A STUDY OF PRE-AND- POST DONATION GLUCOSE LEVEL AMONG BLOOD DONORS IN WOLAYITA SODO TEACHING AND REFERRAL HOSPITAL, SNNPR, ETHIOPIA.

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A STUDY OF PRE-AND POST DONATION GLUCOSE LEVEL AMONG BLOOD DONORS IN WOLAYITA SODO TEACHING AND REFERRAL HOSPITAL, SNNPR, ETHIOPIA.

COMPARATIVE CROSS SECTIONAL STUDY

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<tr>
<td>BTS</td>
<td>Blood Transfusion services</td>
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<tr>
<td>CI</td>
<td>Confidence Interval</td>
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<td>DM</td>
<td>Diabetes Mellitus</td>
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<td>ERCS</td>
<td>Ethiopian Red Cross Society</td>
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<td>HAAF</td>
<td>Hypoglycemic Associated Autonomic Failure</td>
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<tr>
<td>HBV</td>
<td>Hepatitis B Virus</td>
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<td>HCV</td>
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<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
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<tr>
<td>MLT</td>
<td>Medical Laboratory Technologist</td>
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<tr>
<td>RPG</td>
<td>Random Plasma Glucose</td>
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<tr>
<td>SNNPR</td>
<td>Southern Nation Nationality People Region</td>
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<td>SST</td>
<td>Serum separator test tube</td>
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<td>SSA</td>
<td>Sub Saharan Africa</td>
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<td>VBD</td>
<td>Voluntary Blood Donation</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>EQA</td>
<td>External Quality Assurance</td>
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<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
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ABSTRACT

**Background:** 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 donors safe. Acute loss of iron and both psychological and physiological stress can contribute an increment of blood glucose level after donation. So Screening of blood donors for random glucose level before donation is very important to keep donor’s health.

**Objective:** The aim of this study was to determine the increment in random glucose level among blood donors after donation of blood in Wolayita Sodo Teaching and Referral Hospital.

**Methods:** A cross-sectional study design was conducted among blood donors in Wolayita Sodo Teaching and Referral Hospital from April 1- December 25, 2015. A total of 269 volunteer blood donors (30 female and 239 male) who came to the hospital were interviewed. Data were collected by using structured and pre-tested questionnaire. 6ml of blood sample was drawn : (3ml before and 3ml after) donation blood was tested for random glucose levels using fully automated Clinical Chemistry Analyzer (BS 200). Descriptive statistics was used to calculate some variables in the study. Paired t test and 95%CI was used to assess the significance.

**Results:** Most of the study participants were in the age range of 21-31years. About 29.7% of the participants donated blood multiple times. About 6.4% of the participants experienced moderate to severe post-donation reaction. The mean value of blood glucose concentration in many subjects after blood donation was significantly higher than the value before donation, 9.9mmol/L±6.4 Vs 5.6±6.4mmol/L : (P<0.001) indicating an increase in random glucose level following blood donation. The mean random glucose concentration among the various age groups did not show significant difference (P >0.05).

**Conclusion and recommendation:** In general the result of the present study showed that Random glucose level is elevated after blood donation (P<0.001). It is thus important to consider measurement of blood glucose level before blood donation to keep the wellbeing of the donor’s health.

**Key Words:** Donor, Recipient, Plasma glucose, Hyperglycemia, Hypoglycemia
1. INTRODUCTION

1.1 Background

1.1.1 The Blood
Blood is a special connective tissue in which cells are suspended in fluid extracellular materials called plasma. Propelled mainly by rhythmic contractions of the heart, about 5L (in human) of blood in average adult moves unidirectionally within the closed circulatory system. The so-called formed elements circulating in the plasma are red blood cells (erythrocytes), white blood cells (leukocytes) and platelets (Ministry of Health, 2015).

\[ \text{Figure-1: Blood components (American Society of Hematology, 2011)} \]

1.1.2 Blood Cells
Erythrocytes or red blood cells are small non-nucleated cells that contain hemoglobin. Their major function is transporting of gases. Platelets are small non-nucleated cells which intervene in hemostasis in the body. Leucocytes or white cells are of two major categories- the granulocytes and a granular cells(National Guidelines, 2015).
1.1.3 Plasma
Plasma is yellowish fluid in which cells, platelets, organic compounds and electrolytes are suspended and/or dissolved. It transports nutrients from their sit to absorption and synthesis and distributes to the various areas of the organism. It also transports metabolic residues to the excretory organs. Plasma is obtained from the blood after treatment with anticoagulant. In contrast, serum is obtained from the clotted blood. Plasma constitutes are Organic and inorganic substances, enzymes, hormones etc. (*National Guidelines, 2015*).

Glucose is derived from the breakdown of carbohydrates in the diet or body store (glycogen) and endogenous synthesis from the protein or from the glycerol moiety of triglycerides (*Tadesse, 2008*).

Glucose is a simple sugar that provides energy to all of the cells. Glucose gets absorbed from the intestine and distributed by the bloodstream to keep a constant supply of glucose, by maintaining a constant glucose concentration in the blood (*Assefa, 2013*).

1.1.4 Blood Group Systems
Successful blood transfusion can only occur if the blood group systems are known and respected. There are many blood grouping systems, but for transfusion practice in our community, the ABO and Rhesus systems are the most important, others include Kell, Duffy, Kidd, and Lewis (*National Guidelines, 2015*).

1.1.5. Blood Donation and Processing
Effective blood transfusion begins with collection of blood from healthy blood donors, and proper handling and processing of donated blood. Millions of lives are lost each year due to lack of blood and blood products for transfusion, and most of them happen in developing countries (*WHO, 1999*). Quarter million death in the world and 15% of child mortality in Africa is reported to be due to obstetric bleeding and anemia which require blood transfusion (*WHO, 2006*). Annually 81 million units of blood are collected all over the world and 27 million of this is collected from low and middle-income countries, where 82% of the world’s populations live. In SSA out of the estimated need of 18million units of safe blood per year only 15% was collected (*Mirutse et al., 2014*).
The voluntary unpaid blood donation is a humanitarian act towards the sick by the healthy. No transfusion service can survive without blood donors. Accident victims, people undergoing surgery, and patients receiving treatment for leukemia, cancer, or other diseases, such as sickle cell disease and thalassemia, utilizes blood. On any given day, approximately 32,000 units of Red Blood Cells are needed (Badar et al., 2002). Idea of blood banking was initiated by physicians who observed the effectiveness of transfusion therapy during World War II and began to demand that blood be made available for treatment of patients (Blood Bank.Com, 2013).

