

Impact of Blood Donation on Quality of Life and Cardiovascular Outcomes: A Systematic Review

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Abstract:

Background: Blood donation is one of the pillars of modern healthcare systems, offering a critical source for surgeries, trauma treatment, obstetrical emergencies, and management of blood disorders. Blood donation is considered safe and healthy in most cases. The occurrence rate of severe complications, such as myocardial infarction and stroke, has rarely been reported in the general population.

Aim of the study: To systematically review and synthesise observational evidence on impact of blood donation on health-related quality of life and cardiovascular outcomes.

Methods: This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA-2020) guidelines [9] and a SWiM reporting guidance. All authors established and approved the method of analysis. The predefined protocol for the present study was registered in the Prospective Register of Systematic Reviews (PROSPERO) with ID: CRD420261340484. We searched databases such as Scopus, PubMed, Ovid-Medline and Epistemonikos using the keywords Population, Exposure, Outcome, and Time Frame (PEOT). Because of the variation in designs, exposures, and outcomes, results were synthesized descriptively based on the Synthesis Without Meta-analysis (SWiM) guidelines. The risk of bias was appraised via the Newcastle-Ottawa scale.

Results: 441 studies were found through electronic databases, and two were found during manual searches. Using Reference Manager (Zotero), duplicates were removed. After screening the titles and abstracts, finally, in qualitative narrative synthesis, thirteen studies were incorporated. Donation-related adverse events were uncommon and mostly mild in nature. Data on the cardiovascular impact of donation were heterogeneous, with some research indicating possible benefit in certain populations, but when corrected for healthy donor effects, there were no cardioprotective findings.

Conclusion: The available evidence supports the overall safety of blood donation, with potential health benefits observed in specific subgroups rather than universally. Given heterogeneity and observational study designs, causal conclusions remain limited, supporting the use of structured narrative synthesis.

INTRODUCTION

Blood donation is one of the pillars of modern healthcare systems, offering a critical source for surgeries, trauma treatment, obstetrical emergencies, and management of blood disorders. Over 100 million blood donations are carried out worldwide every year, indicating that voluntary blood donors are essential stakeholders in the sustainability of public health [1]. In addition to the numerous studies conducted on the recipient's transfusion safety, there is growing interest in evaluating the health effects of blood donation on the donors' health and well-being in both the short and long terms.

Blood donation is considered safe and healthy in most cases. The occurrence rate of severe complications, such as myocardial infarction and stroke, has rarely been reported in the general population. Studies using large cohort samples have shown that adverse health outcomes in donors are relatively low compared with the benefits of blood donation.[2] However, physiological changes after donation, such as hemoglobin and hematocrit decline, are evident among regular donors.[3,4]

Health-related quality of life (QoL) is another significant measure of donor satisfaction that has gained importance in recent years. A number of studies conducted using validated measures of QoL, such as the Medical Outcomes Study 36-item Short Form Health Survey (SF-36), indicate that blood donors frequently report

similar or better health statuses both physically and mentally when compared to the general population [5]. This can be attributed to the possible beneficial effects of blood donation on the psyche of the donor due to positive social interactions and health-related attitudes, including altruism and health consciousness. On the contrary, perceptions regarding fatigue, dizziness, or even iron deficiency may negatively influence health perception and donor retention, especially in low-income countries [6].

Blood donation and cardiovascular disease remain debatable issues. In terms of theory, there is an assumption that recurrent donations may improve cardiovascular health due to lower body iron content and reduced iron-related oxidative stress. Observational studies have demonstrated the existence of an association between recurrent blood donation and favorable cardiovascular risk factor profile [7].

On the contrary, other literature reviews have not managed to find evidence of protective effect on the cardiovascular system due to selection bias and the so-called "healthy donor effect" because donors have better health conditions in comparison to non-donor population [8].

Systematic reviews conducted among blood donors with respect to cardiovascular outcomes revealed heterogeneity in research methods applied, patient populations, definition of outcomes, and follow-up

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periods. In addition, most of the evidence obtained has been based on observational studies where it was not possible to adequately consider potential confounders, donation frequency, and iron status [7,8]. It should be mentioned that there were very few papers that addressed the issue in terms of patient-related quality of life.

