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Evaluation of Full Blood Cell Count in Donors Referred to Central Blood Bank in Dongola City, North Sudan

A thesis submitted in Partial fulfillment for the requirement of the MSc degree in Haematology and Blood transfusion

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الآية

قال تعالي:

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(قُلْ لَوْ كَانَ الْبَحْرُ مِدَادًا لِكَلِمَاتِ رَبِّي لَنَفِدَ الْبَحْرُ قَبْلَ أَنْ تَنْفَدَ كَلِمَاتُ رَبِّي وَلَوْ جِئْنَا بِمِثْلِهِ مَدَدًا)

صدق الله العظيم

سورة الكهف – الآية (109)

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Dedication

I dedicate this great full work to my mother, brothers and sisters Those who were very close to my heart , whose motivation, encouragement, supported me, also to my teachers ,colleagues and friends, who helping and supported me to complete this research on this best form.

Acknowledgement

First praises and thanks to Allah who supported me and gave me health, strength and helping me to complete this work successfully.

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List of abbreviation:

ATP	Adenine tri phosphate
BTT	Beta thalassemia trait
CBC	Complete blood count
CLL	Chronic lymphoid leukemia
CMV	Cytomegalo virus
EBV	Epstein par virus
EDTA	Ethylene diamine tetra acetic acid
Fl	Fimto liter
g/dl	Grams per deciliter
HAV	Hepatitis A virus
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HGB/Hb	Haemoglobin
HIV	Human immune deficiency virus
HSV	Herbs simplex virus
IDA	Iron deficiency anemia
LCD	Larger crystal display
LED	light-emitting diode
MCH	Mean cell hemoglobin
MCHC	Mean cell hemoglobin concentration
MCV	Mean cell volume
µl	Micro liter
MPV	Mean platelet volume
PCV/Hct	Hematocrit
PDW	Platelet distribution width
Pg	Pico grams
Plt	Platelet
RA	Rheumatoid arthritis
RBC	Red blood cell
RDW	Red cell distribution width
RDW-CV	Red cell distribution width coefficient variation
SLE	Systemic lupus erithromatus
SPSS	Statistical Package for Social Sciences
WBC	White blood cell
WHO	World health organization

Abstract

Background: Pre -donation screening declaration and hemoglobin (Hb) testing are measures used to determine the quality of blood donated and accepted donor for donation. The cyanmet hemoglobin methods and other manual methods used to screen for blood abnormalities can give inaccurate results if strict quality control is not applied. Blood donors who are carriers of thalassemia and those with mild iron deficiency anemia (IDA) are usually asymptomatic and frequently missed at blood donation.

Objectives: This current study aimed to evaluate full blood count in donors referred to central blood bank in Dongola City in North Sudan.

Methodology: This cross sectional descriptive study was performed at the central blood bank in Dongola City during the period from March – June 2018. And aimed to determine the hematological parameters of blood donors. 100 donors were chosen randomly to participate in this study. Venous blood (2.5ml) was obtained from each individual into an EDTA container. The full blood count was done for each donor using fully automated haemayology analyzer Mindray (BC 3000 Plus). Peripheral blood film for morphology was done using lieshman stain.

Results: Results showed haemoglobin mean13.8±1.3g/dl (13.5-17.5) g/dl, 65% of donors within normal value and 35% less than normal. The haematocrit values mean 45±5.5% (38-54) %, 94% normal, 2%high, 4%low. RBC mean5.5±0.5ul (4.2-5.8) ul, 95% normal, 4% high and 1%low. WBC mean 6.7±2.4ul (3.5-9.5), 84%normal, 8%high, 8% low.MCV meam86.7±6.8fl (80-100) fl, 94%normal, 6%low. MCH mean29.8±14.4pg (27-32) pg, 80%normal, 20%low. MCHC mean31.9±1.4g/dl (32-36) g/dl, 62%normal, 38%low. PLt mean258.4±61.1ul (150-400) ul, 96%normal, 4%low. RDW-CV mean13.8±3.3% (11.5-14.5) %, 88% normal, 12% low.

Conclusion: There are some of donors with haemoglobin concentration and RBC indices low than normal also found some abnormal results in others CBC parameters like WBC and PLt. Thus full blood cell count should be incorporated in evaluating blood donors to insure both good quality of blood and safety of donors.

الخلاصة

المقدمة : اجراء فحوصات ماقبل التبرع وقياس تركيز الهيموغلوبين هي قياسات تستخدم لتحديد جودة الدم المتبرع . قياس الهيموغلوبين بالطرق التقليدية او بواسطة الهيموغلوبين سيانايد ممكن ان تعطي نتائج غير طبيعية لو لم تكن هنالك دقة في تطبيق الجودة لهذه الطرق. متبرعين الدم الحاملين للثلاسيميا والذين لديهم انيميا نقص الحديد بصورة بسيطة دائما ليست لديهم اعراض وباستمرار التبرع بالدم يتم فقد كمية الحديد الموجودة لديهم وبالتالي يعانون من نقص الدم.

الأهداف: تهدف الدراسة الحالية إلى تقييم تعداد الدم الكامل في التبرعين الذين يحضرون للتبرع بالدم في بنك الدم المركزي في مدينة دنقلا شمال السودان.

المنهجية: أجريت هذه الدراسة الوصفية المقطعية في بنك الدم المركزي في مدينة دنقلا في الفترة من نهاية شهر مارس - يونيو 2018. وكانت تهدف إلى تحديد قياس الدم الكامل للمتبرعين، وساهم في هذه الدراسة عدد 100 متبرع تم اختيارهم عشوائيا . اخذت 2.5مل من الدم عن طريق الوريد في حاويات دم به مانع تجلط اديتا . وتم فحص الدم الكامل للمتبرعين باستخدام جهاز ميندري وايضا اجريت فحص الدم الطرفي للمتبرعين للاستدلال على وجود الانيميا وكانت محصلة النتائج متوسط تركيز الهيموغلوبين 13.8±1.3جرام/ديسيلتر(13.5-17.5) وكان 65% من المتبرعين داخل المعدل الطبيعي و35% اقل من المعدل الطبيعي. ومتوسط الهيماتوكريت 45±0.5(38-54)%،نسبة 94%من المتبرعين طبيعي و2%اعلى و4%اقل من المعدل الطبيعي. متوسط عدد خلايا الدم الحمراء كانت 5.5±0.5.7ميكرولتر(4.2-5.8)ميكرولتر،حيث كانت نتائج 95%من المتبرعين طبيعي و4%اعلي من الطبيعي و1%اقل من الطبيعي. متوسط خلايا الدم البيضاء6.7±2.4ميكرولتر(3.5-9.5)ميكرولترنسبة 84%طبيعي و8%اعلي و8%اقل من الطبيعي. والوسط الحسابي لمتوسط حجم الكرية الحمراء86.7±6.8فيمتولتر(80-100)فيمتولتر94% طبيعي و6% اقل من الطبيعي. والوسط الحسابي لمتوسط المادة الحمراء بالخلية29.8±14.4بيكوجرام(27-32)بيكوجرام،80% طبيعي و20% اقل من الطبيعي. والوسط الحسابي لمتوسط تركيز المادة الحمراء بالخلية31.9±1.4جرام/ديسيلتر(32-36)جرام/ديسيلتر، 62%طبيعي 38%اقل من المعدل الطبيعي. متوسط عدد الصفائح الدموية258.4 ±61.1ميكروليتر(150-400)ميكروليتر، 96% طبيعي و4% اقل من المعدل الطبيعي. ومتوسط الاختلاف في شكل الكرية الحمراء13.8±3.3% (11.5-14.5)%، 88% طبيعي و12%اعلي من الطبيعي.

الخاتمة : هناك بعض من المتبرعين الذين يعانون من تركيزاقل للهيموجلوبين ومعاملات الدم وقياسات الدم الاخري لذلك يتم ادراج فحص الدم الكامل للمتبرعين وذلك لضمان جودة الدم وسلامة المتبرعين.

