ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 6644-6651 (2026)
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BIOINFORMATION
Discovery at the interface of physical and biological sciences
BIOMEDICAL INFORMATICS
www.bioinformation.net
Volume 22(10)
Research Article

Received October 1, 2026; Revised October 31, 2026; Accepted October 31, 2026, Published October 31, 2026
DOI: 10.6026/973206300226644

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478
2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

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Edited by P Kangueane
Citation: Bharti *et al.* Bioinformation 22(10): 6644-6651 (2026)

Low hemoglobin deferral in female blood donors: A retrospective study from North India

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ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 6644-6651 (2026)
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Abstract:
Low hemoglobin (Hb) is a major cause of blood donor deferral, particularly among women. A retrospective study was conducted from January 2024 to June 2025 at a tertiary care blood center in North India among donors aged 18–65 years. Among 6,668 deferred donors, 29.0% were deferred due to low Hb, with females showing a higher proportion than males (59.7% vs. 25.6%), particularly among those aged 20–40 years. Hypertension and recent medication use were other common causes of deferral. Thus, targeted iron and nutritional interventions, donor education, counselling, and structured recall may reduce preventable deferrals and improve donor retention.

Keywords: Female donor deferral, anemia, iron deficiency, donor motivation clinic, transfusion services, India

Background:
Blood donation is an essential public health service, with tertiary care centers facing a consistently high demand for blood components such as packed red cells, platelets, and plasma. One of the most frequent causes of donor ineligibility, particularly among female donors in India, is low hemoglobin levels **[1].** The National Blood Transfusion Council (NBTC) mandates a minimum Hb of 12.5 g/dL for donation. Physiological differences, menstrual blood loss, and nutritional deficiencies contribute to higher deferral rates in females, reflecting the broader burden of iron-deficiency anemia that disproportionately affects women in mid-life and undermines healthy aging. In high-demand centers, such deferrals create a critical gap between demand and supply **[2].** This study analyzes the proportion of female donors deferred for low Hb over 1.5 years and explores how donor motivation clinics—incorporating dietary counseling, awareness campaigns, and structured follow-up—can improve donor retention and eligibility **[3, 4].** Globally, low Hb is a dominant reason for temporary donor deferral; about 1 in 10 candidates may be deferred for Hb issues, with women affected disproportionately due to iron-deficiency anemia, menstruation, pregnancy/lactation, and dietary factors. This not only limits immediate donation opportunities but also reflects a systemic challenge in women' s health, where untreated anemia contributes to fatigue, reduced work capacity, and long-term risks for cardiovascular and cognitive decline. Apart from the social, economic, geographical, and cultural factors, clinical demand is dependent on healthcare providers' training, behavior, and blood ordering practice within the health system capacity. Ideally, a blood transfusion system should be capable of addressing 100% of clinical demand arising in healthcare facilities within its catchment area **[5].** The National AIDS Control Organization' s statistics show that the annual rate of blood donations in India is about 7.4 million units against the requirement of 10 million units **[6].** This not only reduces immediate collections but also dampens return rates after a negative donation experience. Contemporary Indian evidence—especially from North India and UP—consistently places anemia at the top of deferral lists, though absolute rates vary by thresholds, screening methods, and donor mix **[7].** Therefore, it is of interest to evaluate the burden and pattern of low-hemoglobin-related deferral among female blood donors and to highlight the potential role of donor motivation clinics incorporating dietary counseling, awareness, and structured follow-up in improving donor eligibility and retention.

Materials and Methods:
After obtaining informed written consent, in addition to the blood donor screening questionnaire, information regarding premenopausal or postmenopausal age group, parity, last menstrual period, frequency and number of previous blood donations, previous deferral due to low Hb, dietary intake, and any history of chronic diseases was elicited from the study participants by the investigator. Initial hemoglobin assessment was done on a hemoglobinometer (Hemocue Hb 301). Donors with hemoglobin less than 12.5 gm/dl were retested 2 ml of blood sample was collected in an EDTA vial from all the blood donors and tested by the Medonic CA620/530 hematology analyzer uses the Coulter impedance principle for counting and sizing blood cells. Blood donors with hemoglobin levels ≤12.5 g/dL—based on manufacturer guidelines and Government of India donor selection criteria—were classified as having low Hb and deferred from donation **[9].**

Study design and population:
This is a Retrospective observational study conducted in tertiary care blood center in North India. Donor records from January 2024 to June 2025 were reviewed. It includes all blood donors in the 18–65 years age group who registered for blood donation over and mainly focused on female donors deferred due to low Hb.