The donation of blood is presented to the public as an altruistic service in which one human helps another. In this process of donation, a medical history is taken, an extremely short physical examination is done, and the donor’s blood is tested to avoid transmission of disease and complication during transfusion and ensure the safety of recipients (Byron et al., 1969).

Human blood is scarce, valuable and in high demand but availability of low-risk blood donors in many developing countries is a serious challenge and public health concern. While the need for blood is universal, there is a major imbalance between developing and developed countries in the level of usages and access to safe blood. The practice of voluntary blood donation (VBD) is high in developed countries than developing countries (Salaudeen et al., 2011).

The common sources of blood donations are voluntary unpaid, family/replacement donations and paid blood donation. In many countries less than 25% of the blood supply is from voluntary unpaid blood donors which are adjudged the safest blood source (Salaudeen et al., 2011).

Ethiopia is one of the developing countries in Africa, and 80% of its population lives in rural settlement with the major economic activity being subsistence farming. The National Health Service Coverage is low (61.3%), and it is compounded by poor quality of service (Ministry of Health, 2005). The need of blood transfusion service in Ethiopia was high due to high maternal mortality (676/100,000), high motor accident (among top ten in the world), and with a large non immune population for malaria (Mirutse et al., 2014).

In Ethiopia about 75-80% of blood donors are family and/or replacement donors (ERCS). These have been identified and reported to be unsafe donors because they carry very high risks of transfusion transmissible infections. Thus, it is encouraged that each blood bank or transfusion
service has a pool of regular, benevolent and non-remunerated donors for safer blood (Federal Ministry of Health, 2015).

The ERCS blood bank and governmental hospital based blood transfusion service in Ethiopia rely on family and replacement donors. The ERCS has been the pioneer organization in developing blood bank services in the country and the first blood transfusion center was established in 1969. One of the major components of the blood transfusion service strategy in Ethiopia was to ensure the safety of blood donors and recipients. Safe blood comes from safe voluntary non-remunerated blood donors and this has been documented by several studies (Ministry of Health, 2005).

There are three types of blood donors: Voluntary unpaid, family/replacement and paid. Voluntary unpaid blood donors are vital for ensuring a sufficient, stable blood supply and a well-established voluntary unpaid blood donor program can contribute to a significant reduction in the risk for infections such as HIV, HBV, HCV and Syphilis. These ensure the safety of recipient health. Family/replacement and paid blood donation have high percentage in low-income countries and very less in high-income countries, 36% and 0.3% respectively (WHO, 2012). Family or replacement donations are discouraged because it is believed that family members may be donating under obligation or pressure and be forced to hide any high-risk behaviors and diseases (Mumtaz and Mumtaz, 2012).

The BTS should ensure that the act of blood donation is safe and causes no harm to the donor and it should build and maintain a pool of safe, voluntary non-remunerated blood donors and take all necessary steps to ensure that the products derived from donated blood are efficacious for the recipient. Significant variations have been observed between countries to the extent that national donor selection criteria are defined, prospective donors are assessed and the quality and effectiveness of the donor selection process are monitored. In some countries national systems of blood donor selection are not well-developed and donor selection criteria are not clearly defined or applied uniformly (WHO, 2012).

Blood donation is a very safe procedure which could be made even more event-free by following certain friendly, reassuring and tactful practices (Pathak et al., 2010). The donor is also examined and asked specific questions about their medical history to make sure that donating
blood is not hazardous to their health (Rabeya et al., 2007). Although the number of donors who developed disturbances during or at the end of blood donation are very low, it is nevertheless desirable to reduce the risks to a minimum (Croccu and Elia, 2007).

The goal of donor haemovigilance is to reduce the occurrence of adverse events and reactions and improve the outcomes for both donors and recipients. It also improves donor safety through the implementation of corrective and preventive action to avert the occurrence or recurrence of adverse donor’s events and reactions. Donors who have suffered an adverse reaction have been shown to be less likely to return to donate again. One of the recommendations included in most BTS guidelines is that donors should maintain their usual food and fluid intake before donation to maintain their blood glucose level. This may result in blood being collected from donors who have not been properly assessed for their suitability to donate. Consideration should be given to the donor’s general state of health and ability to tolerate a blood donation (WHO, 2012).

Individuals in good health should be accepted as blood donors. Although it may be difficult to define good health, certain associated parameters may be established from a brief medical history, observation and simple tests (American Red Cross, 2012).

Even though, the wellbeing and health of the blood donors is of prime importance for the medical profession, a lot has been discovered and written about the protection of the recipients from the potential hazards of blood and also a lot of money is spent for screening donors as means of protection of recipients. However, very little attention is given to determine if the health status of donors is adversely influenced by the process of blood donation. This may be because of fear of losing donors in a time when the demand of blood is soaring all over the world and the donors are becoming scarce (Badar et al., 2002).
1.2 LITERATURE REVIEW

Determination of random glucose level before blood donation has not received the attention it deserves from the global community, even though the wellbeing and health of the blood donors has supreme importance to efficient and sustainable blood transfusion services. Study conducted among blood donors in Accra blood center, Korle-bu Teaching Hospital, documented an elevation in RGL following blood donation (Antwi–Baffour et al., 2014).

Generally the amount of blood donated at a time is approximately 450 ml. One gram of hemoglobin contains 3.4 mg of iron. In a normal individual with 15g of hemoglobin per dl, 100 ml of blood contain approximately 50 gm of iron. Thus, if 450ml of blood is taken in a donation approximately 225 mg of iron will be lost. These adequate iron stores are very important in maintenance of the donor’s health. Iron is a universal cofactor for mitochondrial energy generation and supports the growth and differentiation of cell types. The regulation of systemic iron is through the proteins ‘Transferrin’ (iron mobilizer) and ‘Ferritin’ (iron sequestration). The physiologic importance of the storage iron is that it provides a rapidly available supply in the event of blood loss (Badar et al., 2002). Iron stores, as assessed by serum ferritin concentration, are associated with plasma glucose and insulin. In addition high frequency blood donation was associated with reduced serum ferritin and increased flow mediated dilation compared with low frequent donation. It is suggested that the mechanisms linking blood donation to improved vascular function are not likely related to change in glucose metabolism (Zheng et al., 2007). An elevated iron stores, reflected in elevated plasma ferritin levels, and may induce baseline metabolic abnormality that ultimately results in diabetes. Alternatively, elevated ferritin may be just one of several metabolic abnormalities related to the underlying process that ultimately results in diabetes, rather than a causal factor for diabetes (Jehn et al., 2007 and Kiss et al., 2015).