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Chapter One

Introduction

Chapter One

Introduction

1.1 Introduction

Blood transfusion is an essential part of modern medicine. The primary goal of any blood transfusion is to provide the patient with donor blood cells that optimally survive after transfusion , serve their function and to ensure that the patient actually benefit from the transfusion. To achieve this goal, donor red cells that are compatible with those of the patient's blood are selected for transfusion. [1]All "fresh" blood components and manufactured blood products originate from the blood donor. Hence, the safety of blood transfusion begins with careful selection of donors. [2] Donor screening criteria are established to protect both donors and recipient. [3]To ensure blood safety, safe donors are needed to be recruited and high-risk donors should be discouraged from donation [4]. For people who are considering donating blood, a local blood bank can describe the criteria for being a blood donor. [4] Criteria for selection of donor including: the donor age and body weight, body temperature, pulse, the systolic and diastolic blood pressures, and HB should be within the normal range in addition the donor should be free of acute respiratory diseases, cardiovascular disease, epilepsy ,Central Nerves System (CNS) disorders and other any disorders.[5] The pregnant and lactating women are not suitable for donation, because of the high iron requirements for her and her fetus.[6]The main goal of blood donation is to provide good quality blood and blood components. To achieve this proper selection of donors is mandatory to follow the standard procedure of donor selection criteria. [7, 8]

1.2 Full Blood Count or Complete Blood Count (CBC)

CBC is a group of tests used to quantify the number of RBCs, WBCs, and platelets also to provide information about their size and shape of blood cells, to measure the hematocrit and RBC indices, to measure hemoglobin concentration of RBCs, to determine the percentage (relative) and absolute number of the five white blood cell types, and identify early and abnormal blood cells in the circulating system.[9] CBC count can be performed manually by visual examination or automation by fluorescence flow cytometry and impedance to determine multiple parameters of CBC. Automation provides a high level of accuracy and precision for quantification and identification of normal white blood cells; however, this method is not sensitive at identifying abnormal or immature cells especially in WBC differential counts and is not able to accurately identifying and classifying all types of white blood cells.[10].To overcome this problem, most hematology automated analyzers will flag samples with possible abnormal blood cell populations, indicating the need for peripheral blood examination to identify abnormal cells by manual method. However, both automated and manual methods may not detect small numbers of abnormal cells. The false negative rate for detection of abnormal cells varies from 1-20%, depending on the instrument and the detection limit desired (1-5% abnormal cells). Disorders in CBC can be classified as quantitative or qualitative. In quantitative alterations, all cells appear normal but are present in abnormal quantities, either in excess or in defect of normal values. In qualitative defects, abnormal appearing cells or extrinsic cells are found in circulation. [11, 12]A CBC can help diagnose a broad range of conditions, from anemia and infection to cancer. And the platelets are at a level that may affect haemostasis.CBC help doctor to evaluate health, diagnose and monitor health problem, and monitory of treatment. [13]

1.3 Rational

Transfusion of blood is important to save a life for the patients need. The blood should be free of any infectious agent, and any blood cells should be in normal function and shape in order to achieve their jobs, but unfortunately in transfusion practice many workers first focus on the hemoglobin level and screening for infectious disease (HIV, HBV, HCV, HAV and Syphilis), while ignoring the other haemogram parameters and the risk of this issue is an abnormal blood can be transfused to the patient blindly. As observed the majority of the donors are relatives to the patient and this could give a chance to abnormal blood to be transfused especially in case of the minor types of thalassemia for example where hemoglobin level could be normal, but Hb function is not hundred percent, so the important of this study is to gain the attention to the minor haematological abnormalities in transfusion medicine which can be harmful to the patients in need.

1.4 Objectives

General Objective

To investigate the full blood count in donor's attended to Central Blood Bank in Dongola City, North Sudan.

Specific Objective

- To determine the WBC count in donors blood samples.
- To determine the RBC count and RBC indices in donors blood samples.
- To determine the PLT count in donors blood samples.
- To evaluate morphological changes in peripheral blood picture of donor's blood smear.
- To evaluate the RDW_CV% in donors blood samples.

Chapter Two

Literature Review

Chapter Two

2- Literature review

2.1. Donor Selection criteria

The purpose of donor selection is to assess the suitability of an individual to be a blood donor, so that the donated blood and blood products will be safe for the recipients. The selection of the donor based on his general health, medical history and drugs being taken and also a simple physical examination and laboratory tests on his blood sample.[14]

2.1.1. Medical history

For donor history designed questionnaire paper should be used to collect the essential data required. The donor should be rejected and referred for a medication if he have a positive history of allergic disorders, epilepsy renal, cardiovascular, malignant diseases, bleeding tendency tuberculosis, and diabetes mellitus or any other major illness especially the infections that could be transfused by blood.[15]Donor intake medications should be rejected because, this is indicate for the illness and the drugs in his blood stream may affect a recipient, Pregnant women and six months after delivery during lactation the lady is not allowed to donate blood, because the risk on her and her baby before six months of a major surgery and three months of a minor surgery the donor is not to donate blood, donors that suffer from any infectious disease (bacterial, fungal, parasitic or viral) are not accepted and the donors who has undergone tattooing on their body in the last six months also are not acceptable, in case of malaria the criteria for deferral is different for endemic and non-endemic areas. In places where malaria is endemic, the blood banks cannot afford to defer a donor on the history of malaria, even in the recent past. Such

cases are accepted three months after being cured by anti-malarial. In cases of non-endemic, the donor is deferred for three years after a bout of malaria and for six months to one year, if he has visited an endemic area. [15]

2.1.2. Physical examination like the age, bodyweight, blood volume, pulse and blood pressure, hemoglobin concentration, systemic examination. Age wise the donor any person within the age group of 18-60 years, a minimum body weight of 45kg, and having a minimum hemoglobin concentration 12g/dl is eligible to donate.[15]The volume of blood donation should not be more than 13% of the estimated blood volume of the donor in order to protect him/her against vasovagal attacks. The collection bags are designed to contain 350 or 450 ml of blood, the pulse should be regular and the rate should be within 80-100/ minute, the BP should be within 110 to 180 systolic and 70 to 100 diastolic in mmHg,the clinical examination should reveal a normal respiratory and cardiovascular systems and normally functioning kidneys.[15]

2.1.3 Screening of donor blood

The haemoglobin estimation before donation should be carried out, usually, at least by a simple technique based on the specific gravity of a drop of blood introduced into a solution of copper sulphate or by micro haematocrit technique. The acceptable minimum concentrations are 12.5 gm/dl of haemoglobin or 38% of haematocrit, also serological tests to ascertain the blood group ABO and Rh should be carried out on all blood units.Donations negative for D labeled Rh negative, screening test for infectious agent of transfusion transmitted disease must be carried out to blood donors, the mandatory tests are HBsAg for Hepatitis B Anti HCV for Hepatitis C. Antibodies to HIV1and 2 for AIDS .VDRL, TPHA or RPR for syphilis. [15]

2.1.4 Frequency of donation

The frequency of donation is normally two or three times a year or at an interval of at least 3 months between two donations, the time by which the iron stores of the body are replenished. [15]

2.1.5 Special consideration for donor selection for Apheresis

Apheresis is the process by which they require component of whole blood is separated and collected from the donor using an automated blood cell separation device. Component that can be donated by apheresis include platelets, plasma, leucocytes and red blood cell. Medical criteria for selection of donor of whole blood and blood component obtained by apheresis are the same. But special requirement need for donor in apheresis for platelet which should be above 150×10^9/l. Also for apheresis plasma the donors total protein level should be greater than 60g/dl and for double red cell apheresis of either gender require a minimum haemoglobin level 14.0g/dl. [14]

2.2 CBC Definition: Complete (CBC) is a test that measures the count and the morphological changes of the cells that formulate the blood which are the red blood cells, white blood cells and platelets.CBC help doctor to evaluate health status, diagnose and monitory of health problems, and treatment. [16]

2.3 CBC Measurement Parameters:

CBC measure three basic types of blood cells:

2.3.1 White blood cells (WBC):- White blood cells are the cells that help the body fight against different infectious agents. A CBC measures the number and types of white blood cells in the body. Any abnormal increases or decreases in any types of white blood cells could be a sign of

an abnormality (infection, inflammation, cancer, or etc ….).[17]WBCs are involved in the immune response. The normal range: 3.5 – 10.5x 10^9/L.

WBCs have two types:

1) Granulocytes consist of:

– **Neutrophils**: represent 50 - 70% of the total number of the WBCs.The absolute normal count of neutrophils between 2.0 – 8.0×10^9/L. (range can be different for different labs).