Taking into account the increasing number of repeated and regular blood donors across the world, there is a need to conduct a systematic review of the available literature to summarize the existing evidence about blood donation outcomes in terms of quality of life and cardiovascular disease risk. The results obtained will help in donor counseling, donation interval determination, and development of policies for the safety of blood donors.

METHODS

This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA-2020) guidelines [9] and a SWiM reporting guidance [10].” All authors established and approved the method of analysis. The predefined protocol for the present study was registered in the Prospective Register of Systematic Reviews (PROSPERO) with ID: CRD420261340484.

Eligibility criteria

We included observation studies (Cross sectional and Cohort studies) which focused on impact of blood donation on donors’ health specially on cardiovascular outcomes and quality of life among adults conducted in community, hospitals, or clinical settings across all types of genders, races, regions, and countries. Studies that enumerated on cardiovascular profile, risk, donor safety and the quality of life were incorporated. Studies reported as abstracts only or as a thesis or conference paper, as well as those whose full texts were not available and were published in a language other than English, were excluded due to the language barrier.

Source of information

Databases such as Scopus, PubMed, Ovid-Medline and Epistemonikos were searched using the keywords ‘Population’, ‘Exposure’, ‘Comparator’, ‘Outcome’, and ‘Time Frame’ (PEOT); then, titles and abstracts were searched using alternative keywords. A comprehensive investigation was done using a transparent search approach. Manual research using available references was also performed. Research articles published between 2015 and 2026 were searched.

Search strategy:

We searched databases such as Scopus, PubMed, Ovid-Medline and Epistemonikos ed using the keywords Population, Exposure, Outcome, and Time Frame (PEOT); then, titles and abstracts were searched with the

help of alternative keywords ‘("blood donor*" OR "blood donation" OR "voluntary donor*") AND TITLE-ABS-KEY ("quality of life" OR QoL OR "health-related quality of life" OR HRQoL OR "cardiovascular disease*" OR "heart disease*" OR "coronary artery disease" OR "myocardial infarction" OR stroke OR hypertension OR "cardiovascular risk") AND TITLE-ABS-KEY (cohort OR "cross-sectional" OR "case-control" OR observational OR longitudinal). A comprehensive investigation was performed by using a transparent search approach. Manual searches of reference lists were also performed. Research articles from 2015 to 2026 were searched.

Selection of included studies

Two authors (AB and DS) first evaluated the titles and abstracts of the research articles to assess their relevance to the review topic. After screening the titles and abstracts using Reference Manager (Zotero), duplicates were removed. The full text was thoroughly examined to ensure it met the eligibility criteria. Both authors (AB and DS) independently assessed the abstracts and full-text articles. Any discrepancies during the screening process were resolved through consultation with the first author (AB). Only studies published in peer-reviewed journals and in the English language were included.

Data collection process

Two authors (AB and DS) independently extracted quantitative data from the included studies using the Joanna Briggs Institute Manual Experimental Studies data extraction tool. The data extraction form consisted of study type, author, year of publication, location, sample size, participants, and their age, exposure/study context, scales/tools used, outcome measures, and study findings.

Outcome measures

This review included > 18 years age adults of voluntary donors, undergoing whole blood donation. The primary outcome to identify the impact of blood donation on health-related quality of life and the secondary outcome to determine blood donation impact on cardiovascular outcomes using data derived exclusively from open-access studies.

Study risk of bias assessment and effect measures

The methodological quality of the included studies was evaluated using the Newcastle-Ottawa Scale (NOS) [11] tool by two independent authors (AB and DS). It comprises three domains. The domains assessed for NOS were selection (up to 4 Stars), comparability (up to 2 stars) outcome (up to 3 stars). Maximum score 9 Stars. Total NOS score of 7-9 stars High quality/low risk of bias, 5-6 stars moderate quality/moderate risk of bias and 0-4 stars low quality/high risk of bias. Total 9 studies were cohort studies, and their ROB was presented in Table 1

Table 1 Risk- of- bias summary: review authors' judgements about each risk of bias item for each included study and overall risk of bias (The Newcastle-Ottawa Scale (NOS) for Cohort studies.