This elevated iron store may induce diabetes through a variety of mechanisms, including oxidative damage to pancreatic beta cells, impairment of hepatic insulin extraction by the liver, and interference with insulin ability to suppress hepatic glucose production (Jehn et al., 2007 and Kiss et al., 2015).

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
hypoglycemic or hyperglycemic reaction (Antwi-Baffour et al., 2014). Frequent blood donation may lead to a negative iron balance which is corrected by iron supplementation after blood donation (Rosuik et al., 2009). 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 increase in insulin resistance thereby causing plasma glucose to be elevated (Zheng et al., 2007).

It has also been reported that blood loss activates stress response in the body and plasma level of stress hormones, cortisol and epinephrine increase, both of which act to release glycogen stores and promotes gluconeogenesis, hence increasing glucose levels. On the other hand losing blood and fluid in general leads to a more concentrated glucose in a system (Garrioch, 2004).

Diabetes mellitus is a serious condition with potentially devastating complications that affects all age groups worldwide. An estimated 30 million people around the world were diagnosed with diabetes in 1975, which equates to 3 new cases per second and the largest increase is expected to be in developing countries (Canadian Diabetes Association, 2013 and Diabetes Guide, 2015).

Known diabetics are 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 a plasma glucose level to be elevated (Antwi-Baffour et al., 2014). Donation of blood is associated with a high blood glucose level (Hyperglycemia), and can be a serious problem for a person with diabetes (Zheng et al., 2007). Blood glucose concentrations affects gall bladder motility in healthy subjects, an acute hyperglycemia at 8 and 15 mmol/L dose dependently reduces the gall bladder sensitivity to cck-33 (Bore et al., 1993).

Blood donation is generally seen as a safe voluntary and socially useful activity. However the majority of the literature concerning blood donation describes adverse events. Stress reactions are quite common phenomena and various factors, known as stressor or stress stimuli induce stress reactions both psychological and physiological (Hoogerwert et al., 2015).

Stress hyperglycemia (raised blood glucose levels without a previous diagnosis of diabetes) is associated with poorer outcomes but it is a marker for diabetes mellitus either known or undiagnosed, In the absence of diabetes it is associated with increased mortality risk (Kovacevic et al., 2015). Hyperglycemia can also have ‘toxic’ effects and may suppress immune function and
increase circulating inflammatory cytokine concentration (Canadian Diabetes Association, 2013).

1.2.1 Gaps in literature
In the process of blood donation much attention is paid on the safety of recipients by avoiding transfusion of transmissible disease and transfusion reaction. There aren’t many studies that consider if the process of blood donation has an adverse effect on the health of donors. The present study is thus carried out in an attempt to fill this gap by determining the blood glucose level of blood donors before and after donation of blood.
1.3 STATEMENT OF THE PROBLEM

Lack of awareness and motivation in the community, compounded with a fragmented blood transfusion service, often leads to shortage of blood and blood components. Generally two strategies are adopted to meet the public demands of blood and its components-recruitment of new donors and retention of already recruited donors. Adverse events in blood donors can affect donor recruitment and retention and this event is categorized as immediate and delayed depending on whether a reaction was noted at the site of donation or was reported by the donor after leaving the site of donation (Agnihotri et al., 2012).

The National Health Service Coverage in Ethiopia is low (61.3%) and is compounded by poor quality of service. The ERCS blood banks and Government Hospital based blood transfusion service in Ethiopia rely on family and replacement donors, and the donor blood is screened for transfusion of transmissible diseases such as HIV, HBV, HCV and syphilis. In addition more reliable and cost effective tests are introduced in blood transfusion centers (Ministry of Health, 2005).

There is no written document in Ethiopia about screening of blood glucose before blood donation. This study is, therefore, designed to determine the effect of blood donation on blood glucose level by measuring random glucose before and after blood donation in Wolayita Sodo Teaching and Referral Hospital.
1.4 SIGNIFICANCE OF THE STUDY

The wellbeing and health of blood donors has supreme importance in the delivery of effective, efficient and sustainable blood transfusion services and reduction of morbidity and mortality associated with the insufficiency of blood needed for transfusion.

The finding of this study will help to minimize the adverse reaction which occurs during or after blood donation.

It will also provide an input about the magnitude of the problem to policy makers and human resource managers to design appropriate policy, programs and strategies to address factors leading to strong donors’ safety.

Finally it is useful to other researchers as reference material while conducting further studies on similar problems.
1.5 Hypothesis

Blood donation is associated with an increase in blood glucose level.
2. OBJECTIVES

2.1 General Objective
To determine random glucose levels among blood donors before and after donation of blood in Wolayita Sodo Teaching and Referral hospital, SNNPR, Ethiopia.

2.2 Specific Objectives
- To measure and compare the random glucose level before and after donation of blood.
- To evaluate the effect of blood donation in blood glucose level.
3. MATERIALS AND METHODS

3.1 Study Area

The study was conducted at Wolayita Sodo Teaching and Referral Hospital which is located in Sodo city administration, SNNPR, Ethiopia. Sodo is 328 kilometer south of Addis Ababa the capital city of Ethiopia. It has an elevation between 1600 and 2100 meters above the sea level. It was part of the former Sodo woreda which included Sodo Zuria which completely surrounds it. Sodo is served by airport in the past. 166 kilometers long road connecting sodo with chida, whose construction started in 1994, was completed by early 1999. Featuring an 80 meter bailey bridge across the omo rever and five other bridges, this road cost 225 million birr, and reduced the distance between the regional capital at Awassa and Mizan Teferi to 400 kilometer. According to the SNNPR’s Bureau of finance and economic development, as of 2003 Sodo’s amenities include digital and mobile telephone access, postal service, 24-hour electric service, two banks and a hospital. Sodo is also the seat of the Roman Catholic Apostolic vicariate of Sodo-Hosaena.