The Neutrophils increases in (Bacterial infections, Tissue destruction (burns), Inflammation (SLE, RA), Thyrotoxicosis, Cigarette smokingCorticosteroids, Leukemia and etc ...) and they can decreases inbone marrow depression, some Medications (ex. dapsone, cephalosporin's), Immune related (ex. SLE, RA), Post-acute infection (HSV, CMV, HIV, EBV) and etc … [18]

– Eosinophils: represent 1 - 5% of the total WBCs. The absolute number of eosinophils range between

0.0 – 6.0×10^9/L. Eosinophils persist in the circulation for 8 – 12 hours, and can survive in tissue for an additional 8 – 12 days in the absence of stimulation. Eosinophils can be increased in case of parasitic infections, Allergic conditions and hypersensitivity reaction (Aspergillosis, Vasculitis) and they can decrease in sepsis and bone marrow depression. [18]

– Basophiles: Basophiles are the least common of the white cells, representing about 0.01– 0.3% of all white blood cells and the absolute number of basophiles range between0.0– 0.2 × 10^9/L.Thefunction of basophils is not fully understood, but it is known that they are capable of phagocytosis and producing histamine.

BasoPenia (low BasoPhil Count): Basopenia is difficult to demonstrate as the normal basophile count is so low.

BasoPhilia (high Basophile Count): The basophile count will only very rarely be significantly raised. When present, it may indicate a myeloproliferative disorder, or other more obscure causes. A repeat CBC a week or two later may help. [18]

2) Granulocytes consist of:

- Lymphocytes: represent 20 - 40% of total WBCs and the absolute lymphocytes count between $1.0 - 4.0 \times 10^9$/ L.

Lymphocytosis – increased lymphocyte count in viral infection (EBV, CMV, HIV, Infectious), mononucleosis, Leukemia/Lymphoma (CLL)

-Lymphopenia – decreased lymphocyte count in,viral infections, medication induced,and autoimmune disorder. [18]

– Monocytes: represent 1 - 6% of total WBCs and the absolute, and the absolute monocytes count between$0.2 - 1.0\times 10^9$/ L.

Monocytosis increase monocyte count in Pregnancy, TB, Syphilis, and Sarcoid.

Monocytopenia decrease monocyte count in, acute infection, Steroids, Leukemia. [18]

2.3.2 Platelets: - is very essential in blood clot and control bleeding and any changes in platelet levels can risk factor for excessive bleeding. [17]The normal range of platelets between $150\text{-}400\times 10^3$/uL.

The number of platelets can be increased (Thrombocytosis)in case of Splenectomy, Inflammation (Reactive),myeloproliferative disease (ET)and iron deficiency anemia and the decreased (Thrombocytopenia) in

case of TTP, DIC, ITP ,Blood loss , Splenomegaly Medications(antibiotics) , Viral InfectionsandBone marrow disorder (leukemia).[18]

2.3.3 Red blood cell (RBC):- Red blood cells carry oxygen throughout your body and remove carbon dioxide. In health, the red blood cells vary relatively little in size and shape. In well spread, dried, and stained films the great majority of cells have round, smooth contours and diameters within the comparatively narrow range of 6.0-8.5 mm. As a rough guide, normal red cell size appears to be about the same as that of the nucleus of a small lymphocyte on the dried film. The red cells stain quite deeply with the eosin component of Romanwsky dyes, particularly at the periphery of the cell in consequence of the cell's normal biconcavity. [19] A small but variable proportion of cells in well made films (usually less than 10%) are definitely an oval rather than round, and a very small percentage may be contracted and have an irregular contour or appear to have lost part of their substance as the result of fragmentation (schistocytes). According to Marsh, the percentage of pyknocytes (irregularly contracted cells) and schistocytes in normal blood does not exceed 0.1% and the proportion is usually considerably less than this, whereas in normal, full term infants the proportion is higher, 0.3-1.9%, and in premature infants it is still higher, up to 5.6% .[19]Adult humans have roughly 23×10^{13} red blood cells at any given time (women have about 4 to 5 million erythrocytes per microliter (cubic millimeter) of blood and men about 5 to 6 million.[20] People living at high altitudes with low oxygen tension will have more). In humans, the hemoglobin in the red blood cells is responsible for the transport of more than 98% of the oxygen; the remaining oxygen is carried dissolved in the blood plasma. The red blood cells of an average adult human male store collectively about 2.5 grams of iron, representing about 65% of the total iron

contained in the body.[20] Erythrocytes consist mainly of hemoglobin, a complex metalloprotein containing heme groups whose iron atoms temporarily link to oxygen molecules (O2) in the lungs and release them throughout the body. Oxygen can easily diffuse through the red blood cell membrane. The haemoglobin in the erythrocytes also carries some of the waste product carbon dioxide back

From the tissues; most of the carbon dioxide is however transported as bicarbonate dissolved in the blood plasma. Myoglobin, a compound related to hemoglobin, acts to store oxygen in muscle cells. The color of erythrocytes is due to the heme group of hemoglobin. The blood plasma alone is straw colored, but the red blood cells change color depending on the state of the haemoglobin: when combined with oxygen the resulting oxyhemoglobin is scarlet, and when oxygen has been released the resulting deoxyhemoglobin is darker, appearing bluish through the vessel wall and skin.[21]The red blood cell functions when erythrocytes undergo shear stress in constricted vessels, they release ATP, which causes the vessel walls to relax and dilate. When their haemoglobin molecules are deoxygenated, erythrocytes release S-nitrosothiols which also acts to dilate vessels, thus directing more blood to areas of the body depleted of oxygen. Erythrocytes also play a part in the body's immune response: when lyses by pathogens such as bacteria, their haemoglobin releases free radicals that break down the pathogen's cell wall and membrane, killing it.[21] A CBC measures two components of the red blood cells:

2.3.3.1 Hemoglobin: Hemoglobin is oxygen-carrying protein also called the iron-containing protein found in all red blood cells (RBCs) that gives the cells their characteristic red color. Hemoglobin enables RBCs to bind to oxygen in the lungs and carry it to tissues and organs throughout the body. It also helps transport a small portion of carbon dioxide, a product of cell metabolism, from tissues and organs to the lungs, where it is

exhaled. Several diseases and conditions can affect RBCs and consequently the level of hemoglobin in the blood. In general, the hemoglobin level and hematocrit rise when the number of red blood cells increases. The hemoglobin level and hematocrit fall to less than normal when there is a drop in production of RBCs by the bone marrow, an increase in the destruction of RBCs, or if blood is lost due to bleeding. A drop in the RBC count , hemoglobin and hematocrit can result in anemia, a condition in which tissues and organs in the body do not get enough oxygen, causing fatigue and weakness. If too many RBCs are produced, polycythemia results and the blood can become thickened, causing sluggish blood flow and related problems. [22]

2.3.3.2 Hematocrit: percentage of red blood cells in the blood. A hematocrit is a test that measures the proportion of a person's blood that is made up of red blood cells (RBCs). Blood consists of RBCs, white blood cells (WBCs), and platelets suspended in a fluid portion called plasma. The hematocrit is a ratio of the volume of red blood cells to the volume of all these components together, called whole blood. The value is expressed as a percentage or fraction. For example, a hematocrit value of 40% means that there are 40 milliliters of red blood cells in 100 milliliters of blood. Low levels of hemoglobin and hematocrit are often signs of anemia, a condition that occurs when blood is deficient in iron. [22]

2.3.3.3 Red cell indices: -

Red cell indices are valuable in the morphologic classification of anemias. Since different etiologic factors result in characteristically different red cell morphology, the clinician can properly plan the management of a patient with an anemia if he can interpret the blood counts and peripheral blood smear well. Anemia's are classified, according to the size of the red cell, as being normocytic (normal MCV), macrocytic (increased MCV), or microcytic (decreased MCV).

Microcytic anemias were also often described as being hypochromic based on peripheral smear examination and MCHC when this value was determined manually. MCHC as measured by the electronic machines is mostly normal in microcytic anemia, however, and the value of MCH closely parallels the value of MCV. The optical properties of the small, thin microcytes make them appear hypochromic on the blood smear, while the hemoglobin concentration remains in the normal range (microcytic, normochromic anemia).There is no hyperchromicanemia. In spherocytosis, the MCHC is increased due to loss of membrane and the consequent spherical shape assumed by the cell. The general availability of RDW (Red Cell Distribution Width) as a measure of anisocytosis helps further in the evaluation of anemias based on morphology. Significant anisocytosis often leads to an increased RDW, whereas in its absence the RDW remains normal. Red cell indices, RDW, and red blood cell histograms will not help identify conditions such as red cell inclusions (e.g., malarial parasites) or membrane abnormalities such as spherocytosis that might be responsible for the anemia. [23]The RBCs indices divide into three parts:

- mean corpuscular volume (MCV), which is the average red blood cell size
- mean corpuscular hemoglobin (MCH), which is the amount of hemoglobin per red blood cell
- mean corpuscular hemoglobin concentration (MCHC), which is the amount of hemoglobin relative to the size of the cell or hemoglobin concentration per red blood cell.[24]
- According to the American Association for Clinical Chemistry, normal values for RBC indices are:

- The MCV should be 80 -96fl (femtoliters).