Cohort studies	Selection				Comparability		Outcome		Total (0–9)	Overall
	Representativeness of the exposed cohort	Selection of the cohort	Ascertainment of exposure	Outcome of interest not present at the start of the study	Control of important and additional factors	Assessment of outcome	Follow-up long enough for	Adequacy of follow-up of cohorts		
Almutairi et al., 2017	1	1	1	1	2	1	1	0	8	Low risk of bias
Blais et al., 2014	1	1	1	1	2	1	1	0	8	Low risk of bias
France et al., 2017	1	1	1	1	2	1	0	0	7	Low risk of bias
Hulcrantz et al., 2020	1	1	1	1	2	1	1	1	9	Low risk of bias
Kamhieh-Milz et al., 2016	1	1	1	1	2	1	0	0	7	Low risk of bias
Karki et al., 2023	1	1	1	1	2	1	1	0	8	Low risk of bias
Peffer et al., 2019	1	1	1	1	2	1	1	1	9	Low risk of bias
Toss et al., 2021	1	1	1	1	2	1	1	1	9	Low risk of bias
Yücel et al., 2016	1	1	1	1	2	1	0	0	7	Low risk of bias

Synthesis method: Given the extensive heterogeneity amongst studies in terms of design, populations, exposures, and outcomes, it was not possible to conduct a quantitative meta-analysis. Rather, evidence was synthesised using a structured narrative synthesis methodology consistent with PRISMA-2020 and Synthesis Without Meta-analysis (SWiM). Studies were pre-ordered into outcome domains, and qualitative comparisons between studies were conducted for each outcome domain based on effect directionality and consistency. A higher degree of interpretative value was placed upon longitudinal cohort studies of larger sample sizes.

RESULTS:

441 studies were found through electronic databases, and two were found during manual searches. Using Reference Manager (Zotero), duplicates were removed.

After screening the titles and abstracts, 379 studies were identified, out of which 362 were excluded as they did not meet the criteria of this review according to the PEOT framework. Seventeen full-text articles were assessed for eligibility. The rationale for the study selection and elimination process is mentioned in the PRISMA flow chart (figure 2).

Finally, in qualitative narrative synthesis, thirteen studies were incorporated. [12-24]. The main outcome was the Impact of Blood Donation on Quality of Life and Cardiovascular Outcomes. **The Narrative synthesis is presented in Table 2.**

Risk of bias assessment:

Assessment of the risk of bias was performed by using the Newcastle-Ottawa Scale (NOS), which was applied to cohort studies. According to NOS scores obtained across all included articles, risk of bias was assessed as

low because NOS scores varied from 7 to 9. In addition, appropriate selection of cohorts, accurate determination of exposure, and control of important confounders were

evident in all studies. However, minor biases could be observed in the Outcomes section, mainly due to the follow-up period or its completeness.

