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Impact of regular whole-blood donation on hemoglobin level

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Abstract

Background: Blood donation is regarded as a noble, voluntary act that is done without compensation. Prior to donation, donors undergo a preliminary examination (including blood pressure, blood type, hemoglobin levels, pulse, etc.). After donating blood, it is important to recheck their hemoglobin levels to determine whether they are low or remain stable.

Purpose: To determine the impact of regular whole blood donation on hemoglobin levels.

Method: A descriptive study with an observational design. The variable is the hemoglobin level before and after blood donation. The research was conducted at the Indonesian Red Cross Society of Tenggarong, with 45 blood donors as respondents. Hemoglobin levels were measured using a POCT (Point of Care Testing) tool. Data analysis was performed univariately to assess the hemoglobin level changes before and after donation.

Results: The study revealed gender characteristics for male and female donors, with an average Hb level of 14.5 gr/dl for men and 13.25 gr/dl for women in their last donation. For current donation, the average Hb levels were 14 gr/dl for men and 11.65 gr/dl for women. The decrease in hemoglobin levels was 0.5 gr/dl for men and 1.6 gr/dl for women. Almost all donors showed no symptoms post-donation.

Conclusion: Hemoglobin levels decreased after donation, but there were no symptoms such as fainting for both men and women.

Suggestion: Donors can use this information to increase their understanding of hemoglobin levels, ensure they get adequate rest the night before donation, eat iron-rich foods, and avoid strenuous activities after donating blood. It is also recommended that future researchers consider including the menstrual cycle as a factor in similar studies.

Keywords: Donor; Hemoglobin; POCT.

INTRODUCTION

Blood transfusions are a vital component of every country's health service. Ensuring a sufficient and safe supply of blood and blood products is vital for the effective functioning of healthcare systems and patients' overall well-being. However, ensuring a sufficient supply of safe blood may prove challenging because disasters or other emergencies may damage the available civil and healthcare infrastructure, disrupting mobility, transportation, and service provision. Moreover, some population members may not be able to donate blood because of fear or illness (World Health Organization, 2023;

Kalibatas, Kalibatienè, & Imashpayev, 2024; Chiem, Alghamdi, Nguyen, Han, Huo, & Jackson, 2022).

In general, blood donors are healthier than the general population. This phenomenon is known as the healthy donor effect (HDE) and is the result of a selection bias similar to the healthy worker effect. Just as the healthy worker effect can mask potential occupational hazards, the HDE can mask the adverse effects of blood donation, since only healthy people are allowed to donate blood. As a blood bank, we have an obligation to ensure that donors are in good health before and after donating blood

(Erikstrup, Sørensen, Nielsen, Bruun, Petersen, Rostgaard, & Pedersen, 2023).

Blood donation is regarded as a selfless and voluntary act done without compensation, as donors help those in need of blood. Prior to donation, donors undergo an initial screening (including blood pressure, blood type, hemoglobin levels, pulse rate, and more). If they pass this assessment, they are eligible to donate blood. Following this, blood is screened as a precautionary measure to ensure the safety of both the donor and the recipient in the future (Maharani & Noviar, 2018).

The blood screening performed includes testing for four (4) infection parameters transmitted through blood transfusions using either the ELISA or Rapid test method. These parameters are HIV, Syphilis, Hepatitis B, and Hepatitis C, in line with Minister of Health Regulation Number 83 of 2014. The Indonesian Red Cross Society has been conducting syphilis screenings since 1975, currently focusing on *Treponema pallidum* antibodies using the TPHA reagent. The Hepatitis B screening targets HBsAg, while Hepatitis C tests for anti-HCV antibodies, and HIV testing is for anti-HIV antibodies (Djuardi, 2020).

Anyone can become a voluntary donor as long as they meet the established health criteria. These criteria include the general health of the potential donor, who must appear healthy and not under the influence of drugs. The donor must also meet requirements regarding age, weight, body temperature, pulse, blood pressure, hemoglobin levels, as well as specific conditions for women (such as being after menstruation, pregnancy, or breastfeeding). Additional factors include the time elapsed between blood donations, history of blood transfusions, any infectious diseases, vaccination history, surgical history, and history of treatment involving narcotics or alcohol (Ministry of Health of the Republic of Indonesia, 2015).

Hemoglobin levels are used as a reference in the medical world to measure hemoglobin in a certain blood volume. WHO has set the limit for normal hemoglobin levels in adult women at 12 g/dl and in adult men at 13.0 g/dl (Prasetyaningsih, Sari, Prasetya, & Naer, 2019). After donating blood, the donor needs to be retested for hemoglobin levels. It is very important to know whether hemoglobin levels are low or remain stable. A decrease in abnormal hemoglobin levels is a sign of blood deficiency,

which can also be called a condition known as anemia (Kiswari, 2014; Arikunto, 2019).