- The MCH should be 27 -33pg (picograms per cell).
- The MCHC should be 33.4 - 35.5 g/dl (grams per deciliter).[24]

Normal ranges may vary slightly from lab to lab.

- **MCV**: is the average size/volume of an individual RBC; it serves to classify in macrocytic, normocytic or microcyticanemia.

MCV = HCT (%) x10÷RBCs. [24]

- **High MCV:** The MCV is higher than normal when red blood cells are larger than normal. This is called macrocytic anemia. Macrocytic anemia can be caused mainly by Vitamin B12 deficiency, folate deficiency, Chemotherapy, preleukemias.[24]
Low MCV: The MCV will be lower than normal when red blood cells are too small. This condition is called microcytic anemia. Microcytic anemia may be caused by: iron deficiency, which can be caused by poor dietary intake of iron, menstrual bleeding, or gastrointestinal bleeding, thalassemia, lead poisoning chronic diseases. [24]

- **Normal MCV:** Normal MCV means that the red blood cells are normal in size. Sometimes MCV can be normal and there is anemia, in case if there are too few red blood cells or if other RBC indices are abnormal. This is called normocytic anemia. Normocytic anemia occurs when the red blood cells are normal in size and hemoglobin content, but there are too few of them. This can be caused by: a sudden and significant blood loss, a prosthetic heart valve, a tumor, a chronic disease, such as a kidney disorder or endocrine disorder, a plastic anemia or a blood infection. [24]
- **MCH:**   is an average of hemoglobin content of an erythrocyte.

MCH =HB×10÷RBCs.

MCH depends on the size of erythrocytes and their hemoglobin content; when erythrocytes are small MCH is low, and when erythrocytes are large MCH is increased. [25]

-**MCHC:** mean corpuscular hemoglobin concentration in average concentration of erythrocyte hemoglobin expressed as a percentage; shows the percentage of erythrocyte volume occupied by HGB.

MCHC = HB×100÷HCT. [25]

- **High MCHC**: If there is a high MCHC, this means that the relative hemoglobin concentration per red blood cell is high. MCHC can be elevated in diseases such as: hereditary spherocytosis, sickle cell disease, homozygous hemoglobin C disease. Low MCHC means that the relative hemoglobin concentration per red blood cell is low. The red blood cells will take on a lighter color when viewed under the microscope. Individuals with anemia and a corresponding low MCHC are said to be hypochromic. Conditions that can cause low MCHC include the same conditions that cause low MCV, including: iron deficiency, chronic diseases, and thalassemia, lead poisoning generally, a low MCV and a MCHC will be found together. Anemia's in which both MCV and MCHC are low are called microcytic, hypochromic anemia. [24,25]

2.3.4 Other measurement: in addition to three parameters also measure the following parameters:

- **RDW (red cell distribution width):** Measure the variability in the size of red blood cells, not useful in the absence of anaemia.

-**Reticulocyte count:** useful in determine what cause of anaemia.

- **MPV (mean platelets volume):** the size of platelet in blood.

- **PDW (platelet distribution width):** variation in platelet size.[26]

Interpretation of results of CBC: for interpretation the CBC result, the result must be compare to the reference / normal range of measurement.

Reference value is asset of measured quantity obtained from group of individuals in defined state of health. If results are inside the normal range they are normal. If results higher or lower than normal range they are abnormal result. [27]

2.4 Disorders and its result indications associate complete blood count:

Disorder with RBC count, hemoglobin, and haematocrit is anaemia in low result tan normal and polycythemia in high result. While WBC disorder auto immune disorder, bone marrow problem or cancer also certain medication in low WB count, high WBC count in case of infection and inflammation. If PLT outside than normal value as a result of medical condition like homeostasis disorder and need additional tests to diagnose the cause. [27]

2.5 Disorder associated RBCs and RBCs indices in Donor blood that normal hemoglobin level by manual (cyan met hemoglobin) method:-

in the majority of blood bank estimate hemoglobin level by manual and simple method then the result has been reported to have poor sensitivity in the detection of early stages of iron deficiency. Iron deficiency is the world's most widespread nutritional disorder, affecting both industrialized and developing countries. [28] Because IDA is the last stage of iron-deficiency, Hb measurement alone is inadequate to detect blood donors with iron deficiency but without anemia. Recent publications have suggested that serum ferritin levels could be a reliable indicator for body iron stores since they provide a determination of iron deficiency at an early stage. [29, 30] As ferritin testing is comparatively costly, various red blood cell (RBC) parameters have been proposed as markers for low ferritin/iron depletion.[31] Chronic iron deficiency is a well-recognized complication of regular blood donation. In the majority of blood banks, hemoglobin (Hb) measurement is used as a screening test for the ability

to donate blood. Since hemoglobin levels may be normal in the presence of reduced iron stores. [32, 33]The use of this parameter has been reported to have poor sensitivity in the detection of early stages of iron deficiency. [34] Indeed, an accurate diagnosis of a state of iron deficiency requires several laboratory tests. Measurements of serum ferritin concentrations and red cell indices such as mean cell volume (MCV) and mean corpuscular haemoglobin (MCH) can be used with a high degree of accuracy and precision. [35, 36]Beta-thalassemia trait (BTT) is the second most common cause of microcytic anemia and, for this reason; the possibility of this disease must be discarded when anemia or microcytosis is present. [37, 38]

2.6 Previous studies:-

Till now few studies were done for evaluation of full blood count in blood donors in Sudan, due to difficulty of counting by manual methods and due to cost of reagent of automated techniques.In these studies explain the full blood count and RBC and its indices and related disorders in different area, two studies in Sudan (one in,White Nile state, other in Gezira state), and also two studies in Malaysia.

1- In 2015, at University of Putra Malaysia, one hundred fifty eight volunteer blood donors at the Universities Putra Malaysia (UPM), who had passed the CuSo4 screening method, were recruited for this study. Their bloods specimens were examined with a complete blood count. Subjects with a low mean corpuscular hemoglobin (MCH) level were examined further by checking a serum ferritin level, Hb quantification, and molecular analysis to examine for common RBC disorders. Fourteen point six percent of subjects had a low Hb level, two (1.3%) had IDA and four (2.5%) had thalassemia or some other hemoglobinopathy.[39]

2- In 2015, another study was written by Samuel et al. talk about the prevalence of anemia among the total deferred patients (538) was 17.1 %. Four different types of anemia were found among the subjects. These were normocytic normochromic (46.74 %), microcytic hypochromic (42.39 %) normocytic hypochromic (8.70 %), and microcytic normochromic anemia (2.17 %).Anemia in prospective blood donors deferred by the copper sulphate technique of hemoglobin estimation. [40]

3-Elnour *et al* in Sudan a study a conducted in University of El Imam El Mahdi, for Evaluation of blood count among blood donors attending kosti teaching hospital blood bank, White Nile state, Results showed that hemoglobin concentration was normal in 55% of the donors, less than the normal in 43% and above the normal in 2% of studied group. RBCs were 70% normal, 4% lower than normal and 26% higher than normal. 78% of the donor showed WBC within normal range and the remaining 18% were lower than normal. Platelets counts in donors were 90% normal, 8% low and 2% high. The Haematocrit values were 87% normal, 7% low and 6% high. The MCV in donors was 74% normal and 26% low. MCH value was 2% normal, 97%low and 1%high. The MCHC was 3%normal and 93% low. [41]

4-An article written by Abbas, A. A., *et al.* about hemoglobin level and Red Blood Cell Indices in Apparently Healthy Sudanese Blood Donors in Gezira state (Sudan) .Published in Pyrex Journal of Biomedical Research show the minimal level of haemoglobin, haemotocrit in male blood donors are 12.5 g/dl and 39% respectively. All donors were screened for hemoglobin estimation using copper sulphate method and their haemoglobin reported as satisfactory for donation. The mean hemoglobin values were 14.5g/dl +/- 1.2076, with minimum count (10.1 g/dl) and maximum count 17.8 g/dl. Haemoglobin less than 12.5g/dl was obtained

in30 donors (6%) and they were reported as fit for blood donation using copper sulphate for hemoglobin estimation. Those 30 donors actually they are not fit for blood donation because their hemoglobin concentration must be more than 12.5g/dl. Hematocrit found to be less than 39% in 45cases (9%), with MCV less than 80 fl in 79 donors (15.8%) and donors with MCH less than 27 pg in 99 (19.8%) which indicate iron deficiency. MCV found to be more than 95 flin 23 (4.6%) (May be suggestive of megaloblastic anemia or other causes like smoking and alcohol, liver disease). A total number of 1263 prospective blood donors presented to donate blood during the period of this study. Out of these, 1120 (88.68 %) were males and 143 (11.32 %) females. A total of 538 (42.6 %) involving 444 males and 94 females were deferred due to varied reasons and 114 (21.2 %) of these were due to low hemoglobin (Hb) level. [42]

Chapter Three

Material and Method

3. Material and Methods

3.1 Study, Type and design

Descriptive cross-sectional study.