![Figure-2: The study area, Wolayita Sodo Teaching and Referral Hospital](image)
3.2 Materials for sample collection and Analysis
Materials used for the work include:

1. BS-200 Clinical Chemistry Analyzer
2. SST
3. Centrifuge
4. Test tube rack
5. Pasteur pipette
6. Micro pipette
7. Gloves
8. Cotton
9. 70% Alcohol
10. Vacutainer needle and tube holder
11. Micro pipette tips
12. Tips rack
13. Reagents
14. Tourniquet
15. Syringe with needle
16. Distilled water
17. Refrigerator
18. Marker for labeling
19. Nunc tube

3.3 Study Period
The study was conducted from 8 April 2015 to 25 December 2015.

3.4 Source Population
All people who are 18-65 years of age.

3.5 Study Population
All blood donors 18-65 years of age and able to donate blood at to Wolayita Sodo Teaching and Referral Hospital Blood Bank during the study period and willing to participate in the study.

3.6 Study Design
A cross-sectional study design and quantitative method were used to assess the plasma glucose levels among blood donors in Wolayita Sodo Teaching and Referral Hospital Blood Bank.

3.7 Eligibility

3.7.1 Inclusion Criteria
Healthy individuals 18-65 years of age who give consent to donate blood and have hemoglobin level above 12g/%, haven’t current history of any medication, haven’t recent history of operation, haven’t serious illness, weight greater than 45kg, people who don’t refuse to give informed consent.
3.7.2 Exclusion Criteria
Individuals whose hemoglobin level is below 12g/%, have current history of any medication, recent history of operation, serious illness, weight less than 45kg, people who refuse to give informed consent.

3.8 Ethical Approval
The study was approved by the research and ethical committee of the Department of Physiology School of Medicine College of Health Science, Addis Ababa University. Written informed consent was taken from each donor and the risk and benefit of the study was properly explained. Donors were also informed that participation in the study was voluntary and that they can withdraw from the study at any point without losing any thing.

3.9 Variables

3.9.1 Dependent Variables
- Random plasma glucose level

3.9.2 Independent Variables
- Age, sex, family history of DM, frequency of donation, stress, weight.

3.10 Operational Definitions
- Hyperglycemia- High blood glucose(>11mmol/L)
- Hypoglycemia- Low blood glucose(<4mmol/L)
- Diabetes Mellitus- Metabolic disease in which there are high blood glucose over a prolonged period.
- Blood bank- A bank that gives transfusion service.
- Donors- People who donate blood
- Volunteer blood donors- People who gives blood without any payment
- Paid blood donors- People who give blood with payment
- Replacement blood donors- People who give blood for the replenishment of used blood

Adverse Events- The symptoms or signs of donors discomfort of sufficient severity such that either the donor called for attention of the staff or they were noticed by the staff.
3.11 Sample Size Determination

The sample size was determined by using single population proportion by assuming 5% margin of error and 95% CI. Alpha (α) = 0.05 and assuming the prevalence of Alteration in plasma glucose level among blood donors was (P = 0.235) at Accra Area Blood Bank Center, Korle-bu Teaching Hospital, Accra, Ghana (Antwi-Baffour et al., 2014).

\[
\begin{align*}
    n &= \frac{Z^2 \alpha / 2 \times P \times q}{d^2} \\
    n &= \frac{(1.96)^2 \times 0.1975(1-0.1975)}{(0.05)^2} \\
    n &= \frac{3.8416 \times 0.1585}{0.0025} \\
    n &= 243.55 \\
    n &= 244
\end{align*}
\]

Add 10% (25) of non-respondents’ and the total sample size is **269**

Where

- \( Z \) = alpha risk express in Z-score
- \( P \) = expected prevalence
- \( q = 1-p \)
- \( d \) = absolute Precision

3.12 Sampling Procedure

All blood donors who donate blood at Wolayita Sodo Teaching and Referral Hospital Blood Bank during April 8, 2015 to December 25, 2015 were included in the study. Full history, physical examination and screening of donors were performed and recorded for all blood donors to see their eligibility for donation. Donors who did not meet the criteria for blood donation stated in the inclusion criteria were excluded from the study.

3.13 Personnel for Data Collection

Data collectors were hired from medical laboratory technicians/technologist, who works in Wolayita Sodo Teaching and Referral Hospital Blood Bank.
3.14 Sample Collection
A total of 6ml of whole blood (3ml before and 3ml after) was collected from each study participant from median cubital vein of both arms by medical laboratory technologist/technicians aseptically into SST. Each blood containing tube was marked with ‘PRE’ prefix for sample taken before donation and ‘POST’ prefix for sample collected after blood donation. The plasma was separated within 15 minutes after collection.

3.15 Laboratory Analysis
The samples were analyzed within 3 hours after collection. It was stored to ensure that the identification number of all ‘PRE’ samples matched their corresponding ‘POST’ samples. Each sample was spun in a centrifuge at 3000rpm, for 5 minutes. The serum was pipetted and gently dispensed into plain tubes pre-labeled 1 and 2, for pre-donation and post-donation samples respectively and analyzed by BS 200 fully automated clinical chemistry analyzer following the manufacturer’s instruction.

![Figure-3: BS 200 fully automated clinical chemistry analyzer](image)

3.16 Quality Assurance
The questionnaire was pre-tested in the study area to see the validity and completeness. The data collectors were regularly monitored to make sure the reliability of data. For laboratory sample which was analyzed by BS 200, its quality was checked by previously documented EQA sample.
result feedback report in every three month. In addition standard quality control protocols were performed and passed prior to run the sample.

3.17 Data Analysis
Data entry and analysis was performed using Epi info data version 3.1 and statistical package for social sciences (SPSS) version 20 and summary was presented as a descriptive statistics of 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 are reported as mean ± standard deviation and there after statistical bar graphs were drawn with the aid of Microsoft Excel 2010. 95% Confidence interval was used with significant value of < 0.05.

3.18 Dissemination Plan
The finding of the study will be disseminated to Addis Ababa University College of Health Sciences School of Medicine, Department of Physiology, SNNPR State Health Bureau, Wolayita Sodo Teaching and Referral Hospital. The findings will also be presented at various seminars, and workshops and an effort will also be made to publish results on scientific journals.
4. RESULTS

4.1 Demographic Characteristics

A total of 269 blood donors were included in this study, of these study subjects 239 (88.8%) were males and only 30 (11.2%) were females. The age range was from 18 to 50 years. Most of the participants were in the age category of 21-30 years. From the study participants, 189 (70.3%) donated blood for the first time and 80 (29.7%) donated for more than once (Table -1).