From previous studies it was concluded that after donating blood, hemoglobin levels usually decrease quite significantly, both in men and women. However, the difference can still be said to be within the normal Hb range. Therefore, it is necessary to re-examine patients after donating blood to determine the stability of the donor's body (Zainuddin, 2015).

When donating blood, around 350 ml of blood is taken from a person. This amount is approximately 10% of the total blood volume of an adult. When the body bleeds, it is generally considered safe and usually does not cause side effects (Cahyadi, Rohan, & Yuanda, 2021). However, in relatively rare cases, blood donors may experience side effects during or after donating blood, such as weakness, dizziness, chills, fainting, cold sweat and other symptoms. Because there are several cases of donors who have side effects as above, causing people to be afraid to donate blood (Triwijaya, Darmawan, Puspitasari, Feriando, & Iswanto, 2021). As happened at Indonesian Red Cross Society of Tenggara, according to the Chairman of Indonesian Red Cross Society Kukar, Mr. Ismed, on Monday, January 23 2023. He explained that the need for blood stock in hospitals in one day is around 15 to 20 bags more. Meanwhile, if calculated in one month, it requires around 700 bags. This means that our blood availability for Kukar is still very low (Yadha, 2023).

Mature red blood cells (RBCs), or erythrocytes, are the most abundant cells in the human body and specialize in carrying oxygen. As erythroblasts and reticulocytes emerge from the bone marrow to form mature RBCs, they lose their nucleus, mitochondria, and ribosomes to make room for hemoglobin, the oxygen-binding molecule. Each human RBC contains about 270 million hemoglobin molecules, which are composed of globin, a protein with two pairs of identical polypeptide chains ($\alpha_2\beta_2$), and four heme groups (iron-chelated structures) (Hadjesfandiari, Khorshidfar & Devine, 2021). Donating blood can have some physiological and psychological effects on the donor, although these are typically temporary and easily managed. Understanding these effects and implementing appropriate post-donation care practices ensures a smooth recovery experience for donors while

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maintaining a readily available blood supply for those in need (Singh, Saxena, & Saxena, 2025; Das, Raturi, Agrawal, Kala, & Kusum, 2021)

RESEARCH METHOD

A descriptive observational study carried out in May 2024 with the objective of examining hemoglobin levels in donors before and after blood donation at the Indonesian Red Cross Society in Tenggarong, East Kalimantan.

The research population comprised 50 blood donors, with a sample size of 45 participants. Inclusion criteria included donors whose data were recorded in the medical records of the Indonesian

Red Cross Society in Tenggarong and those who consented to participate. Exclusion criteria were prospective donors who did not pass the informed consent selection process of the Indonesian Red Cross Society in Tenggarong.

The data of hemoglobin level for the last donation was derived from the data base of Indonesian Red Cross Society in Tenggarong, while the data of hemoglobin level for current donation was collected by doing hemoglobin check 15 minutes after the donors donating blood.

Data analysis was performed using univariate analysis, and the study received ethical clearance under letter number DP.04.03/7.1/22190/2024.

RESEARCH RESULTS

Table. Characteristic of Respondents (N=45)

Variables	Result	Hemoglobin Level (gr/dl) (Mean±SD)(Range)	
		Last Blood Donation	Current Blood Donation
Age (n/%)			
(Mean±SD)(Range)(Years)	(32.5±21.920) (17-50)		
17-27	7/15.55		
28-38	21/46.67		
39-50	17/37.78		
Gender (n/%)			
Male	24/53.33	(14.5±1.058) (13.2-16.8)	(14±1.275) (12.1-16.4)
Female	21/46.67	(13.25±0.353) (12.6-15.9)	(11.65±1.202) (9.8-13.9)
Blood Donor Per Year (n/%)			
Twice	2/4.45		
Three times	2/4.45		
Four times	7/15.55		
Six times	34/75.55		
Dizziness or Nausea (n/%)			
Absent	41/91.12		
Present	4/8.88		

Table 1 indicates that nearly half of the respondents (46.67%) were between the ages of 28 and 38, with males making up the majority (53.33%). Most participants donated blood six times per year, with 34 respondents (75.55%) reporting this

frequency. Additionally, 91.12% of respondents did not experience dizziness or nausea. Among male donors, the average hemoglobin level from their last donation was 14.5 g/dl, with a standard deviation of ±1.058 and a range of 13.2-16.8 g/dl. For current

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male donors, the average hemoglobin level was 14 g/dl, with a standard deviation of ± 1.275 and a range of 12.1-16.4 g/dl. In female donors, the last recorded hemoglobin level had a mean of 13.25 g/dl, with a standard deviation of ± 0.353 and a range of 12.6-15.9 g/dl. However, for current female donors, the mean hemoglobin level was 11.65 g/dl, with a standard deviation of ± 1.202 and a range of 9.8-13.9 g/dl. These findings indicate a difference between the hemoglobin levels of past and current blood donors.