3. 2 Study area

Central Blood Bank in Dongola City.

Dongola is the capital of The State of Northern on Sudan; it lies on the west bank of the Nile River about 278 miles (448km) northwest of Khartoum. The town is agricultural centre for the surrounding, in education the town is home of university, found many tribes from locality of state and from different parts of Sudan. Dongola has a hot desert climate in summer and very cold in winter. Population of Dongola 13,473. The Central Blood Bank provides blood donation service to governmental and private hospital in Dongola. Different types of blood components (whole blood, packed red cells, platelets, fresh frozen plasma) are prepared from whole blood using large refrigerated centrifuges.

3.3 Study population

Apparently health male donor who attend Central Blood Bank in dongola for Blood donation.

3.4   Sampling

3.4.1 Inclusion criteria

Any donor fit the donation criteria.

3.4.2 Exclusive criteria

Any donor doesn't fulfill the donation criteria.

3.4.3 Techniques of Sample collection

Simple random sample techniques were used to select participant.

3.4.4 Sample Size

A total of 100 apparently healthy adult male donors, whose attend the Central Blood Bank in Dongola City during March – June 2018,were screened for Hemoglobin level and red blood cells indices.

3.5 Data collection tools

Data were collected by a well designed questionnaire and observation of the laboratory investigation.

3.6. Material:-
3.6.1. Instrument Material:-
-Reagents:-

- Diluent: to dilute the blood samples, and provide the blood cells with an environment similar to the blood plasma, and the cell volume of each red blood cell and platelet during the count and sizing portion of measurement cycle, and provide a conductive medium for impedance counting of white and red blood cells and platelets.

- Lyse: - to rapidly break down red blood cell walls release the hemoglobin from the cell and reduce the size of cellular debris to a level that does not interfere white blood cell counting. To convert hemoglobin to a complex whose absorbance is determined by the hemoglobin concentration.

- Rinse: - to rinse the baths and metering tubes and to provide proper meniscus formation in the metering tubes and maintain it during each measurement cycle.
- E-Z Cleanser: - is enzyme- based isotonic, cleaning solution and wetting agent, formulated to clean the fluidic lines and baths.
- Probe cleanser: - is alkaline cleaning solution formulated to clean fluidic lines, apertures and baths.
- Controls and calibration: - the controls and calibrators are used to verify accurate operation of and calibrate the analyzer.
  -Power supply: - -voltage: $(100v - 240v \pm 10\%)$.

3.6.2 Staining method material:-

-Roman wesky stain (leishman) stain.

-Methanol for fixation.

-Slides and spreaders.

-Buffer.

 -Microscope.

-Oil.

3.6.3 Collection material:-

- Disposable plastic syringes.

-Cotton.

-Antiseptic 70% ethanol.

-K3EDTA, Na2EDTA and K2EDTA fluid blood containers.

3.7 Methodologies

3.7.1 Blood sampling

- Pre-analytical standardization of the preparation of individuals.

-Data were collected from the selected donors they were asked specific questions as per donor questionnaire i.e. age, name, last donation date or previous donation.

-Blood sample collection: Two and half milliliters of blood were withdrawn from vein of each patient after cleaning the patient skin with 70% alcohol and applying of the tourniquet above the   vein puncture site, using sterile non biogenic disposable   plastic syringes with disposable needles size 21G for adults and 23G for children in dipotassium ethylene diamine   tetra-acetic acid (K_2EDTA) plastic containers and the blood specimens were mixed well with the anticoagulant by inverting the containers several times after capping of the tubes, which were marked with the patient name and number.[43]

3.7.2 Laboratory analysis

3.7.2.1Measurement of CBC Parameters

Laboratory investigations were done within two hours of sample collection using and the samples were checked for clot and mixed well before proceed. The automatic cell counters BC3000 Plus (Mind ray); auto hematology analyzer and leukocyte differential counter for in vitro diagnostic use in clinical laboratories was used. The mind ray processes approximately 60 samples in hour and display on LCD screen. And

perform speedy and accurate analysis of 19 parameters and 3 histogram in blood samples and detect abnormal samples. This instrument work in two analysis mode:-Whole blood mode and pre-diluted mode. [44] The two independent measurement methods used in this analyzer are:-

-Impedance method for determining the WBC, RBC, PLT data.

-The colorimetric method for determining HGB.

During each analysis cycle the sample is aspirated, diluted, before the determination for each parameter is performed.

A -Aspiration

When analyze whole blood sample, present sample to sample probe then press aspirate key to spirate13ML of the sample into the analyzer, and when analysis capillary blood first manually dilute sample (20MLof capillary sample diluted in 0.7 ml of diluents and then present the pre-diluted sample to the sample probe and press aspirate key to aspirate 0.3ml of the sample into analyzer. [44]

B - Dilution

Usually in blood samples the cells are too close to each other to identify or counted for this reason the diluents is used to separate cells so they are drawn through the aperture p one at a time as well as to create a conductive environment. For each two type of blood samples(whole blood, per-dieted) the analyzer make dilution then calculate each cell. [44]

3.7.2.1.1 CBC parameters (WBC, RBC, and PLt) measurement principles

" (RBCs, WBC, and PLTs are counted and sized by the impedance method. This method is based on the measurement changes in electrical

resistance produce by particle, which in this case is a blood cell, suspended in conductive diluents as it passes through aperture of known dimensions. An electrode is submerged in the liquid on both sides of the aperture to create an electrical pathway. As each particle passes through aperture, a transitory change in the resistance between the electrodes is produced. The changes produce a measurable electrical pulse. The number of pulses generated indicates the number of particles that passed through the aperture .the amplitude of each pulse is proportional to the volume of each particle. Each pulse is amplified and compared to the internal reference voltage channel. This only accepts the pulses of certain amplitude. If the pulse generated is above the WBC threshold it counted as a WBC, RBC/PLT lower threshold, it is counted as WBC/RBC/PLT)". [44]

3.7.2.1.2 HB Measurement Principle

" (HGB is determined by the colorimetric method. The WBC/HGB dilution is delivered to WBC bath where it is bubble mixed with a certain amount of lyse, which converts hemoglobin to a hemoglobin complex that is measurable at 525nm. An LED is mounted on one side of the bath and emits a beam of light, which passes through the sample and 525nm filter, and then is measured by a photo-sensor that is mounted on the opposite side. The signal is then amplified and the voltage is measured and compared to the blank reference reading (reading taken when there is only diluents in the bath). The HGB is calculated per the following equation and expressed in g/L.

HGB (g/L) = Constant×log10 (Blank Photocurrent/Sample Photocurrent)". [44]

3.7.2.1.3 Method of CBC Parameters measurement:-

-Inspection before turning on the power (reagent, instrument, waste and printer paper).

-turning on the power switch on the right side of unit, self-check, auto rinse and back ground check will be automatically performed, and then "Ready" will appear.

-For sample number input selected sample number.

-Mix the blood sample by sample rotator.

-Remove the container blug with care to avoid blood scatter.

-Set the tube to the sample probe and in that condition, press start switch.

-The instrument start to analyze the sample, part of sample diluted with cell pack for count RBCs and to estimate MCV, RBCs lyses by stromatolyser for Hb estimation.

By three measured parameters (HB, MCV, and RBCs count) the instrument derived other three parameters (MCH, MCHC, HCT). The result exact simply displayed after approximately 40 second on larger crystal display (LCD), then the instrument clean all tube to be ready for next sample by displaying ready status.

-When the LCD screen displays (Ready) prepare the next sample and repeat the above procedure. After print the last sample result select shout down, then turning of the power. [44]

3.7.2.2 Staining method for blood morphology

Also was applied preparation of staining thin blood film for last comment on morphological abnormalities.

