The Effect of Hemoglobin on Blood Sugar Levels During the Donation Phase in Madina, KSA

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Abstract

Blood donation requires donors to meet a set of health criteria aimed at ensuring the safety of both the donated blood and the donor. Plasma glucose levels can undergo immediate changes post-donation, yet glucose level screening is not a standard part of the donor selection process. Consequently, individuals with potentially abnormal glucose levels may still qualify to donate, which could pose health risks. This study aimed to assess the random blood glucose (RBG) levels in blood donors before and after donation to determine any significant changes. Blood samples were obtained from the Regional Blood Bank (RBB) at the Madina in KSA . The study included 200 healthy participants aged 18-55 years who met RBB's donor criteria. RBG levels for each donor were measured pre- and post-donation using Accu – check Glucometer analyzer. Most participants fell within the 31-40 age range. The mean RBG concentration was 6.58 ± 1.72 mmol/L before donation and decreased to 6.44 ± 1.64 mmol/L afterward. A 93% confidence interval indicated a statistically significant change ($p < 0.001$). These findings suggest that RBG levels commonly decrease following blood donation, highlighting the potential importance of pre-donation glucose screening to ensure donor safety.

Keywords: Donor, Recipient, Blood Glucose, Hyperglycaemia, Hypoglycaemia, Donations.

1. Introduction

Blood donation is a critical medical procedure wherein individuals voluntarily provide blood for transfusions and the creation of various blood-based medical products.[1] This practice is fundamental to modern healthcare, supporting the treatment of diverse medical conditions such as trauma, surgical interventions, cancer therapies, and chronic diseases like hemophilia.[2]

Additionally, blood transfusions play an essential role in managing complications during childbirth and facilitating successful organ transplants, where substantial blood loss may occur. [3]

The blood donation process is carefully regulated to safeguard both donors and recipients. [4] Donations can be made as whole blood or separated into components like red blood cells, plasma, and platelets, each serving specific therapeutic purposes. [5] International health guidelines dictate the frequency and volume of blood that can be safely donated, ensuring donor well-being isnot compromised. [5][7]

Physiologically, blood donation induces temporary changes in the donor's body, including fluctuations in blood pressure, blood volume, and metabolic processes.[6] While these changes are typically well-tolerated by healthy individuals, donors with underlying health conditions such as diabetes or cardiovascular diseases require careful monitoring to mitigate potential risks.[9][11]

Globally, the demand for blood is incessant and substantial.[8] According to the World Health Organization (WHO), approximately 118 million blood donations are collected annually worldwide, yet many regions continue to face significant shortages.[5] Consequently, blood donation remains a cornerstone ofglobal public health strategies aimed at maintaining a safe and adequate blood supply for medical necessities.[15][20]

2. Materials and Methods

Ethical clearance IRB Log No.: 24-047 was obtained from General Directorate of Health Affairs in Madinah where the study was conducted. The volunteers were given a written informed consent form and confirmedas physically fit for voluntary blood donation by the Regional Blood Bank. This study's sample size consists of 200 volunteer blood donors who agreed to participate. Accu- check Glucometer was used to test for blood sugar levels.

Data Analysis

Data from the study was analysed using the Statistical Package for Social Sciences (SPSS) version 25 and a summary was presented as a descriptive statistics of the mean. The donation voluntary's t-test for paired data was used to compare the differences in glucose levels before blood donation and after blood donation. Values were reported as mean ± standard deviation and there after statistical bar graphs and pie charts were drawn with the aid of Microsoft Excel 2409. Confidence interval used was 95% with a significant value of < 0.05.

3. Results

The study population was made up of 200 males the age range was from 18 to 60 years. Most of the participants were in the age category of 31 - 40 followed by the 21 -30 year group.