Selection criteria:
All age group donors, who, registered for blood donation, will be selected according to the guidelines laid down by the Drugs and Cosmetics Act,1940(23 of 1940) (DCA), Ministry of Health and Family Welfare, Government of India **[8]**.

Inclusion criteria:
All individuals aged 18 to 65 years who presented for whole blood donation

Exclusion criteria:
Donor with incomplete records & who left before completing the pre donation screening process

Statistical analysis:
In the analysis, categorical data were expressed as proportions and percentages, and 95% confidence intervals were calculated to represent the range of prevalence estimates. Reasons for donor deferral were compared using the 95% pooled confidence limits method. A p-value of less than 0.05 was considered statistically

significant. Data analysis was performed using IBM SPSS version 25 and Microsoft Excel.

Results:

In this study, a total of 52,029 whole blood donors were registered; out of these, 6,668 donors (12.8%) were deferred based on the standard donor selection criteria given CI (as per DSR 10). Out of the total 6,668 registered donors, 6,015 (90.2%) were male, while 653 (9.8%) were female. Age-wise analysis of deferred donors showed that the majority of deferrals occurred in younger age groups. Donors aged 20–30 years accounted for the highest proportion at 40.5%, followed by those aged 30–40 years (32.7%), 40–50 years (16.6%), 50–60 years (5.9%), and less than 20 years (3.8%). Only a small fraction (0.5%) of deferred donors was aged 60 years or above **(Figure 1).** The deferred blood donors, according to the reason for deferral, showed that low hemoglobin (Hb) level was the most common cause, accounting for 29.0% of deferrals (95% CI: 27.9%–30.1%). A substantial proportion of donors (20.6%, 95% CI: 19.6%–21.6%) were deferred for unknown reasons. Other notable causes included high blood pressure (6.3%, 95% CI: 5.8%–6.9%), piercing or tattoo (3.1%, 95% CI: 2.6%–3.5%), fungal infection (2.8%, 95% CI: 2.4%–3.2%), absence at donation (2.8%, 95% CI: 2.4%–3.2%), recent antibiotic intake (2.5%, 95% CI: 2.2%–2.9%), and other medications or miscellaneous diseases (each 2.2%, 95% CI: 1.9%–2.6%). Less frequent reasons included ARV therapy (1.0%), diabetes (0.9%), alcohol intake (0.7%), thyroid disorder (1.2%), active or open wound (1.2%), recent surgery (1.5%), typhoid vaccination (1.5%), and rabies vaccination (1.8%). Rare causes, contributing less than 1% each, included underage donors, underweight, steroid use, jaundice, fever, lactating mother, cold & cough, dental procedures, fasting, allergy, low BP, and hepatitis B **(Figure 2).** The age-wise distribution of deferred blood donors according to the reason for deferral highlights significant variations across different age groups. Among donors below 20 years, the main reasons were low hemoglobin (26.3%), followed by unknown causes (16.7%), underage (7.2%), and issues like piercing/tattoo (5.6%) and suspicious donors (5.2%). In the 20–30 years age group, the leading reasons were again low hemoglobin (26.1%) and unknown causes (21.6%), followed by piercing/tattoo (4.4%), suspicious donors (3.4%), absence (3.4%), fungal infection (2.8%), antibiotic use (2.5%), and rabies vaccination (2.5%). Menstruation (1.6%) was also a relevant factor among female donors. For donors aged 30–40 years, low hemoglobin (30.9%) was the most prominent reason, followed by unknown causes (21.8%). High blood pressure (4.6%), fungal infection (2.9%), antibiotic use (2.8%), absence (2.8%), and piercing/tattoo (2.8%) were also observed. Conditions like thyroid disorder (1.6%), surgery (1.7%), and other infections (1.5%) were more noticeable in this age group compared to younger donors. In the 40–50 years group, low hemoglobin (33.9%) remained the leading cause, followed by unknown causes (18.8%). High blood pressure became more significant in this group (14.1%), while diabetes (1.9%), thyroid disorder (2.8%), and surgery (1.4%) were also more common. Among donors aged 50–60 years, the most frequent causes were high blood pressure (32.1%), low hemoglobin (27.0%), and unknown causes (15.7%), indicating a shift toward chronic health-related conditions. Diabetes (3.8%) was also more common in this age group. For donors above 60 years, the discards were mainly due to high blood pressure (35.3%), low hemoglobin (17.6%), and unknown causes (11.8%). A notable proportion (29.4%) was attributed to "other reasons", reflecting a range of health or eligibility issues not classified elsewhere. Overall, the analysis shows that younger donors (<30 years) were more likely to be discarded due to anemia, underage, tattoos, or menstruation-related factors, while older donors (>40 years) were predominantly deferred due to chronic conditions such as high blood pressure, diabetes, and thyroid disorders. Unknown reasons remained a considerable contribution across all age groups; underlining the need for more precise documentation of deferred causes **(Figure 4).** The gender-wise deferred blood donors, according to reasons, showed marked differences between males and females. Low hemoglobin (Hb) level was the leading cause among females, accounting for 59.7% of deferrals, compared to 25.6% in males given CI (as per DSR 10), reflecting a difference of –34.1%. Menstruation accounted for 13.0% of female deferrals and was absent in males (–13.0%). Conversely, conditions such as high blood pressure (6.8% vs. 2.1%), fungal infection (3.0% vs. 0.2%), recent antibiotic intake (2.7% vs. 1.2%), recent blood donation (2.2% vs. 0.3%), and piercing/tattoo (3.3% vs. 1.1%) were more common among male donors. Other gender-specific differences included thyroid disorder, more prevalent in females (4.3% vs. 0.9%, difference –3.4%), and lactating mother, reported only among females (1.2%). Certain deferral reasons, such as ARV therapy, diabetes, alcohol intake, high hemoglobin, dengue, cold & cough, allergy, dental treatment, jaundice, low BP, typhoid, fever, and not sleeping well, were predominantly observed in males. Additionally, a significantly higher proportion of males were deferred for unknown reasons (22.4%) compared to females (4.0%), with an 18.4% difference **(Figures 5 and 6).** Taken together, these findings highlight that gender disparity in donor deferrals is not merely a donor pool issue but reflects broader mid-life health challenges for women. The predominance of low hemoglobin and menstruation-related deferrals among females underscores the burden of iron-deficiency anemia and reproductive health factors that compromise women' s eligibility for donation and, more importantly, signal vulnerabilities in their long-term health trajectory. In contrast, male deferrals were more often linked to behavioral or temporary health conditions. This pattern emphasizes the need for targeted health education and pre-donation screening strategies, particularly focusing on women, to reduce the high burden of donor deferrals due to anemia in the region and to support healthier aging outcomes **(Figure 7).**