3.7.2.2.1 Principle and Procedure for Staining Thin Blood Film

Staining usually take place at a neutral pH. pH of blood is 7.4, the basic part of stain methylene blue stained the acidic part of the cell i.e. the nucleus while the acidic part of stain eosin stained the basic part of the stain i.e. cytoplasm. Thin blood film was made on clean grease free glass slide and stained using Leishman staining technique. Thin blood film was made from well mixed EDTA anticoagulated blood; the film was allowed

to air dry and flooded with Leishman stain for 3minutes. The slide was diluted with buffered distilled water and allowed to stain for 10minutes. Slide was rinsed with water; back of the slide was cleaned with damped cotton wool in methylated spirit. The slide was allowed to air dry and examined under microscope using X100 objective lens.[45, 46, 47]

3.8 Data analysis:-

The results were analyzed using statistical software package of social sciences (SPSS) and descriptive data were expressed as means.

3.9 Ethical clearance:-

Ethical clearance was obtained from Shendi University Ethical Research Committee and Ministry of Health in Northern state then blood bank authority. A consent form was taken from any participant in the study after detailed demonstration about the importance of the study, before data and blood sample collection.

Chapter Four

Results

Chapter Four

Results

A number of 100 Samples from adult male Blood donors were included in this study, data was collected using structured questionnaire then result was analysis by SPSS method, figure (4.1) explain distribution of study group according to age group, figure (4.2) distribution according to exercise , figure (4.3) distribution according to tribe, and figure (4.4) demonstrate distribution of study group according to location, also distribution according to smoking status in table (4.1), table (4.2) demonstrate comparison mean of study parameters with normal range, table (4.3) explain distribution of study parameters among study population, table (4.4) demonstrate frequency and percentages of blood morphology.
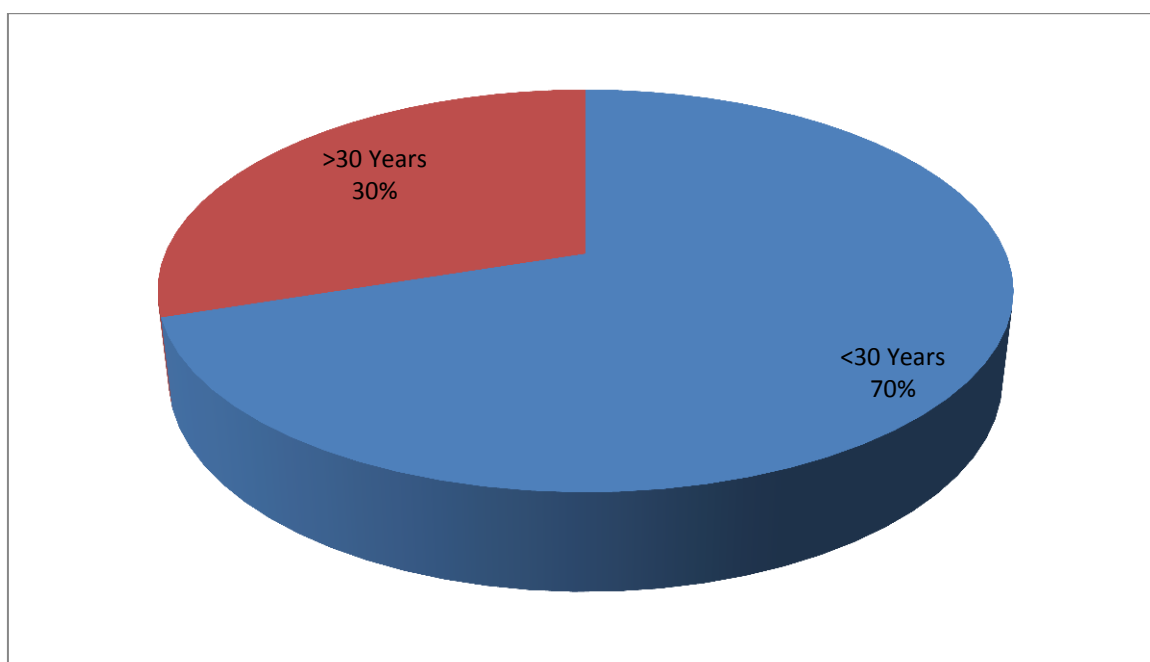
Figure (4.1): distribution of study group according to age group
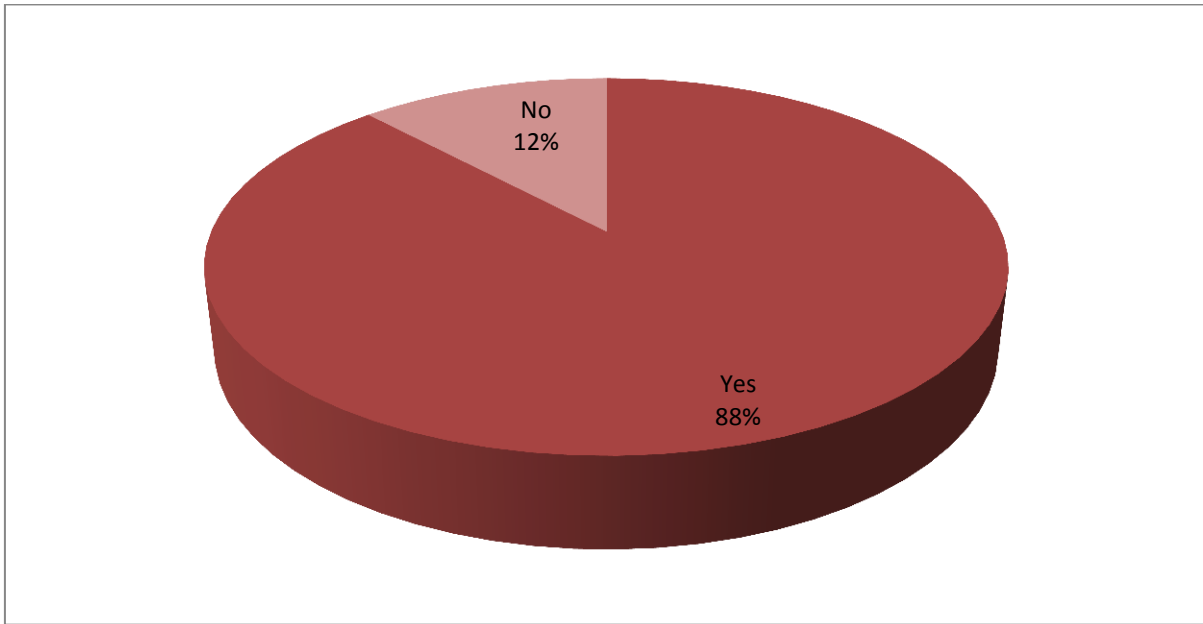
Figure (4.2): distribution of study group according to **Exercise**
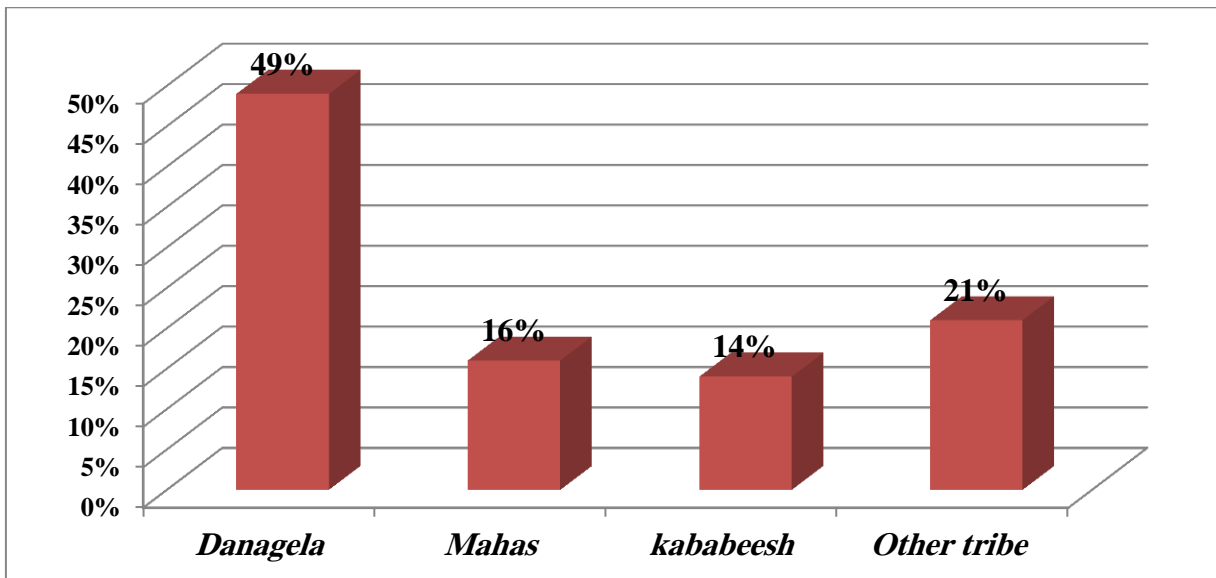
Figure (4.3): distribution of study group according to **Tribe**.
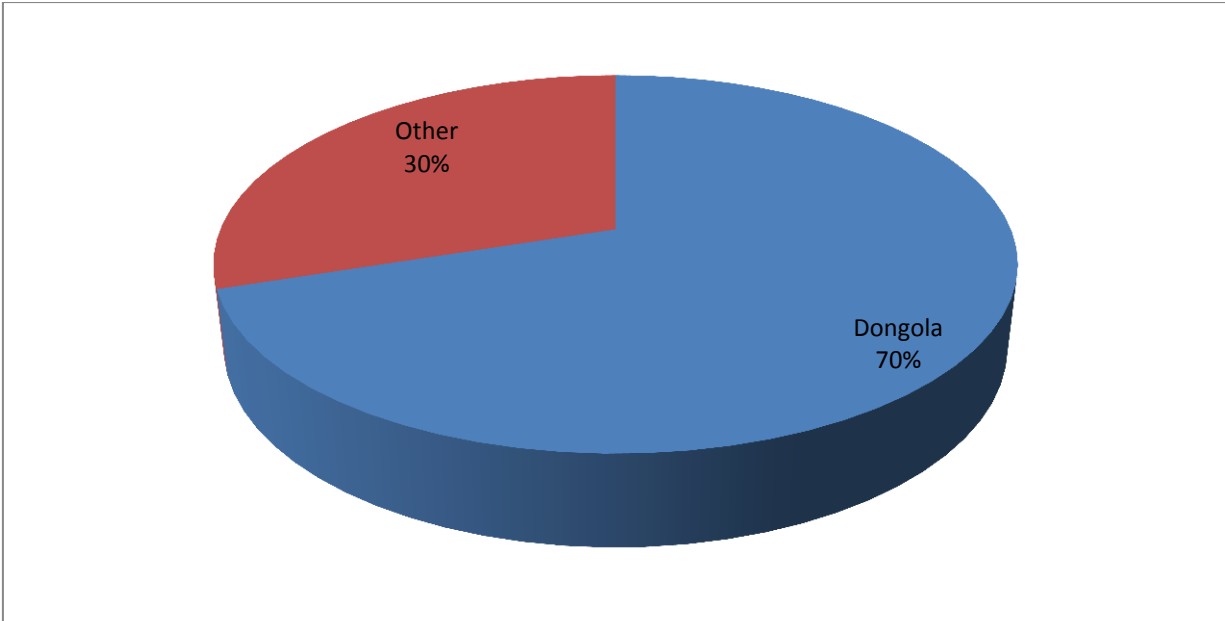
Figure (4.4): distribution of study group according to **location.**

