferral	-
Wevers (2014b)	NLD	2,169	43.4¶	42.7	OD/MD	Age, sex, mot.	-
White (2016)	AUS	190	21.6	24.0	D/ND	Mot.	-
Wiersum (2016)	NLD	551,744	46.0	58.0	FTD/RPTD	Age, sex, adverse reaction	-
<b>Total</b>		<b>8,488,757</b>				<b>53/66</b>	<b>29/66</b>

\* ISO ALPHA-3 code<sup>87</sup>.

† Abbreviations for donor groups: D: donor; AD: active donor; ED: experienced donor; FTD: first-time; GD: group donor; HFD: high frequency donor; NFD: new frequent donor; EFD: existing frequent donor; ID: individual donor; LFD: low frequency donor; LPD: lapsed donor; MD: multigallon donor; ND: non-donor; NVD: novice donor; NWD: new donor; OD: occasional donor; PD: previous donor; RD: regular donor; RPD: replacement donor; RPTD: repeat donor; VD: veteran donor; POP: general population; MZ: monozygotic twin; DZ: dizygotic twin.

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§ "nr" means that the specific value was not reported in the study. Eder *et al.*<sup>65</sup> and Notari *et al.*<sup>43</sup> both report age groups, but due to large ranges within these groups and the fact that the USA has no maximum eligible blood donation age, an accurate mean age could not be given; || BC refers to "blood centre factor"; ¶ exact mean age or percentage of men is not specified in the paper. Numbers computed from information available in the paper, such as distribution among age group.