Discussion:

Low hemoglobin (Hb) remains the leading cause of temporary blood donor deferral worldwide and continues to represent a major challenge for maintaining an adequate blood supply. In the present study, low Hb accounted for **29.0**% of all donor deferrals and was the predominant cause of temporary donor ineligibility.

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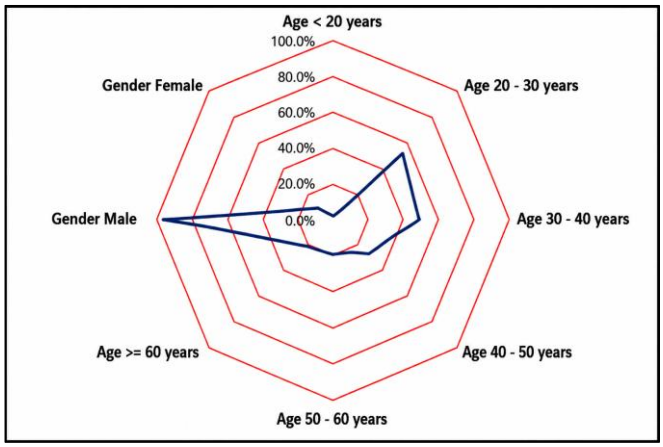


Figure 1: Deferred blood donors according to age and gender

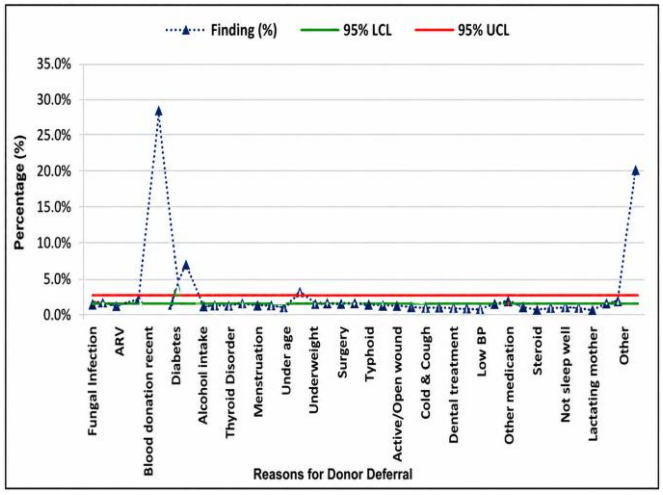


Figure 2: Deferred blood donors according to reasons

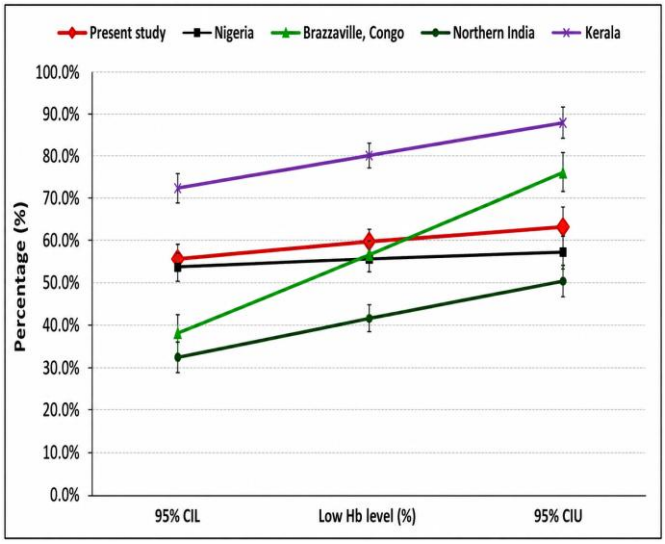


Figure 3: Female deferred blood donors according to the reason of low hb level comparison with geographical areas