Table 1. Demographic Characteristics of Study Population in Wolayita Sodo Referral Hospital, SNNPR, Ethiopia, 2015.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N(269)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>239</td>
<td>88.8</td>
</tr>
<tr>
<td>Female</td>
<td>30</td>
<td>11.2</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-20</td>
<td>9</td>
<td>3.3</td>
</tr>
<tr>
<td>21-30</td>
<td>209</td>
<td>77.9</td>
</tr>
<tr>
<td>31-40</td>
<td>43</td>
<td>15.9</td>
</tr>
<tr>
<td>41-50</td>
<td>8</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Donors Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>189</td>
<td>70.3</td>
</tr>
<tr>
<td>Multiple</td>
<td>80</td>
<td>29.7</td>
</tr>
</tbody>
</table>
4.2 Assessment of donors Awareness on some causes of an individual high blood glucose level and Adverse Reaction

From the study participants, 120(44.6%) of the blood donors have knowledge about their family DM status but the majority 149(55.4%) have no information about it. On the other hand, only 31(11.5%) of the participant have now about their DM status. Most of the participants did not screened for blood glucose level before 208(77.3%). Finally some of the donors 44(16.4%) of the participants have moderate/sever adverse reaction during or after blood donation (Table-2).

Table 2. Donors Awareness on blood glucose level and adverse reaction in Wolayita Sodo Teaching and Referral Hospital, SNNPR Ethiopia.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N(269)</th>
<th>Percent (%)</th>
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</thead>
<tbody>
<tr>
<td>Knowing Family History of DM</td>
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<tr>
<td>Yes</td>
<td>120</td>
<td>44.6</td>
</tr>
<tr>
<td>No</td>
<td>149</td>
<td>55.4</td>
</tr>
<tr>
<td>Knowing Their DM Status</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>31</td>
<td>11.5</td>
</tr>
<tr>
<td>No</td>
<td>238</td>
<td>88.5</td>
</tr>
<tr>
<td>Problem After Blood Donation</td>
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<td></td>
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<tr>
<td>Yes</td>
<td>44</td>
<td>6.4</td>
</tr>
<tr>
<td>No</td>
<td>225</td>
<td>83.6</td>
</tr>
<tr>
<td>Screening for Blood Glucose Before</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>61</td>
<td>22.7</td>
</tr>
<tr>
<td>No</td>
<td>208</td>
<td>77.3</td>
</tr>
</tbody>
</table>
4.3 Random Glucose Level Before and After Donation

4.3.1 Random glucose level before donation

The random glucose level before donation; was as follows: eleven (11) had a random plasma glucose concentration < 3.9 mmol/L; two hundred thirty five (235) had 3.9-7.8 mmol/L; fifteen (15) had 7.8-11.0 mmol/L and eight (8) had > 11.0 mmol/L (Fig -4).

![Frequency distribution of random plasma glucose concentration before blood donation.](image)

**Figure-4:** Frequency distribution of random plasma glucose concentration before blood donation.
4.3.2 Random glucose level after donation

The random glucose level after donation was as follows: eight (8) had a random plasma glucose concentration <3mmol/L; one hundred fifty three (153) had a concentration of 3.9-7.8mmol/L; thirty two (32) had 7.8-11 mmol/L and seventy six (76) had >11.0 mmol/L (Fig. 5).

*Figure-5:* Frequency distribution of random plasma glucose concentration after blood donation.
4.3.3 Comparison of glucose level before and after donation

Significant difference was observed in the random glucose concentration (RPG) before and after blood donation; 11 participants had RBG of <3.9mmol/L before and this was reduced to 8 participants after donation. 235 participants had RBG of 3.9-7.8mmol/L and this was again reduced to 153 after donation. On the other hand the RBG from 7.8-11.0mmol/L and >11.0 mmol/L showed an increment in participant number after donation as compared with RBG before donation. For the concentration range of 7.8-11.0mmol/L, the number of participants increased from 15 to 32, and for the concentration >11.0mmol/L, the number of participants increased from 8 to 76 (Fig-6).

Figure-6: Comparing frequencies of random blood glucose concentrations before and after blood donation.
4.4 The Random Blood Glucose Concentration among the Various Age Groups

The mean random plasma glucose concentration among the various age groups did not give an indication as to whether age was a factor in a donor being hyper or hypo glycemic except that the post donation mean for the age 41-50 years group appeared higher than the rest (*Table -2*).

**Table 3. Mean random plasma glucose concentration among the various age groups in Wolayita Sodo Teaching and Referral Hospital, SNNPR, Ethiopia, 2015.**

<table>
<thead>
<tr>
<th>Age group (Year)</th>
<th>Number of blood Donors</th>
<th>Pre-donation mean glucose Concentration ±SD (mmol/L)</th>
<th>Post-donation mean glucose Concentration± SD (mmol/L)</th>
<th>P-Valu</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-20</td>
<td>9</td>
<td>5.21±1.1</td>
<td>7.03±2.3</td>
<td>0.62</td>
</tr>
<tr>
<td>21-30</td>
<td>209</td>
<td>5.36±1.9</td>
<td>9.89±6.5</td>
<td>0.55</td>
</tr>
<tr>
<td>31-40</td>
<td>43</td>
<td>5.84±3.1</td>
<td>9.89±5.6</td>
<td>0.58</td>
</tr>
<tr>
<td>41-50</td>
<td>8</td>
<td>10.61±6.2</td>
<td>18.82±8.1</td>
<td>0.65</td>
</tr>
<tr>
<td>Total (N)</td>
<td>269</td>
<td>5.55±2.5</td>
<td>9.93±6.4</td>
<td>p&gt;0.5</td>
</tr>
</tbody>
</table>
4.5 Paired Sample T-test Result

The mean value of glucose concentration after blood donation was higher than the pre-donation value; this is an indication of a general increase in glucose level of participants after blood donation (Table 3).

Table 4. Comparison of RPG level before and after blood donation (Independent sample t-test) in Wolayita Sodo Teaching and Referral Hospital, SNNPR, Ethiopia, 2015

Paired-sample T test shows a significant difference in random plasma glucose concentration (P<0.0001) before and after donation.