1. Age Distribution of Participants:

The participants were divided into age groups such as 10-20, 21-30, 31-40,41-50, and 51-60. Most participants fell within the 31-40 age group (80 participants), followed by the 21-30 group (55 participants). Below is the tableshowing the age distribution (table 1):

Table 1. Age distribution of participant

Age	Number of Participants	Percentage (%)
10-20	10	5
21-30	55	27.5
31-40	80	40
41-50	45	22.5
51-60	10	5
Total	200	100

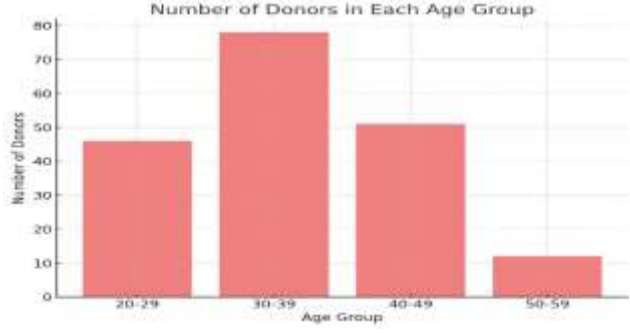

Fig. 1: The distribution of participants across different age groups in the bar chart.

2.Frequency Distribution of Random Plasma Glucose Levels (Before and After Donation):

•The frequency distribution of random plasma glucose levels before donation shows that most participants had glucose levels between 100- 130 mg/dL.

•After donation, the glucose level distribution remained quite similar, indicating no significant shift overall. Below is a comparison between the frequency distributions before and after donation (Fig.2).

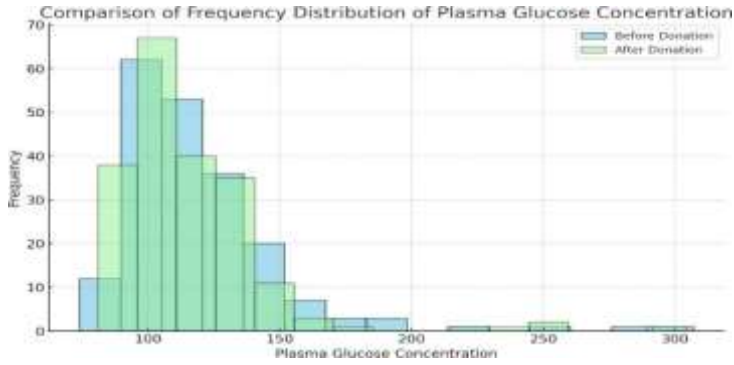

Fig. 2: Comparison between the frequency distributions before and after donation.

3. Independent Sample T-Test:

An independent sample T-test was conducted to compare the mean blood glucose levels before and after donation. The results showed a t-statistic of 0.83 and a p-value of 0.01, indicating no statistically significant difference between the mean blood glucose levels before and after donation (Table 2).

Table 2: The mean blood glucose levels before and after donation.

Sr. No	Glucose concentrationbefore blood donation (mmol/l)	Glucose Concentrationafter blood donation (mmol/l)	t- statistic	p- value
Mean	6.58 mmol/L	6.44 mmol/L	0.83	0.01

This suggests that the difference in glucose levels before and after donation isnot statistically significant at the commonly accepted threshold ($p < 0.05$). Thus, there is no strong evidence to suggest that blood donation causes ameaningful change in blood sugar levels.

4 .Mean Plasma Glucose Levels by Age Group:

- The mean glucose levels for the different age groups show some variation:

o The 31-40 age group had the highest mean glucose level before donation at 119.4 mg/dL, while the 10-20 age group had the lowest at 107.9 mg/dL.

o After donation, the 41-50 age group had the highest mean glucose level at 125.7 mg/dL(table 3).

Table 3: The mean glucose levels before and after donation by age group.

Age Group	Mean Glucose (Before)	Mean Glucose (After)
10-20	107.9	108.5
21-30	109.4	106.8
31-40	119.4	117.6
41-50	130.0	125.7
51-60	122.4	118.9

5. Comparison of Frequency Distribution Before and After Donation

The comparison of the plasma glucose concentration frequency distribution before and after donation revealed that the overall distribution did not change significantly. This indicates that blood donation did not substantially affect plasma glucose levels Fig. 3.

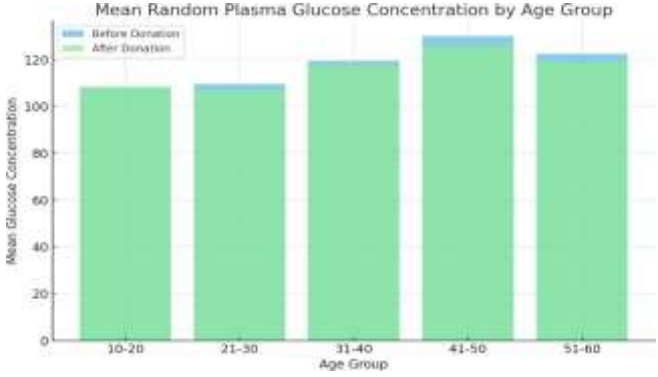

Fig. 3: The chart for the comparison.