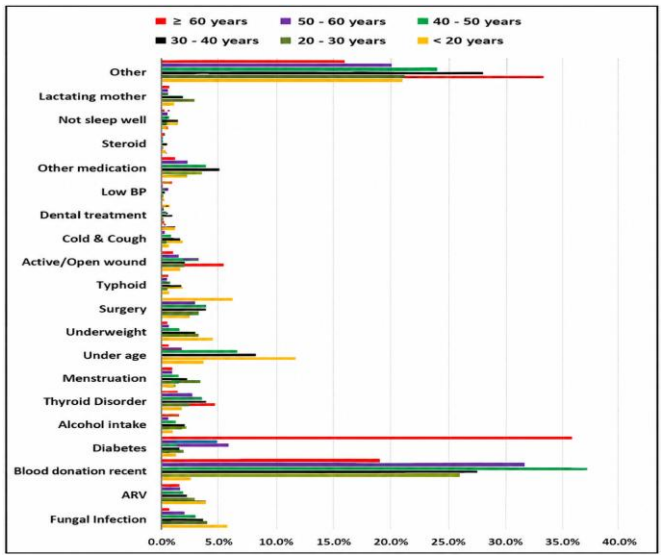


Figure 4: Age-wise, deferred blood donors according to reasons

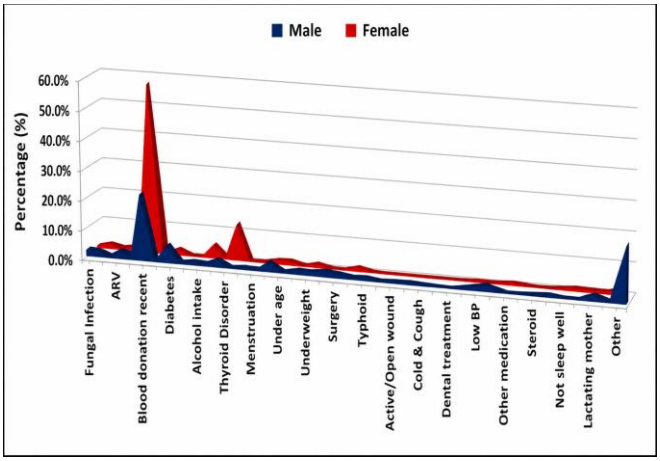


Figure 5: Gender wise, deferred blood donors according to reason

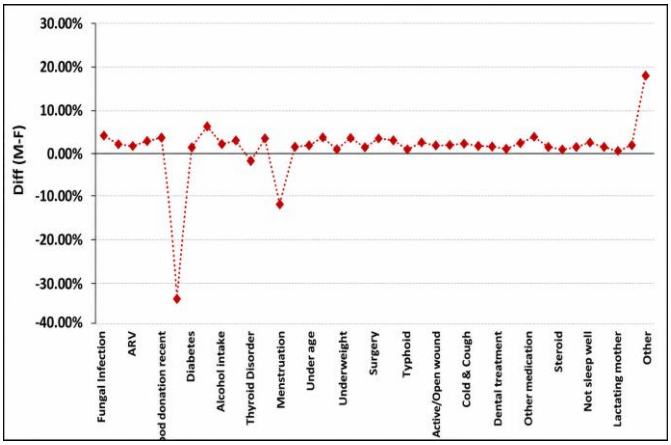


Figure 6: Line chart of proportion differences of genders according to reason

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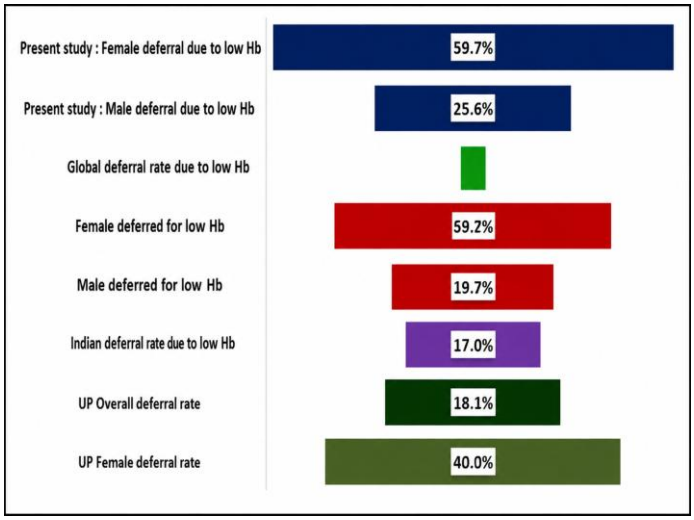


Figure 7: Comparative analysis of deferred blood donors/due to low Hb with global, Indian and UP regions