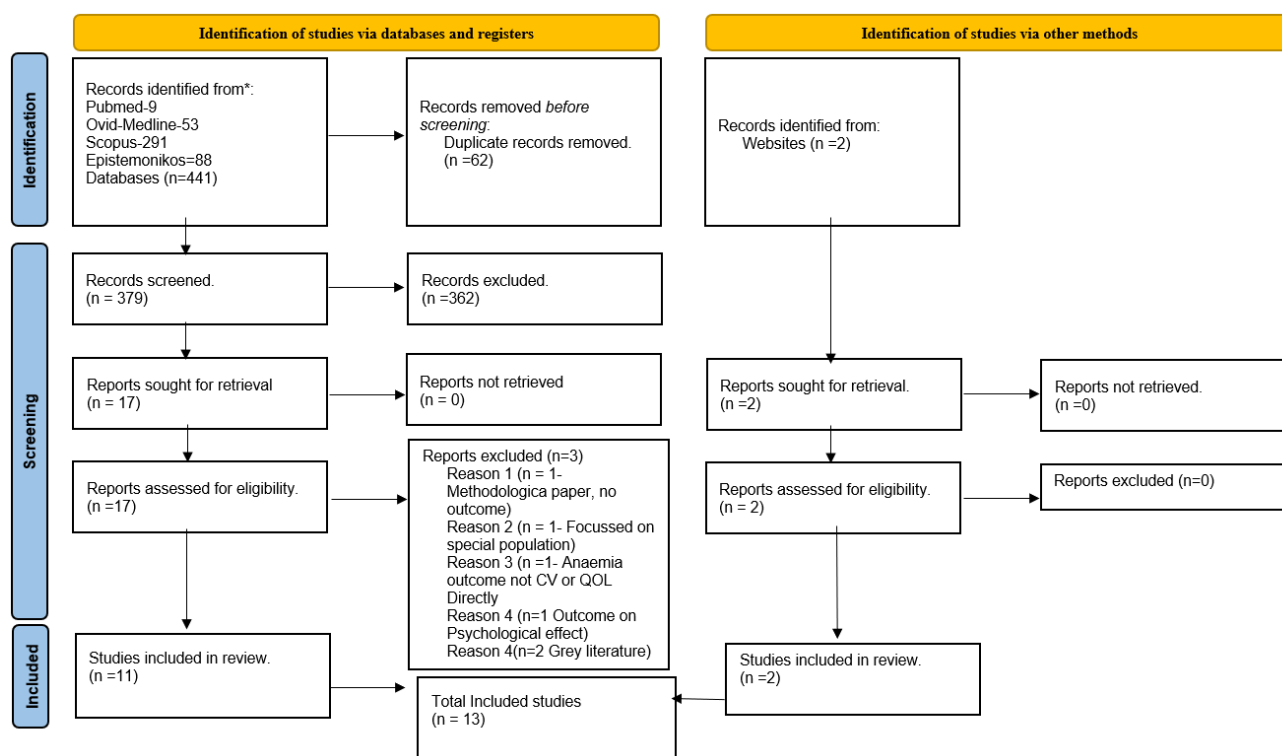


Fig 2: PRISMA flow chart

Table 2: Narrative synthesis

Study (Author, Year)	Study design	Population (sample size)	Exposure / Comparator	Outcome measures	Key findings
Almutairi et al., 2017	Prospective cohort	Voluntary blood donors (n = 16,121)	Whole blood donation episodes	Magnitude of adverse effects of donation (vasovagal response, local effects)	Adverse reactions during donation were rare and minor, illustrate the safety of routine whole blood donation
Blais et al., 2014	Cohort	Repeat blood donors (n = 1,600)	Donation frequency	Overall health status, and rate of donor deferrals	Repeated donation did not result in worsening of overall health status or increase in abnormal clinical findings
Dinh et al., 2019	Cross-sectional	Australian donors (n =3,400)	Donor vs non-donor status	Quality of life associated with health using standard measures of physical and psychological well-being	Donors had better physical and psychological health compared to those who had never donated blood

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France et al., 2017	Cohort	US blood donors (n=90,000)	Repeated blood donation	Systolic and diastolic blood pressures with correction for regression to the mean	Blood pressure changes were mostly due to regression towards the mean rather than a physiological phenomenon
Hultcrantz et al., 2020	Registry-based cohort	Scandinavian blood donors (n=1.5 million)	Hemoglobin concentration categories	Thrombotic episodes and severe cardiovascular events recorded using the national health registers	Elevated levels of hemoglobin were linked with greater chances of arterial clot formation arterial thrombosis
Longo et al., 2007	Cross-sectional	Italian blood donors (n=11,000)	Cardiovascular risk profiling	Calculating the risk of heart disease using a validated multivariate risk score	The majority of donors fell under low and medium categories of cardiovascular disease risk
Kamhieh-Milz et al., 2016	Prospective cohort	Normotensive and hypertensive donors (n=292)	Regular blood donation	Change in systolic and diastolic blood pressures in repeated cycles of donation	Significant blood pressure lowering seen among donors with previous hypertension condition
Karki et al., 2023	Linked-data cohort	Australian donors aged ≥ 45 years (n=5,653)	High-frequency vs lower-frequency donation	Admissions for cardiovascular disease based on administrative health data	No relationship between frequent donations and decreased admissions for cardiovascular disease
Marić et al., 2026	Cross-sectional	Slovenian blood donors (n=1,543)	Subclinical risk evaluation	Lipid profile and other biochemical risk factors for heart disease	Some donors showed poor cardiometabolic disease risk profile
Peffer et al., 2019	Nationwide cohort	Dutch blood donors (n=159,934)	Long-term high-frequency donation	Cardiovascular disease morbidity and mortality obtained from hospital discharge and death records	Decreased CVD risk seen among females but not males
Toss et al., 2021	Self-controlled cohort	Swedish blood donors (n=963,000)	Short-term post-donation period	Immediate post-donation serious adverse events (syncope, hypotension, cardiovascular	Only minor reactions such as fainting and hypotension increased, while no major acute problems noted