<table>
<thead>
<tr>
<th></th>
<th>RBG Concentration before blood donation mmol/L</th>
<th>RBG Concentration after blood donation mmol/L</th>
<th>Mean Difference mmol/L</th>
<th>T-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.55±2.51</td>
<td>9.93±6.4</td>
<td>4.38±3.9</td>
<td>-12.7</td>
<td>0.0001</td>
</tr>
</tbody>
</table>
5. DISCUSSION

Similar to our study, Study done in Accra Area Blood Center, Korle-bu Teaching Hospital, Accra, Ghana also reported an increase in mean glucose level after donation. In their study the mean blood glucose level after donation was 9.07±6.48 mmol/L (Antwi-Baffour et al., 2014).

The pre-donation random glucose concentration measured in this study showed that, majority (87.4%) of the study participants had a random glucose concentration that fell within the normal range (3.9-7.8 mmol/L), 4.1% below and 8.5% above. After blood donation 56.9% of the participants had random plasma glucose concentration within the normal range, 2.9% below and 40.2% above.

It can, therefore, be inferred that a total of 8.5% of the participants were moderately or severely hyperglycemic before donation which increased to 40.2% immediately after blood donation. The mean glucose level before donation was 5.55±2.5 mmol/L and increased to 9.93±6.4 mmol/L. This is a general increase by 4.38±3.9mmol/L. The present study suggested that plasma glucose level tend to increase immediately after blood donation, with a mean glucose level of 9.93±6.4 mmol/L.

According to (Badar et al., 2002) the increase in blood glucose level after donation may be associated with reduction in iron level. A donor generally donates approximately 450 ml of blood at the time of donation. One gram of hemoglobin contains 3.4mg of iron. In a normal individual with 15 g of hemoglobin per dl, 100ml ml of blood contains approximately 50mg of iron. Thus removal of only 2ml of blood results in the loss of 1gm of iron. If 450 ml of blood is taken in a donation, approximately 225 mg of iron will be lost. If the donors have no iron deficiency, the erythrocytes and hemoglobin level will generally return to normal within 3-4weeks. So donation reduces iron level which may lead to an increased insulin resistance and therefore, increased plasma glucose levels.

In addition, a study conducted by (Koracevic et al., 2007 and Hoogerwerf et al., 2015). Suggested that blood donation is generally seen as a safe, voluntary and socially useful activity. However, the majority of the literature concerning blood donation describes adverse events, such as fatigue, vasovagal symptoms, fainting and bruises. Adverse events may upset the donors, causing increased anxiety. However, despite some indication that anxiety is increased before and
during donating blood, it remains largely unclear what factor are associated with such a stress reaction. Stress reactions are quite common phenomena. Various factors, known as stressors or stress stimuli, can induce a stress reaction. Although any situation and any object may elicit a stress reaction, the resulting stress experience may differ between individuals and circumstances. After being confronted with a stressor, a psychological stress reaction occurs, which can consist of high levels of anxiety, irritation, fear, worry, tension or anger. At the same time, physiological stress reaction takes place, such as increased levels of cortisol and nor-adrenaline.

It is also stated that stress hyperglycemia represents increased blood glucose level that is a result of activation of neuro-hormonal processes in organisms exposed to stress. Normal blood glucose level is less than 5.6 mmol/L (fasting) and 6.1mmol/L (2 hour value after the oral glucose tolerance test). Increased glucose level during stress is a result of sympathetic nervous system activation and raised production of catecholamine’s and cortisol that stimulate processes of gluconeogenesis, glycogenolysis and lipolysis. These hormones are responsible for insulin resistance, on receptor and post receptor level leading to hyperglycemia, hyperinsulinemia and insulin resistance *(American Diabetics Association, 2013)*. So it could also be possible that a lot of people experiences various degrees of stress during blood donation that might contribute to increase in their blood glucose level.

The finding from this study showed that plasma glucose level has a tendency to increase following blood donation. Thus in individuals with asymptomatic hyperglycemia as observed in 8.4% of our participants, the blood glucose level can be increased further after donation leading to adverse consequences and attendant problems.
6. CONCLUSION
This study showed that the plasma glucose levels increased immediately after blood donation and if undiagnosed individuals are allowed to donate, it may result in severe medical consequences.
7. LIMITATION OF THE STUDY

- Not obtaining urine for glucose estimation.
- Because of financial constraints the sample size was limited.
8. RECOMMENDATION
Since blood donation is the major concern worldwide, WHO should support ministry of health on screening materials needed for blood glucose measurement.

Ministry of health and regional health bureau should work hard to aware health professionals in screening blood glucose before donation and measurement of blood glucose level should be one of the criteria for donors’ recruitment.

Counseling for donors should be strengthened to exclude donors based on previous test result.

Further similar studies on large sample size should be carried out.
9. REFERENCES


World Health Organization, Ethiopian Regional Training Work Shop on Blood Donors Recruitment: Pre and Post Donation Counseling. Fact Sheet no. 405


Annex I- Information, Consent and Questionnaire

Information and Consent

Title of the Project: Determination of plasma glucose Levels among blood donors before and after donation in Wolayita Sodo Teaching and Referral Hospital, SNNPR, Ethiopia.

Name of Investigator: Kassahun Tekle

Name of the organization: Addis Ababa University College of Health Science School of Medicine Department of Physiology

Name of Sponsor: Addis Ababa University and Wolayita Sodo University

Introduction: The information sheet and consent form prepared by the investigator with the aim of explaining the research project that you are asked to join by the group of research investigators. The main aim of this research is to determine the random plasma glucose level among blood donors in Wolayita Sodo Teaching and Referral Hospital Blood Bank, SNNPR, Ethiopia. Decision on your involvement will be made by you and only you. The investigator includes 2 Medical Laboratory Technologist, 1 Supervisor and 1 Advisor from Addis Ababa University.

Purpose: To determine the effect of blood donation in the concentration of plasma glucose level among blood donors in Wolayita Sodo Teaching and Referral Hospital, SNNPR, Ethiopia. And recommend possible intervention based on the finding.

Procedure: To determine the random plasma glucose level among blood donors before and after donation in Wolayita Sodo Teaching and Referral Hospital Blood Bank, SNNPR, Ethiopia. Blood donors are invited to participate in this project you need to understand and sign the agreement form. Then you will be requested to give response to some questions that will take few minutes (about 10 minutes) and then there will be blood pressure and body weight measurement taken after that 3ml of blood collected before donation and the other 3ml of blood Collected after donation.
**Risk:** By participating in this study you may feel mild pain related with needle insertion and you may feel that it has some discomfort especially on wasting time (20-30 minutes) to respond to question and giving blood to the determination of blood glucose before and after donation but this may not be too much as you are one of the communities, your response will help as an important input to the screening of blood glucose is one of the criteria of blood donors before blood donation. However there is no physical or psychological risk expected being involved in the study.

