

Alterations in plasma glucose levels among blood donors

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Abstract: Blood donors are required to meet several criteria which are intended to ensure that safe blood is made available for transfusion as well as keeping the donor safe. Plasma glucose levels may be altered immediately after blood donation. However, since plasma glucose testing is not part of the screening tests, individuals who may have low or high plasma glucose levels are likely to be passed fit to donate. This may be detrimental to their health. The objective of the study was to measure the random plasma glucose (RPG) levels in blood donors before and after donation and determine whether there is any significant change in their levels. Samples were obtained from the Accra Area Blood Centre (AABC) at the Korle-Bu teaching Hospital. Two hundred (200) subjects were recruited who were healthy individuals between the ages of 18-52 years who had satisfied the donor criteria set by the AABC. Pre-and-post donation RPG level for each sample was determined using the VitaLab Junior Selectra Clinical Chemistry analyzer. Majority of the subjects were in the age-range of 21-30 years and there were more males than females. The mean RPG concentration before donation was 5.70 ± 2.24 mmol/l and 9.07 ± 6.48 mmol/l afterwards. 95% confidence interval was used and the difference was statistically significant ($p < 0.001$). The findings indicate that the level of RPG is altered (mostly elevated) after blood donation. Knowing pre-donation glucose levels may therefore be important in keeping the donor safe.

Keywords: Donor, Recipient, Plasma Glucose, Hyperglycaemia, Hypoglycaemia

1. Introduction

Various people such as accident victims and patients receiving treatment for leukaemia, cancer sickle cell disease and thalassaemia as well as those undergoing surgery all utilize blood as in [1]. These bloods are donated by voluntary-unpaid and replacement donors which are a humanitarian act towards the sick by the healthy as in reference [2]. In fact no transfusion service is likely to survive without blood donors as in [2]. The well being and health of the blood donors is therefore of prime importance for the medical profession as in [3]. In most countries, strict regulations have been established for the selection of blood donors as in [4]. The donor selection criteria seek to ensure that, an amount of blood donated at a particular time is not harmful to the donor and that the blood is not likely to transmit any infection/disease to the recipient as in [5].

The criteria therefore serve to protect both the donor and the recipient as in [5].

A pre-requisite to blood donation is that blood donors must eat adequately. This is because donating blood may interrupt the blood glucose control and potentially lead to a severe hypoglycaemic or hyperglycaemic reaction in donors as in [6]. Known diabetics are also exempted from donating blood as a loss of any appreciable amount of blood reduces iron levels which can lead to an increased insulin resistance thereby causing plasma glucose to elevate as in [7]. It has also been reported that when an amount of blood is lost from the body, the body activates its stress response, meaning, cortisol and epinephrine levels increase, both of which act to release glycogen stores and promote gluconeogenesis, hence increasing glucose levels as in [8]. Losing blood and fluids in general leads to a more concentrated glucose in the system (Hyperglycaemia) as in reference [6].

The concern therefore is that, if glucose levels are not checked – and most blood centers do not – to confirm blood donors who may be temporally or permanently diabetic, they may be included in the donor population unknowingly. This may have severe consequences on their health after they have donated blood as in [9]. This study will bring into focus the need and importance of measuring glucose levels of blood donors before donation as in reference [9]. This way, those that are found to be hypoglycaemic or hyperglycaemic (diabetics) may be deferred or stopped from donating. So that the medical consequences those people may experience after donation may be prevented as in [10].

2. Materials and Methods

2.1. Participants

Convenience sampling was employed to recruit 200 blood donors consisting of both voluntary and replacement donors who had satisfied the inclusion criteria set by the Accra Area Blood Centre.

2.2. Materials

Material used for the work include: VitaLab Junior Selectra clinical chemistry analyser, sodium fluoride vacutainer, EliTech reagent (Glucose PAP SL), plain test tubes, centrifuge, test tube racks and Pasteur pipettes.

2.3. Sample Collection

For each blood donor, approximately 2 ml of whole blood was taken aseptically from the carpal vein into a sodium fluoride anticoagulant tube. The sample was mixed gently, given an ID number and “PRE” prefix to indicate this sample was taken before blood donation. After the blood donation, 2 ml of whole blood was collected into another sodium fluoride tube from the venesection line extending from the antecubital vein. This was given the same ID number and “POST” prefix, to indicate the sample was taken after blood donation.

2.4. Laboratory Analysis

The samples were analyzed within 4 hours of collection. They were sorted to ensure that the identification number of all “PRE” samples matched their corresponding “POST” samples. Subsequently, each sample was spun in a centrifuge at 2500g for 5 minutes. The plasma was pipetted and gently dispensed into plain tubes pre-labeled A and B for pre-donation and post-donation samples respectively. They were then analyzed on the VitaLab Junior Selectra analyzer following the manufacturer’s instruction.