				disease, death in 30 days)	
Wang et al., 2019	Cross-sectional	Chinese whole-blood donors (n = 837)	Donation frequency and cognition	Donor quality of life (SF 36 PCS & MCS) and attitude toward donation	Increased donation rate associated with better QoL partially through cognitive effects
Yücel et al., 2016	Prospective cohort	Healthy male donors (n = 50)	Serial blood donation	Endothelial function using flow-mediated dilatation and ambulatory blood pressure	Enhanced endothelial function and decreased diastolic BP upon repeated donation

OUTCOME MEASURES

Narrative synthesis of findings

The narrative synthesis included 13 observational studies, involving both prospective/retrospective cohort studies and cross-sectional designs. In summary, there was evidence to suggest that blood donation does not cause negative health effects in the long run, but this varied with respect to the health outcome area and populations examined. [12-24]

Donor safety outcomes

There are two significant studies on adverse effects associated with blood donations. According to Almutairi et al., there is a low incidence of adverse effects following the whole blood donation process. The authors also stated that there was no indication of severe side effects in their study.[12] On the other hand, Toss et al. found that there is no risk of severe cardiovascular complications or death within the 30-day period following the blood donation process.[22].

Cardiovascular outcomes

The results associated with cardiovascular disease (CVD) outcomes were inconclusive. Peffer et al. noted a slight decrease in cardiovascular disease complications among female subjects who engaged in regular blood donation practices for prolonged periods, whereas no protective benefit was seen among male individuals.[21] On the contrary, Karki et al., using combined administrative databases and the healthy donor effect, did not note any reduction in CVD hospitalizations among frequent blood donors.[19] Similarly, Hultcrantz et al. showed that higher hemoglobin levels could be a risk factor for developing arterial thrombosis; nevertheless, this relationship is physiologically driven and does not reflect the frequency of blood donation practices.[16]

Blood pressure and vascular physiology

Several research papers investigated physiological cardiovascular indicators. According to Kamhieh-Milz et al., hypertensive individuals participating in regular blood donation exhibited a marked decrease in both their systolic and diastolic blood pressure.[18] On the other hand, according to France et al., any observed decreases in blood pressure levels were largely a result of the regression-to-the-mean effect. [15] Yücel et al. found an improvement in the endothelial function and a decrease in diastolic blood pressure after consecutive blood donations in healthy men. [24]

Quality of life and psychosocial outcomes

Cross-sectional analysis on HRQoL were carried out by two independent groups. The first study found better physical and psychological quality of life scores in blood donors than in non-blood donors. [14] In another analysis, increased frequency of blood donation correlated with better physical and psychological quality of life scores, and the relationship was partially mediated by a positive cognitive attitude to blood donation. [23]

Subclinical cardiovascular risk

The cross-sectional data analysis revealed the absence of an association between donor eligibility and the lack of subclinical cardiovascular risk factors. According to Longo et al. and Marić et al., some blood donors had unfavorable lipid levels or high cardiovascular risk scores even though they met the donor requirements. [17,18]

Overall, the data confirm the safety of blood donations, although it should be noted that there are a few studies showing health benefits for some subgroups of people such as females and hypertensive patients. Nevertheless, a considerable amount of heterogeneity in terms of methodology, exposure, population, and outcomes as

well as the continued impact of the healthy donor bias contribute to avoiding statistical meta-analysis. [12-24]

Evidence synthesis

Pursuant to PRISMA-2020, evidence synthesis was performed through a narrative approach since there was no need for a quantitative meta-analysis. The studies reviewed displayed significant heterogeneity in terms of methodology, study population, definition of exposure, outcome measurement, and analysis approach. Thus, quantifying the effect sizes obtained would be incongruent.

A systematic narrative synthesis framework was thus utilized, according to SWiM guidelines, whereby studies were classified a priori into outcome domains depending on the nature of the health outcome measured, namely, donor safety, cardiologic, blood pressure, and vascular function, quality-of-life, and psychosocial outcomes, and sub-clinical cardiologic risk. Each category of health outcome was systematically analyzed in terms of qualitative consistency of effects rather than their quantification.