Table (4.1): distribution of study group according to **Smoking status.**

Variable	Frequency	Percentage (%)
Yes	2	2.0
No	98	98.0
Total	100	100.0

Table (4.2): comparison mean of study parameters with normal range.

Parameters	Mean±SD	R.V	*P-value*
HB (g/dl)	13.8±1.3	15.5 (13.5-17.5)	0.000
PCV (%)	45.1±5.5	46 (38 -54)	0.094
RBCS (ul)	5.1±0.5	5 (4.2-5.8)	0.003
WBC (ul)	6.7±2.4	6.5 (3.5-9.5)	0.497
MCV (fl)	86.7±6.8	90 (80-100)	0.000
MCH (pg)	29.8±14.4	29.5 (27-32)	0.904
MCHC (g/dl)	31.9±1.4	34 (32-36)	0.000
PLt (ul)	258.4±61.1	275 (150-400)	0.008
RDW-CV (%)	13.8±3.3	13 (11.5-14.5)	0.011

Table (4.3): distribution of study parameters among study population:

Variable	Frequency	Percentage (%)
HB		
Normal	65	65
Low	35	35
PCV		
Normal	94	94
High	2	2
Low	4	4
RBC		
Normal	95	95
High	4	4
Low	1	1
WBC		
Normal	84	84
High	8	8
Low	8	8
MCV		
Normal	94	94
Low	6	6
MCH		
Normal	80	80
Low	20	20
MCHC		

Normal	62	62
Low	38	38
PLt		
Normal	96	96
Low	4	4
RDW.CV		
Normal	87	87
High	13	13
Total	**100**	**100**

Table (4.4): Frequency and percentages of Blood Morphology

Variable	Frequency	Percentage (%)
Normocyic normochromic	83	83.0
Microcytic hypochromic	5	5.0
Normocytic normochromic with mild hypochromia	12	12.0
Total	100	100.0

Chapter Five

Discussion

Chapter Five

Discussion

In spite of applied WHO criteria for blood donors in blood bank center, a lot of donors are deferred for the reasons of manual method for hemoglobin estimation not accurate and automation method is expensive and then found low HGB and RBC indices duo to found some anaemic cases also some abnormality in other parameters therefore this study was done in 100 blood donors attending to central blood bank in Dongola City North Sudan, after lab diagnosis made in this donors sample and then the result analysis by SPSS method it was found ,the age of majority of study group (70%)less than 30 years and (30%) more than 30 years. According to exercise the study group were distributed, 88% have exercise and 12% no exercise. According to tribe 49%Danagela, 16% Mahas, 14% Kababeesh, and 21% others tribes. Their distribution according to location 70% Dongola locality and 30% in other localities. Majority of participant no smokers 98%, 2% smokers. Hb mean13.8gldl±1.3 with minimum value13.5g/dl and maximum value17.5g/dl, 65%with in normal value and 35%low Hb level. That mean more than half of donor (65) within normal value this result agree with study done by Elnour *et al* in White Nile state in Sudan 55% of participant were in normal value. PCV mean45%±5.5 (38-54) %, normal PCV94%, high 2%, low4%. [40] Majority of donor's normal PCV value also re simple of Elnour *et al* study. [40] RBC mean 5.5ul±0.5 (4.2-5.8) ul, normal95%, high 4%, low1 %. WBC mean 6.7ul±2.4 (3.5-9.5) ul, normal 84%, high8%, low 8% .WBC and RBC also similar to Elnour *et al* study but in Elnour *et al* study not found WBC high than normal.[40] MCVmean86.7fl±6.8 (80-100) fl, normal 94%, low 6%.MCH mean29.8pg±14.4 (27-32) pg, normal 80%, low 20%. MCV and MCH

resemble to Abbas *et al* study.[41] and inconsistent with Elnour *et al* study[40] MCHC mean31,9g/dl±1.4(32-36)g/dl, normal 62%, low 38% this study contrast to Elnour *et al* study.[40] PLt mean258.4ul±61.1 (150-400) ul, normal 96%, low 4%. PLt in this study agree with Elnour *et al* study. [40] But in this study not found PLt higher than normal. RDW-CV mean13.8%±3.3 (11.5-14.5) %, normal 88%, high 12%. Not found RDW measurement in previous studies done for evaluation of blood donors. RDW in heterozygous B- thalassemia the cells are uniformly small (low MCV, RDW) tend to be normal, whereas in iron deficiency anisocytosis increase RDW may be first laboratory abnormality, even before anemia and microcytosis[23] are seen. In blood morphology show normocytic normochromic in 83% donor, microcytic hypochromic in 5%,and normocytic normochromic with mild hypochromia in 12% of donors. Blood morphology of this study agree with morphology of Elnour *et al* study.

Chapter six
Conclusion and Recommendations

Chapter Six

6.1 Conclusion

This study was done to evaluate of blood donors attending in central blood bank in Dongola City, blood samples were diagnosis by using (B3000 Plus Mindray) automated haematoanalyzer, some abnormal result in CBC parameters, were detected especially HGB and RBC indices, although the HGB result done by hemoglobin cyanide method was normal, low PLt count and some leucocytosis and mild leucopenia. The screening HGB level by manual or hemoglobin cyanide method not accurate and doesn't reflect the full haematological status of blood donors.