2.5. Data Analysis

Data from the study was analysed using the Statistical Package for Social Sciences (SPSS) version 16.0 and a summary was presented as a descriptive statistics of the

mean. The student’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 \pm standard deviation and thereafter statistical bar graphs and pie charts were drawn with the aid of Microsoft Excel 2007. Confidence interval used was 95% with a significant value of < 0.05 .

2.6. Ethical Consideration

The project proposal was submitted to the Research and Ethics Review Committee of the School of Allied Health Sciences for approval before commencement of the research. Blood donors were formally consulted and their consent sought. They were also educated on the terms and conditions for which the samples would be taken.

3. Results

The study population was made up of 182 males (91%) and 18 females (9%) and the age range was from 18 to 52 years. Most of the participants were in the age category of 21–30 followed by the 31–40 year group (table 1).

Table 1. Age distribution of participants.

| Age (years) | Number of participants | Percentage (%) |
|-------------|------------------------|----------------|
| 18-20 | 4 | 2 |
| 21-30 | 104 | 52 |
| 31-40 | 67 | 33 |
| 41-50 | 23 | 12 |
| 51-60 | 2 | 1 |
| Total | 200 | 100 |

The concentrations of random plasma glucose for the pre-donation samples were as follows: nine (9) had random plasma glucose concentration < 3.9 mmol/l; one hundred and seventy-nine (179) had 3.9–7.8 mmol/l; eight (8) had 7.8–11.0 mmol/l and four (4) had > 11.0 mmol/l (fig.1).

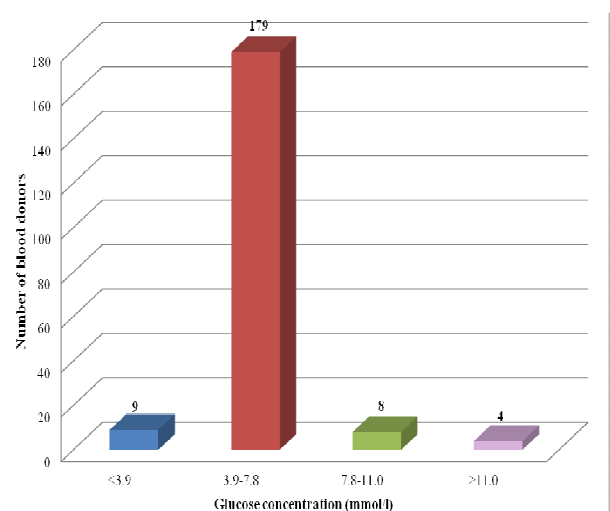


Fig 1. Frequency distribution of random plasma glucose concentration before blood donation.

The concentrations of random plasma glucose for the post-donation samples were as follows: four (4) had < 3.9mmol/l; one hundred and twenty-nine (129) had 3.9 - 7.8 mmol/l; twenty (20) had 7.8 - 11.0 mmol/l and forty seven (47) had > 11.0 mmol/l (fig.2).

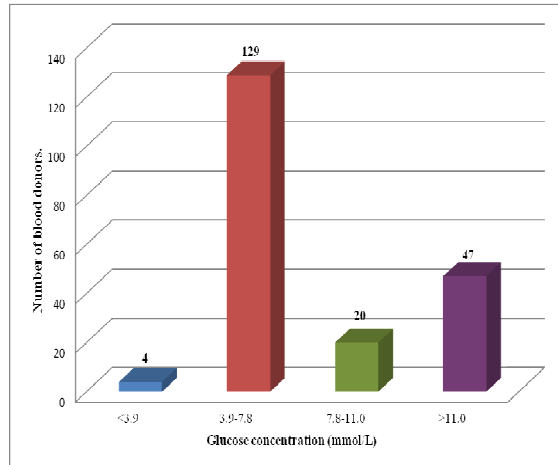


Fig 2. Frequency distribution of random plasma glucose concentration after blood donation.

Combining the before and after donation random plasma glucose analysis, There was a significant difference between random plasma glucose concentration (RPGc) for before and after blood donation. Whereas 9 participants had RPGc of < 3.9 before donation, 4 participants had < 3.9 mmol/l after donation. For RPGc range of 3.9 – 7.8 mmol/l, 179 participants changed to 129 after wards showing a decrease. For the concentration range of 7.8 – 11.0 mmol/l, the number increased from 8 to 20 and for the concentration > 11.0mmol/l, the number increased from 4 to 47 (fig. 3).