DISCUSSION

Based on the research conducted at the Indonesian Red Cross Society, hemoglobin levels were measured before blood donation using the POCT (Point of Care Testing) method on 45 donors. The average hemoglobin level prior to donation was 14.5 gr/dl for men and 13.25 gr/dl for women. These levels meet the criteria for blood donation, which require hemoglobin levels of 12-15 gr/dl for women and 13-17 gr/dl for men. This indicates that the donors' hemoglobin levels were within the normal range, ensuring that donating blood would not pose any risks to their health.

Before donating blood, donors should inform medical staff about any medications, supplements, or herbal products they are taking, as well as any medical conditions or treatments they are undergoing. Individuals with certain conditions—such as recent dental extractions (less than three days prior), blood transfusions (within the past year), ongoing therapy, or recent tattoos, piercings, pregnancy, or breastfeeding (within the last year)—are temporarily ineligible to donate blood (Zainuddin, 2015).

Post-donation, the average hemoglobin levels decreased to 14 gr/dl for men and 11.65 gr/dl for women, showing a reduction of 0.5 gr/dl in men and 1.6 gr/dl in women. This research highlights a decrease in hemoglobin levels following blood donation (Zainuddin, 2015).

Blood donation leads to a reduction in circulating blood volume and hemoglobin levels, directly impacting the blood's oxygen-carrying capacity. This is because the donor's body loses approximately 350-470 ml of blood, equivalent to about 8-12% of the total blood volume (Komandoko, 2013). Red blood cells, which are essential for transporting

oxygen throughout the body, become less abundant after donation. A decline in the production or quality of red blood cells can result in anemia, a condition where the body lacks sufficient oxygen to function properly, potentially leading to various health issues (Sari, 2012).

Variations in hemoglobin levels are influenced by factors such as gender, age, and frequency of blood donation. In this study, about half of the respondents were male. Gender differences significantly impact hemoglobin levels, with men typically having higher levels due to greater muscle mass. In contrast, women are more prone to iron deficiency because of menstruation and unbalanced diets, which often result in lower hemoglobin levels, making many women ineligible to donate blood (Komandoko, 2013).

In addition, nearly half of the respondents were aged 28-38 years. Blood donation becomes riskier for individuals over 60 years old because aging reduces the body's ability to produce new red blood cells and repair damaged tissue. This decline is linked to decreased bone marrow function and hormonal changes affecting red blood cell production. Consequently, the recommended safe age for blood donation is between 17-60 years (Erwin, 2019). Nearly all respondents had donated blood 1-5 times, with one remarkable case of a donor who had donated blood 104 times without experiencing a significant drop in hemoglobin levels. This suggests that regular blood donation, supported by a healthy diet, enables the body to adapt effectively and maintain a balance in red blood cell production (Zainuddin, 2015).

The frequency of blood donation significantly impacts hemoglobin levels, particularly for first-time donors. For example, one of four first-time donors had an initial hemoglobin level of 15.9 gr/dl, which dropped to 11.0 gr/dl after donating, a decrease of 5.0 gr/dl. These donors often experienced symptoms like dizziness, weakness, and nausea after donating. Such symptoms are likely linked to mild shock caused by poor dietary habits. Irregular eating patterns and insufficient intake of iron-rich foods can lead to iron deficiency and anemia (Philip, Sarkar, & Jain, 2014).

Most donors exhibited stable hemoglobin levels before and after donation, particularly those who donated regularly and maintained healthy diets. A

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reduction in hemoglobin levels post-donation is considered normal, as donating blood decreases circulating blood volume and hemoglobin, temporarily impacting oxygen transport capacity. Younger donors typically have higher hemoglobin levels and recover more quickly after donating blood.

Proper nutrition, especially adequate intake of iron, folic acid, and vitamins B12 and C, is essential for maintaining hemoglobin levels and supporting red blood cell production. To address this, the Indonesian Red Cross Society provides iron supplements to donors to help replenish hemoglobin lost during donation. Iron is a crucial component of hemoglobin, which transports oxygen throughout the body. Iron supplementation aids in faster red blood cell production and helps prevent anemia. While not all donors require supplements, they are particularly beneficial for those with low hemoglobin levels before donation or those who lose significant blood volume.

The body can adapt to regular blood donation, minimizing significant reductions in hemoglobin levels among frequent donors. Factors such as gender, donation frequency, and baseline health condition also play key roles in influencing hemoglobin levels and the body's recovery response after donation.

CONCLUSION

Hemoglobin levels dropped after donation; however, neither men nor women experienced symptoms like fainting.

SUGGESTION

Donors can use this information to increase their understanding of hemoglobin levels, ensure they get adequate rest the night before donation, eat iron-rich foods, and avoid strenuous activities after donating blood. It is also recommended that future researchers consider including the menstrual cycle as a factor in similar studies.

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