**Benefit:** If you participate in this study, you may not gain direct benefit but your participation will help us to determine the plasma glucose level before and after blood donation and to take measures based on the funding.

**Confidentiality:** Information about you will be collected without your name and a code number assigned to it will be stored in a file and kept locked. Your personal information will only be used for the purpose of the study. Your response will be aggregated to yield summary data, but your individual response will not be reported.

**Right of Participants:** You have to know that your participation is largely based on your willingness and approval. There are questions to be answered by you; you are expected to answer all of the questions and giving 6ml of blood (3ml before and 3ml after). You have the right to say “no” and not participate in the study. You have also a full right to withdrawal from this study at any time you wish without losing any of your right and without penalty.

**Person to contact:** This research project will be reviewed and approved by the ethical committee of Addis Ababa University. If you want to know more information and to ask any question at any time you can contact with the following address.

1. Tewabech Zewde (PhD) Addis Ababa University Mob. 09 11 86 02 19
   Email:

2. Kassahun Tekele (Bsc) Wolayita Sodo University Mob. 09 11 06 99 98
   Email: tekelekassahun@gmail.com

At this time, do you have any question about the study?
May I begin the interview now?

Yes [Continues interviews]  
No [Interviewer; end interview]

Name of interviewer -----------------------

Start time ------------------------  
End time-----------------------------

I certify that I filled this questionaries’ is accordance with the training I was given and instruction stated in it. I have confirmed that information in it is correct.

Signed-----------------------------------------  
Date------------------------------------------
<table>
<thead>
<tr>
<th>No</th>
<th>Socio demographic and Donors profile</th>
<th>Coding</th>
</tr>
</thead>
</table>
| 1  | Sex                                 | 0. Male  
                  | 1. Female          |
| 2  | Age                                 | --------, Years |
| 3  | Have you ever donated blood before  | 1. Yes  
                  | 2. No  
                  | If, 1, how many times |
|    |                                     | ------------------ |
| 4  | Did you feel any Discomfort after blood donation | 1. yes  
                  | 2. No  
                  | If, 1, State the feeling |
|    |                                     | ------------------ |
| 5  | Did you know your Family DM status  | 1. Yes  
                  | 2. No          |
| 6  | Did you know your DM status         | 1. Yes  
                  | 2. No          |

This is the end of the questionnaire. Thanks you very much for taking time to answer these questions. We appreciate your help.
ANNEX II: Information, Consent and Questionnaire Amharic Version.

 Ethiopian Public Health Institute

 SUPPORTING DOCUMENTATION

 This document contains information on the study protocol, consent form, and questionnaire. The aim is to provide a comprehensive understanding of the study's objectives, methods, and expected outcomes.

 SUPPORTING DOCUMENTATION:

 - Supportive Documents:
   - Study Protocol
   - Consent Form
   - Questionnaire

 These documents are part of the larger research project and are intended for use in the context of the study's implementation.
የሸልክ

1. የ/ር እስክ የስራ ከላይ ከሰ. ለብ. የሚሰጠሌት: ከሰ. 09 11 86 02 19 እ.የሆ.

2. ከቶ እስክ ከተለ ለወራ የሚሰጠሌት: ከስ. 0911069998 እ.የሆ tekelekassahun@gmail.com

የቅወ ከመጠቀም ይወሱ እስክ ያመጠቀም የገን እስክ እና? ከሆነ የቅወን ያመጠቀም እንወጣን?

አም የቅወ ያመጠቀም እንወጣን

የመራ ከም የቅወ እንወጣን ያስቻለው:

የመራ ከም የቅወ እንወጣን በማስቻል ያስቻለው:

የመራ ከም ያስቻለው ከስራ ከእ ከግ. መንገድ ያስቻለው እና የቅወ ያስቻለው እንወጣን በማስቻል ያስቻለው:

አም የቅወ እንወጣን በማስቻል ያስቻለው:
1. ይህ ዲ freopen ከ بصيغة 

2. ይህ ዲ freopen ከ بصيغة 

3. ይህ ዲ freopen ከ بصيغة 

4. የአብ ዋሉት ይህ የአብ ዋሉት ያለ ወይ ያለ ዋሉት ከ RCS ከ.setAttribute

5. የአብ ዋሉት የአብ ዋሉት ከ AttributeSet ከ ATTRIBUTE ከ.setAttribute

6. የአብ ዋሉት የአብ ዋሉት ከ AttributeSet ከ.setAttribute

7. የአብ ዋሉት የአብ ዋሉት በ AttributeSet ከ.setAttribute
ANNEX III. Blood Donors Enrollment Form for Sample Collection:

Name-----------------------------  City-----------------  Sub city/region-------------------
Age -------------  Sex------------  Zone----------  Woreda  -----------  Kebele---------
House number---------------------  Registration No.--------

<table>
<thead>
<tr>
<th>Date</th>
<th>Code no</th>
<th>Pack no</th>
<th>Wt</th>
<th>Hb</th>
<th>B/p</th>
<th>Hct</th>
<th>Vol</th>
<th>Screed by</th>
<th>HCV</th>
<th>HBV</th>
<th>Type of donation</th>
<th>remark</th>
</tr>
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<tbody>
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</table>
ANNEX IV: Bs 200 Clinical Chemistry Analyzer Procedures and Test Principle

Calculation Methods

Analytical Methods

The analyzer can provide three analytical methods:

- Endpoint
- Fixed-time
- Kinetic

**Endpoint**

The endpoint or, more correctly, equilibrium method, is the most ideal. The reaction reaches equilibrium after a period of time. Because the equilibrium constant is very large, it can be considered that all substrates (analytes) have changed into products, and the absorbance of the reactant does not change any more. The absorbance change is directly proportional to the analytes concentration.