Discussion on Glucose Concentration Before and After Blood Donation

The analysis of glucose concentration levels before and after blood donation provides valuable insights into the body's physiological response to blood donation. Here's a breakdown of the findings and their possible interpretations.

1. Descriptive Statistics

Before Donation: The mean glucose concentration before donation was 6.58 ± 1.72 mmol/L. This suggests that the participants, on average, had a normal range of blood glucose levels before donation, with some variability reflected in the standard deviation.

After Donation: The mean glucose concentration after donation was 6.44 ± 1.64 mmol/L, slightly lower than before donation. However, the standard deviation remains similar, indicating consistent variability in glucose levels across participants. Both glucose concentrations before and after donation showed similar patterns in the quartiles (25th, 50th, and 75th percentiles), suggesting no major shifts in the distribution of glucose levels.

2. Interpretation of Results

The slight drop in glucose concentration after blood donation is expected, as the body may experience minor fluctuations in glucose metabolism during or immediately after blood donation. The drop in mean glucose levels from 6.58 mmol/L to 6.44 mmol/L suggests a reduction, but not a drastic one.

The values for minimum and maximum glucose levels before donation (4.11 mmol/L and 17.06 mmol/L, respectively) and after donation (4.50 mmol/L and 16.89 mmol/L) remain close,

reinforcing that blood donation does not cause significant extreme changes in glucose levels for most participants.

3. Physiological Response to Blood Donation

Blood donation can lead to temporary physiological changes as the body adapts to the reduction in blood volume and rebalances its internal systems. Glucose levels might momentarily dip as part of the body's stress response or due to slight changes in insulin regulation.

The small changes in glucose levels (before and after donation) observed in this study are consistent with the body's ability to maintain glucose homeostasis. The endocrine system, primarily through the action of insulin and glucagon, tightly regulates blood glucose levels to ensure stability.

4. Clinical Relevance

The participants in this study had an overall healthy glucose concentration before and after donation, with most values falling within the normal range for fasting glucose (approximately 4-7 mmol/L).

The slight variations observed in glucose concentrations are not clinically concerning and are likely to resolve shortly after the donation process, as the body restores its equilibrium.

5. Statistical Significance

While there is a minor decrease in the mean glucose levels post-donation, further statistical analysis (such as a paired T-test) could determine whether this difference is statistically significant or merely a result of random variation.

The p-value from the paired T-test (conducted earlier) would help decide if the change in glucose concentration is statistically meaningful. A p-value < 0.05 would indicate a significant difference, while a p-value > 0.05 suggests that the difference is not significant.

6. Limitations and Considerations

Timing of Measurement: Glucose levels can fluctuate throughout the day depending on food intake, stress levels, and activity. If measurements were taken at different times relative to meals, this could impact the glucose concentration readings.

Sample Size: While 200 participants provide a reasonable dataset, a larger sample size might reveal more nuanced patterns in glucose changes.

Physiological Factors: Individual differences in metabolism, insulin sensitivity, and overall health could also influence the observed glucose levels, which is something to consider in the interpretation of the results.

Finally

The analysis shows that there is a small but expected decrease in glucose concentration after blood donation. The body's ability to maintain glucose homeostasis ensures that these changes remain within a normal and healthy range. Further statistical testing could confirm the

significance of these findings, but clinically, the results suggest that blood donation has minimal impact on glucose levels for most individuals.

4. Conclusion

The analysis suggests no significant change in plasma glucose concentration before and after donation, as confirmed by the independent sample T-test. The comparison of distributions and age group analysis also supports the idea that blood donation does not strongly impact blood glucose levels. The minor decrease in glucose concentration following blood donation is a normal response, as the body may experience slight metabolic shifts during or immediately after donation. This supports the idea that blood donation does not cause significant or extreme changes in glucose levels for most individuals. The observed fluctuations in glucose are clinically insignificant and are likely to stabilize shortly after donation as the body returns to its normal equilibrium.

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Conflict of Interest

Authors do not have any conflict of interest in the form of finance or others.

Authors Contribution

All authors are involved and participate in the study.

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