Among female donors, 59.7% of all deferrals were attributed to low Hb compared with 25.6% among male donors, highlighting a marked gender disparity. Similar findings have been reported from tertiary care centers in India and other countries, where low Hb consistently remains the most frequent reason for temporary donor deferral **[15].** The proportion of donors deferred because of low Hb observed in the present study is comparable with previous reports. Soundharya *et al.* reported that most temporary donor deferrals were related to low hemoglobin and recent alcohol intake **[10]**. Chauhan *et al.* demonstrated that low Hb accounted for approximately one-third of all donor deferrals in North India **[12]**, while Chaurasiya *et al.* reported anemia as the commonest cause of temporary donor deferral (34.1%) **[18].** Similar observations have also been reported by Patil *et al.* **[17]**. Gonnade *et al.* **[21]** Chavan and Ingole **[28]**, Meena *et al.* **[29]**, Malhotra *et al.* **[30]**, Attri *et al.* **[31]**, confirming that anemia remains the predominant cause of temporary donor deferral across different regions. Female donors exhibited a substantially higher frequency of low Hb-related deferral than males. This observation is consistent with studies from Kerala, Nigeria, and other developing countries, which have shown that women are disproportionately affected by anemia-related donor deferral **[13]**. The higher prevalence among females is likely attributable to physiological iron loss associated with menstruation, pregnancy, lactation, lower body iron stores, and inadequate dietary iron intake. Frequent blood donation without appropriate iron replacement further aggravates iron depletion, increasing the likelihood of temporary donor deferral **[16]**. Age-specific analysis demonstrated that donors aged **20–40 years** experienced the highest frequency of low Hb-related deferral. Similar age distributions have been reported by Kothari *et al.* **[14]** and Oyedeji *et al.* **[19]**, suggesting that younger adults constitute the population most vulnerable to nutritional anemia while simultaneously representing the most valuable group of repeat voluntary blood donors. Comparison of female low Hb-related deferrals across different geographical regions **(Figure 3)** demonstrated considerable regional variation. The prevalence observed in the present study (59.7%) was comparable to reports from Nigeria and Congo but exceeded several studies from Northern India while remaining lower than observations reported from Kerala **[11]**. These differences may reflect variations in nutritional status, socioeconomic conditions, dietary habits, healthcare accessibility, donor selection practices, and regional prevalence of iron deficiency. The findings of the present study have important implications for donor retention and blood availability. Temporary donor deferral frequently discourages first-time donors from returning, thereby reducing the pool of repeat voluntary donors. Since repeat donors are generally associated with improved donor safety and blood availability, reducing preventable causes of temporary deferral should remain a priority for transfusion services **[20]**. The establishment of donor motivation clinics has the potential to extend the role of blood banks beyond transfusion services and contribute significantly to public health. The high prevalence of low hemoglobin among female blood donors is not merely a transfusion medicine concern but reflects the broader burden of nutritional anemia in India. According to the National Family Health Survey (NFHS-5), more than half of women of reproductive age in India are anemic, highlighting the urgent need to integrate blood donor screening with national anemia control strategies **[22]**. In this context, blood banks can function as sentinel centers for the early detection of anemia, health education, counseling, and referral for appropriate management. Targeted educational interventions focusing on adolescent girls and women of reproductive age in schools, colleges, and workplaces may substantially reduce the prevalence of anemia while simultaneously improving future donor eligibility and maternal health outcomes. Collaborative efforts involving transfusion medicine specialists, public health professionals, primary healthcare providers, and dietitians are essential to address nutritional deficiencies at the community level and strengthen preventive healthcare initiatives **[26].** A comprehensive strategy is therefore warranted to reduce donor deferrals due to low hemoglobin. Key measures include institutionalizing donor motivation clinics in tertiary care blood centers, integrating community-based nutrition and anemia control programs with donor recruitment initiatives, implementing policy-level interventions promoting iron supplementation among women of reproductive age, and establishing structured follow-up programs for temporarily deferred donors. Furthermore, prospective research evaluating donor return behavior after temporary deferral would provide valuable insights for developing evidence-based donor retention strategies and optimizing blood donor recruitment. Anemia continues to be a major global public health challenge, affecting both developed and developing countries. It is estimated that approximately 1.62 billion individuals worldwide are affected by anemia, representing nearly one-quarter of the global population **[23].** Blood donor eligibility criteria, developed on the basis of scientific evidence, clinical judgment, and regulatory standards, play a critical role in ensuring the safety of both donors and recipients while inevitably influencing donor demographics and

deferral patterns **[24].** Although these criteria are essential for maintaining transfusion safety, temporary donor deferral may negatively affect donor motivation and reduce the likelihood of future donations. Reported donor deferral rates range from 5% to 24% across blood centers, resulting in a substantial loss of potentially eligible blood units and posing a significant challenge to maintaining an adequate and sustainable blood supply **[25].** In view of these findings, donor motivation clinics may represent an effective and sustainable strategy to reduce temporary deferrals, improve donor retention, enhance donor health, and strengthen national blood transfusion services while simultaneously contributing to broader public health goals through early anemia detection and intervention **[27].** The high prevalence of low Hb among female donors also reflects the broader burden of nutritional anemia in the community rather than an isolated transfusion medicine problem. Blood donation screening therefore provides an opportunity for early identification of women with previously undiagnosed anemia and facilitates timely nutritional counselling and referral for appropriate medical evaluation. Integration of donor screening with public health initiatives focusing on anemia prevention may improve both women's health and donor retention. Establishment of structured Donor Motivation Clinics may provide an effective strategy to reduce repeat deferrals. Individualized dietary counselling, iron supplementation where appropriate, menstrual health education, periodic hemoglobin monitoring, donor recall systems, and psychological reassurance may improve hemoglobin recovery and encourage deferred donors to return once eligible. Such interventions have the potential to strengthen voluntary blood donation while improving long-term donor health **[32]**. Overall, the present study confirms that low Hb remains the leading and largely preventable cause of temporary blood donor deferral, particularly among women. Comprehensive interventions involving nutritional counselling, iron supplementation, donor education, structured follow-up, and public health programs targeting anemia are likely to improve donor eligibility, donor retention, and the sustainability of blood transfusion services **[33, 34]**.