Figure 7-1 Single-reagent Endpoint reaction

As shown in Figure 7-1, 1 \( t \) is the time when the reagent is added and 2 \( t \) is the time when the sample is added. The reaction starts when they are mixed. At 3 \( t \) the reaction reaches equilibrium and the absorbance reading is taken. The reaction period is 2 \( t \) to 3 \( t \).
As shown in Figure 7-2, 1 \( t \) is the time when the first reagent is added and 2 \( t \) is the time when the sample is added, incubation starts when they are mixed. 3 \( t \) is the time when the second reagent is added, and then the reaction starts when they are mixed. At 4 \( t \) the reaction reaches equilibrium and the absorbance reading is taken. 2 \( t \) to 3 \( t \) is the incubation period and 3 \( t \) to 4 \( t \) is the reaction period.

The endpoint reaction is largely insensitive to minor changes in such condition changes as amount of enzyme, pH and temperature, provided the changes are not significant enough to affect the reaction time.

**Fixed-Time**

For the fixed-time reaction method (namely, first-order kinetic method or initial rate method), the reaction velocity (v), within a specific period, is directly proportional to the substrate concentration \([S]\), namely, \(v=k[S]\). As the substrate is consumed continuously, the reaction velocity becomes smaller and smaller, and so does the change rate of the absorbance. It takes much time for such a reaction to reach equilibrium. Theoretically, the absorbance reading can be taken at any time. The reaction can, however, become steady only after a delay because it is complicated at the beginning and there are miscellaneous reactions due to the complex serum compositions. For any first order reaction, the substrate concentration \([S]\) at a given time after the start of the reaction is given by the following:

\[
[S] = [S_0] \times e^{-kt}
\]

Where,

\([S_0]\) - Initial substrate concentration
The change in substrate concentration $\Delta[S]$ over a fixed-time interval, $1\, t$ to $2\, t$, is related to $[S_0]$ by the following equation:

$$[S]_t = \frac{-\Delta[S]}{e^{-kt} - e^{-kt}}$$

That is, within a fixed time interval, the change in substrate concentration is directly proportional to its initial concentration. This is the general property of first order reactions. Within this interval, absorbance change is directly proportional to the analytes concentration.

As shown in Figure 7-3, $1\, t$ is the time when the reagent is added and $2\, t$ is the time when the sample is added. The reaction starts when they are mixed. From $3\, t$ the reaction becomes steady and $4\, t$ is the time to stop monitoring the reaction. $2\, t$ to $3\, t$ is the delay period, and the absorbance readings are respectively taken at $3\, t$ and $4\, t$. 

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e - Base of the natural log
k - Rate constant
As shown in Figure 7-4, 1 t is the time when the first reagent is added, and 2 t is the time when the sample is added, and then the mixture absorbance reading is taken after they are mixed. 3 t is the time when the second reagent is added, and then the reaction starts when they are mixed. At 4 t the reaction reaches equilibrium, and 5 t is the time to stop monitoring the reaction. 2 t to 3 t is the incubation period, and 3 t to 4 t is the delay period. The absorbance readings are respectively taken at 4 t and 5 t.

The fixed-time reaction is more demanding technically than the equilibrium method. Because reaction rate is measured at two different points, all the factors that affect reaction rate, such as pH, temperature, and amount of enzyme, must be kept constant from one assay to the next, as must the timing of the two measurements. A reference solution of the substrate must be used for calibration.

**Kinetic**

For the kinetic method (namely, zero-order kinetic or continuous-monitoring method), the reaction velocity is not related to the substrate concentration and remains constant in the reaction process. As a result, for a given wavelength, the absorbance of the analytes changes evenly, and the change rate (ΔA/min) is directly proportional to the activity or concentration of the substrate.

The kinetic method is usually used to measure enzyme activity. In fact, it is impossible for the substrate concentration to be high enough, and the reaction will be no longer a zero-order reaction when the substrate is consumed to a certain degree. Therefore, the theory only stands
within certain period. In addition, the reaction can become steady only after a certain period of time, because the reaction is complicated at the beginning and there are miscellaneous reactions due to the complex serum compositions.

As shown in Figure 7-5, 1 \( t \) is the time when the reagent is added, 2 \( t \) is the time when the sample is added and the reaction starts when they are mixed. From 3 \( t \) the reaction becomes steady. \( n t \) is the time to stop monitoring the reaction. 2 \( t \) to 3 \( t \) is the delay period, and 3 \( t \) to \( n t \) is the monitoring period, during which the absorbance readings are taken.

As shown in Figure 7-6, 1 \( t \) is the time when the first reagent is added and 2 \( t \) is the time when the sample is added, and then they are mixed. 3 \( t \) is the time when the second reagent is added, and then the reaction starts when they are mixed. At 4 \( t \) the reaction reaches equilibrium, and \( n t \) is the time to stop monitoring the reaction. 3 \( t \) to 4 \( t \) is the delay period, and 4 \( t \) to \( n t \) is the monitoring period, during which the absorbance readings are taken.

**Calculation Process**
The analyzer adopts such a measurement and calculation flow as shown in Figure 7-7.

**Absorbance**

The analyzer measures the light intensity through photoelectric conversion, linear amplification and AD conversion. For the light intensity signal \( I_i \) of Channel \( i \), the AD output \( D_i \) is:
In theory, when the lights are off, the AD output of each channel will be zero. In practice, because of the existence of dark current, there is still a background output \( D_{\text{ibackground}} \), which should be deducted. Then, the complete absorbance formula should be:

\[
D_i = K_{pe} \cdot K_a \cdot K_{ad} \cdot I_i
\]

Where,

- \( K_{pe} \) - photoelectric conversion factor
- \( K_a \) - linear amplification factor
- \( K_{ad} \) - AD conversion factor
- \( D_i \) - data of Channel i
- \( I_i \) - light intensity of Channel i

So,

\[
A_i = \log \frac{I_i}{I_i} = \log \frac{D_{i0}}{D_i}
\]

Where,

- \( A_i \) - absorbance of Channel i
- \( D_{i0} \) - background AD output
- \( D_i \) - AD output after the substrate is added
DECLARATION

I Kassahun Tekle do hereby declare that “Determination of random plasma glucose levels before and after blood donation among blood donors in Wolayita Sodo Teaching and Referral Hospital.” Is entirely my original work, except where acknowledged, and that it has not been submitted before to any other University or Institution of higher learning for the award of degree.

Kassahun Tekle

Name

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Date of Submission

Signature

This thesis report has been submitted for examination with the approval of the following supervisors:

Tewabech Zewde

Name

---------------------------------------------

Date of Submission

Signature

Place and date of submission: - Addis Ababa University College of Health Sciences, School of Medicine Department of Physiology, 2016.