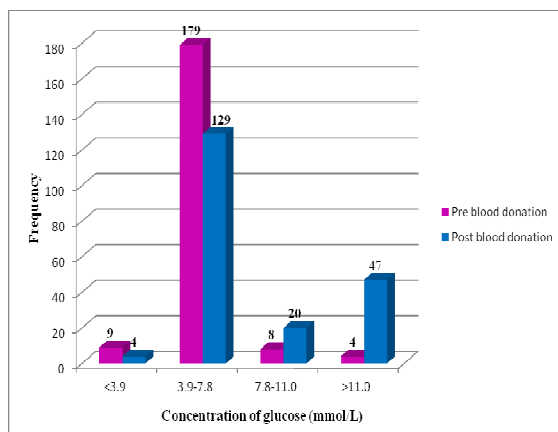


Fig 3. Comparison between frequencies of random plasma glucose concentrations before and after blood donation.

The mean random plasma glucose concentrations among the various ages did not give an indication as to whether age was a factor in a donor being hyper or hypoglycaemic. Except that the post-donation mean for the 18–20 years group appeared higher than the rest (table 2).

Table 2. Mean random plasma glucose concentration among the various age groups.

| Age group (Years) | Number of blood donors | Pre-donation Mean glucose concentrations \pm SD (mmol/l). | Post-donation Mean glucose concentrations \pm SD (mmol/l). |
|-------------------|------------------------|---|--|
| 18- 20 | 4 | 4.70 \pm 1.07 | 10.85 \pm 12.23 |
| 21-30 | 104 | 5.90 \pm 2.82 | 9.58 \pm 7.04 |
| 31-40 | 67 | 5.44 \pm 1.27 | 7.95 \pm 4.58 |
| 41-50 | 23 | 5.77 \pm 1.50 | 9.75 \pm 7.52 |
| 51-60 | 2 | 4.83 \pm 0.93 | 8.16 \pm 1.64 |
| TOTAL (N) | 200 | 5.70 \pm 2.24 | 9.07 \pm 6.48 |

The mean for the glucose concentration after blood donation was higher than that of pre-donation an indication of general increase in glucose levels of participants post-donation (table 3).

Table 3. Table showing Independent sample Test.

| | Glucose concentration before blood donation (mmol/l) | Glucose concentration after blood donation (mmol/l) | T Value | P-value |
|------|--|---|---------|---------|
| Mean | 5.70 \pm 2.24 | 9.07 \pm 6.48 | 6.85 | < 0.001 |

4. Discussion

The pre-donation plasma glucose concentrations measured in the study showed that, majority (89.5%) of the study participants had a random glucose concentration that fell within the normal range (3.9 -7.8 mmol/l), 4.5% below and 6% above. After blood donation, 64.5% of the participants had random plasma glucose concentration within the normal range, 2.0% below and 33.5% above. It can therefore be inferred that a total of 6 % of the participants were moderately or severely hyperglycaemic pre-donation which increased to 33% immediately after blood donation. The mean glucose level before donation was 5.70 \pm 2.24 mmol/l and increased to 9.07 \pm 6.48 mmol/l - a general increase by 3.37 mmol/l.

An article published by the Canadian Diabetic Association (2010) as in reference [6], gives a possible explanation for this increase in blood glucose after donation saying that donation reduces iron level which may lead to an increased insulin resistance and therefore increased plasma glucose levels. A study conducted by Facchini FS in reference [7] also stated that the greater the plasma ferritin concentration, the greater the plasma glucose and insulin concentrations meaning the opposite is true. Stress has equally been reported to cause a considerable increase in plasma glucose levels and a lot of people experience various degrees of stress during blood donation as in reference [10].

The finding from this study that most people's plasma glucose levels tend to increase immediately after donation

is of keen interest. This is because if an individual is already hyperglycaemic as seen in 6% of our participants and their glucose level increase further after donation, such people may suffer severe consequences that may result in fatality in some cases. Other participants were observed to have low glucose levels before blood donation which may tend to rise after donation or they may go into further hypoglycaemia which can also have attendant problems. Generally, the statistical analysis of the study revealed that there was a significant difference between glucose levels before and after blood donation. This implies that blood donation has a direct effect on glucose concentrations bringing to the fore the importance of knowing the glucose levels of individual before they donate blood. There were some limitations during the research work. These include not obtaining urine for glucose estimation as well as the sample size used which could have been higher.

5. Conclusion

It can be concluded that, plasma glucose levels are altered (mostly elevated) immediately after blood donation and if undiagnosed diabetics and severely hypoglycaemic individuals are allowed to donate, it may result in severe medical consequences.

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