The synthesis of evidence involved an examination of trends within the body of literature in light of study methodology, sample size, exposure features, and quality of methods used. The interpretative weight of evidence was higher for results obtained in large-scale longitudinal cohort studies, with long follow-up periods, whereas cross-sectional and mechanistic data provided background information on the association under investigation. Direction of effect synthesis was employed to categorize results in terms of their indication of beneficial, null, detrimental, or reassuring relationships between blood donation and health.

There was no certainty of evidence assessment performed (i.e., GRADE), since the current literature review does not seek to calculate pooled estimates or draw causal conclusions. Inference of conclusions was made based on the overall internal consistency and plausibility of results.

DISCUSSION

This review has consolidated the information from 13 observational studies involving various health parameters of blood donors. The overall results from this review suggest that there are no negative health impacts of blood donation on suitable donors. It has been found that the occurrence of any adverse effects in relation to blood donation was infrequent and generally mild. [12, 22]

Data on cardiovascular health effects were mixed. While Peffer et al. noted that regular blood donations by women reduced their cardiovascular morbidity rates to some extent, no such effects were found among men [21]. On the other hand, Karki et al., employing robust analysis to control for the healthy donor bias, reported that there was no significant decrease in cardiovascular disease admissions among frequent donors [19]. This is in line with criticisms of the observational studies conducted earlier, wherein any protective effect seen among donors may not be causally linked to blood donation itself. [16,17]

Physiological responses showed potential benefits in certain sub-groups. Repeated blood donation was linked to decreased blood pressure in hypertensive donors [18], while there were reports of improved endothelial function as a consequence of repeated blood donation in healthy male donors.¹³ Other studies, on the contrary, have shown that changes in blood pressure levels found in repeat donors can be accounted for by regression toward the mean effect rather than the physiological effect of blood donation itself [15].

Generally, the psychosocial and quality of life outcome results were positive. Findings from cross sectional analysis indicated that donors had better quality of life scores both in terms of physical and psychological well-being than non donors, [14] and there was an association between more frequent blood donation and improved quality of life outcomes due to positive cognitive attitude toward blood donation. [23]

However, despite mostly positive results, some risk factors for cardiovascular disease existed among certain donors. Findings from studies on the lipid profile and cardiovascular risk score indicate that even though the donor is eligible to donate blood, this does not guarantee absence of cardiovascular risks. [17, 20].

The interpretation of the results is hampered by differences in study methodology, definition of outcomes, exposure measurement, follow-up time, and the overwhelming impact of the healthy donor effect. For this reason, the causal conclusions from the analysis cannot be drawn, making structured narrative synthesis the only appropriate approach to evidence synthesis.

In conclusion, the evidence presented indicates that blood donation is generally safe with positive health impacts for certain subpopulations but not all. Further studies should employ longitudinal study designs with adequate control for selection bias, standardized definitions of outcomes, and investigation into sex-specific mechanisms behind the effects of blood donation.

CONCLUSION

In this review, evidence from 13 observational studies has been collated on the health effects of blood donation in terms of various health outcomes. On the whole, the available evidence suggests that blood donation is a safe procedure and does not have any adverse health impacts in eligible candidates. Furthermore, any complications arising from blood donation are rare and mostly mild. The evidence base for cardiovascular health outcomes is mixed, with some possible benefits found in certain subgroups of the population, such as female gender and hypertension. No significant cardioprotective effects have been found when the "healthy donor effect" is considered. Some physiological and mechanistic studies showed potential benefits in terms of reduced blood pressure and improved endothelial function in select subgroups. Psychosocial outcomes such as HRQoL were mostly positive. Subclinical markers of cardiometabolic disease were present in some donors, meaning that donation eligibility does not automatically mean cardiometabolic health.