Conclusion:

Low hemoglobin was the predominant cause of temporary blood donor deferral among female donors in our tertiary care center, substantially limiting donor availability. The high frequency of hemoglobin-related deferrals underscores the need for targeted anemia screening, counselling, and appropriate referral among female donors. Addressing anemia and nutritional deficiencies may reduce recurrent deferrals and improve the availability and retention of eligible female blood donors.

Future perspectives:

Future strategies should focus on establishing structured donor motivation clinics within tertiary care blood centers to provide individualized nutritional counselling, dietary education, appropriate iron supplementation, menstrual health education, and periodic hematological assessment for temporarily deferred donors. Electronic donor databases, automated reminders, and scheduled follow-up evaluations could facilitate timely reassessment and re-entry of eligible donors into the donor pool, thereby improving long-term donor retention. Integration of donor health services with national anemia-control programs, women's health initiatives, and community nutrition programs may further support improvement in hemoglobin status before subsequent blood donation. Future prospective multicenter studies are warranted to evaluate the effectiveness of donor motivation clinics, structured counselling, iron supplementation, and systematic donor recall systems in reducing recurrent low-hemoglobin deferrals, improving donor return rates, and assessing long-term donor health outcomes. Such evidence could help establish standardized donor-management strategies that simultaneously strengthen blood availability and contribute to the prevention of anemia among women.

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Declaration:

No. This manuscript has not been published as a preprint on any preprint server or any other platform. Therefore, no preprint version exists and no removal from any primary source is required.

Limitations:

This study has certain limitations. First, it was conducted at a single tertiary care blood center, which may limit the generalizability of the findings to other regions or healthcare settings. Second, the retrospective study design relied on routinely recorded donor data, restricting the availability of information on dietary habits, socioeconomic status, menstrual history, body mass index, iron supplementation, and other potential risk factors associated with low hemoglobin. Third, laboratory assessment was limited to pre-donation hemoglobin estimation, and confirmatory investigations such as serum ferritin, transferrin saturation, vitamin B12, and folate levels were not routinely available. Consequently, the underlying etiology of anemia could not be established. Finally, donor follow-up data after temporary deferral were unavailable, precluding assessment of donor return rates and the long-term effectiveness of counseling or treatment interventions.

Clinical Implications:

The findings of this study have important implications for transfusion medicine and public health. Blood donation centers should function not only as providers of safe blood but also as sentinel sites for early detection of nutritional anemia. The establishment of structured donor motivation clinics within tertiary care blood centers may facilitate individualized nutritional counseling, iron-rich dietary education, appropriate iron supplementation, menstrual health education, periodic hematological assessment, and counseling for temporarily

deferred donors. Integration of electronic donor databases with automated reminder systems and scheduled follow-up assessments may further improve donor retention and successful re-entry into the donor pool. Primary care physicians and family medicine practitioners have a pivotal role in the prevention, diagnosis, and management of iron deficiency anemia through dietary counseling, iron supplementation, lifestyle modification, and longitudinal follow-up. Integration of donor health services with national anemia control programs, women' s health initiatives, and community nutrition programs may improve hemoglobin levels before blood donation while simultaneously contributing to broader preventive healthcare goals. A multidisciplinary approach involving transfusion medicine specialists, primary care physicians, gynecologists, dietitians and public health professionals is likely to maximize both donor health and blood availability.

Advancement of knowledge:
This study advances current knowledge by providing evidence on the magnitude and pattern of low-hemoglobin-related blood donor deferral among female donors in a tertiary care blood center in North India. The markedly higher proportion of low-Hb deferral among female donors, particularly in the 20–40-year age group, identifies an important and potentially modifiable gap in maintaining an adequate donor pool. The findings emphasize the need for targeted nutritional assessment and counseling, donor education, and structured follow-up of deferred female donors. Such strategies may help reduce preventable deferrals, improve donor eligibility, and promote repeat blood donation, thereby contributing to a more sustainable blood supply.

Author contributions:
All listed authors involve and give substantial input into the study's concept, data acquisition, analysis, writing, critical review and final approval of the manuscript.

Financial support and sponsorship:
Nil.

Conflicts of interest:
There are no conflicts of interest.

Acknowledgment:
I would like to express my sincere gratitude to technical and nursing staff for their invaluable support throughout this study.

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ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 6644-6651 (2026)
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