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REFERENCES:

1. World Health Organization. Blood safety and availability. WHO; 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/blood-safety-and-availability>
2. Toss F, Zhao J, Sjölander A, Edgren G. Short-term health outcomes following whole blood donation: a nationwide retrospective cohort study. *Transfusion*. 2021;61(8):2330–2339. doi:10.1111/trf.16445
3. Kaptoge S, Di Angelantonio E, Moore C, et al. Longer-term efficiency and safety of increasing the frequency of whole blood donation (INTERVAL): extension study of a randomized trial. *Lancet Haematol*. 2019;6(10):e510–e520. doi:10.1016/S2352-3026(19)30106-1
4. Bagesh SK, Kumar A, Jaiswal CP. Assessment of serum ferritin levels and hematologic changes in blood donors: impact of donation frequency. *J Cardiovasc Dis Res*. 2024;15(4):245–251.
5. Wang L, Shi H, Zhu Y, et al. Blood donation and health status based on SF-36: the mediating effect of cognition in blood donation. *PLoS One*. 2019;14(10):e0223657. doi:10.1371/journal.pone.0223657
6. Thorpe R, Masser B, Coundouris SP, et al. The health impacts of blood donation: a systematic review of donor and non-donor perceptions. *Blood Transfus*. 2023;22(1):7–19. doi:10.2450/bloodtransfus.494
7. Quee FA, Peffer K, ter Braake AD, van den Hurk K. Cardiovascular benefits for blood donors? A systematic review. *Transfus Med Rev*. 2022;36(3):143–151. doi:10.1016/j.tmr.2022.04.004
8. Edgren G, Hjalgrim H, Reilly M, et al. Donation frequency, iron loss, and risk of cardiovascular disease in blood donors. *Transfusion*. 2020;60(2):454–462.
9. Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. *BMJ*. 2020;368:l6890. doi:10.1136/bmj.l6890.
10. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
11. Wells GA, Shea B, O’Connell D, Peterson J, Welch V, Losos M, Tugwell P. The Newcastle–Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Ottawa (ON): Ottawa Hospital Research Institute; 2011.
12. Almutairi H, Salam M, Alajlan A, Wani FA, Al-Shammari B, Al-Surimi K. Incidence, predictors and severity of adverse events among whole blood donors. *PLoS One*. 2017;12(7):e0179831.
13. Blais C, Delage G, Germain M, Grégoire Y, Tardif JC. Blood donation frequency and health outcomes: a cohort study. *Transfusion*. 2014;54(6):1535–43.
14. Dinh KM, van de Mortel TF, Jancey J. Health-related quality of life in blood donors: a cross-sectional study. *Health Qual Life Outcomes*. 2019;17:42.
15. France CR, France JL, Carlson BW, Himawan LK, Stephens KY, Rebosa M. Blood donation and blood pressure: a retrospective cohort study. *Transfusion*. 2017;57(3):653–60.
16. Hultcrantz M, Modlitba A, Rostgaard K, et al. Hemoglobin concentration and risk of arterial and venous thrombosis in blood donors. *Transfusion*. 2020;60(10):2276–86.
17. Longo G, Zaza G, Maruzzi M, et al. Cardiovascular risk profile of blood donors: results from the Progetto CUORE. *Blood Transfus*. 2007;5(3):136–41.
18. Kamhieh-Milz S, Kamhieh-Milz J, Schmidt R, et al. Blood donation may reduce blood pressure in hypertensive blood donors. *Transfusion*. 2016;56(3):637–44.
19. Karki S, Davison TE, Masser BM, et al. High-frequency blood donation and risk of cardiovascular disease: a cohort study. *Transfusion*. 2023;63(2):243–52.
20. Marić P, Boban M, Kušec V, et al. Subclinical cardiovascular risk factors among blood donors. *Blood Transfus*. 2026;24(1):45–
21. Peffer K, den Heijer M, de Kort WLAM, Verbeek ALM, Atsma F. Cardiovascular risk in 159 934 frequent blood donors while addressing the healthy donor effect. *Heart*. 2019;105(16):1260–5.
22. Toss F, Zhao J, Sjölander A, Edgren G. Short-term health outcomes following whole blood donation: a nationwide cohort study. *Transfusion*. 2021;61(8):2347–55.
23. Wang L, Shi H, Zhu Y, et al. Blood donation and health status based on SF-36: the mediating effect of cognition in blood donation. *PLoS One*. 2019;14(10):e0223657.
24. Yücel H, Zorlu A, Kaya H, Yılmaz MB. Regular blood donation improves endothelial function in healthy men. *Anatol J Cardiol*. 2016;16(3):154–8.