6.2 Recommendation

Full blood count should be incorporation in evaluating blood donors to insure both good quality of blood and safety of donors. Also peripheral blood smears should be done and other test must be done to differentiate types of anemias like ferritin and transferin and TIBC and HB A2 to differentiate iron deficiency anemia and thalassaemia.

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Appendix

Appendix I
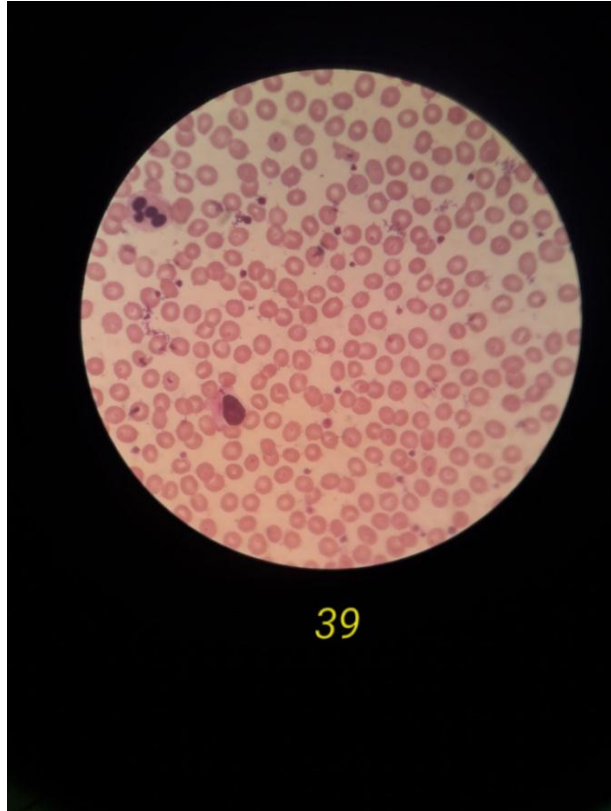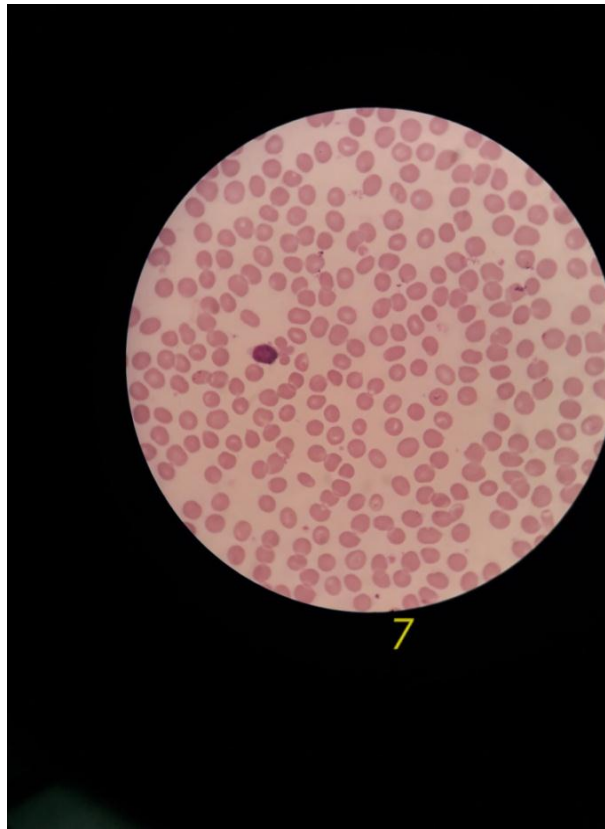
Normocytic Normochromic

Appendix II

34

5
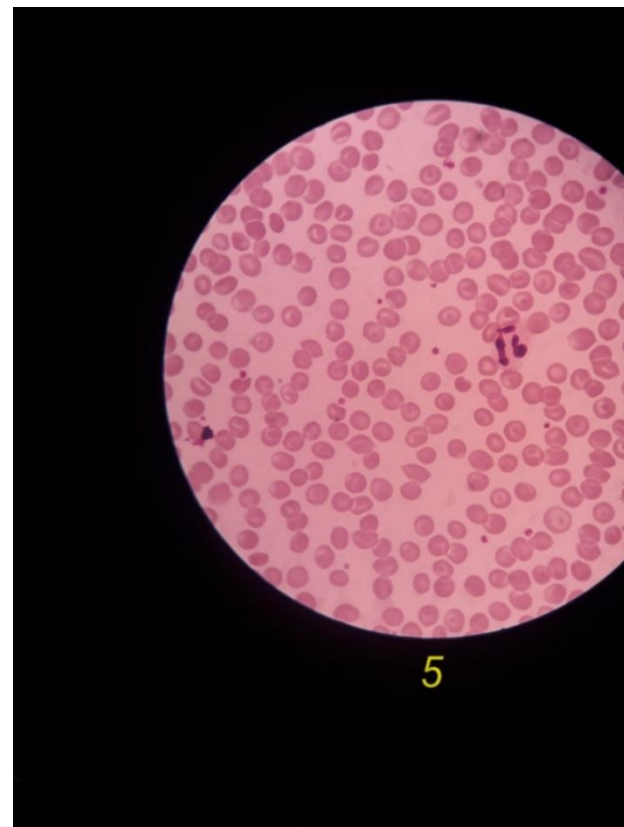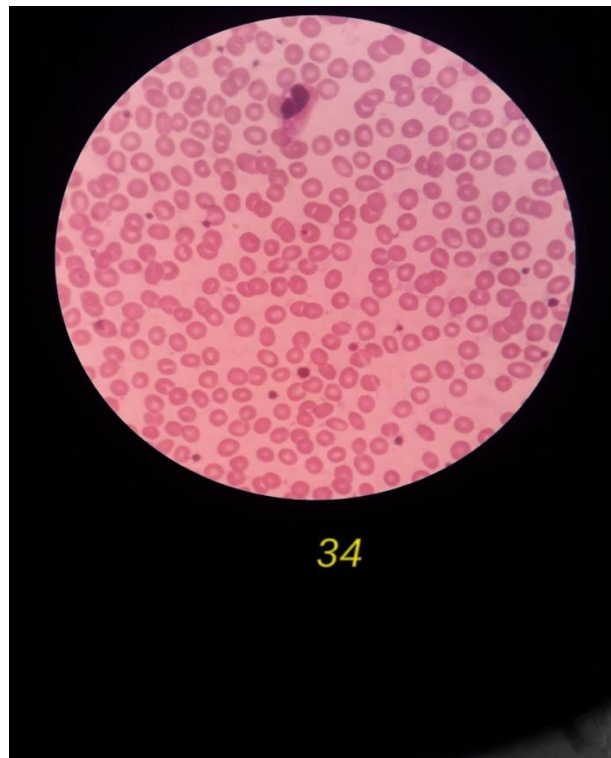
Normocytic Normochromic with mild hypochromia

With some target cell in slide number 5

AppendixIII
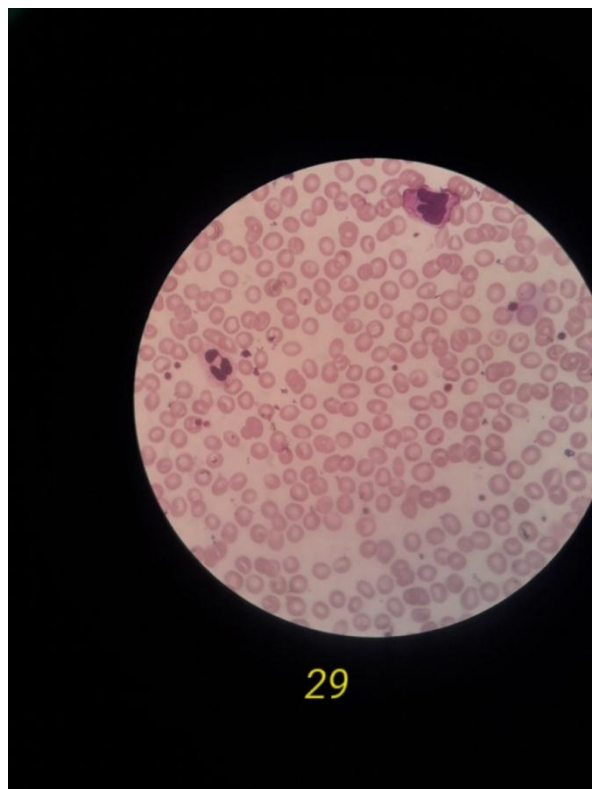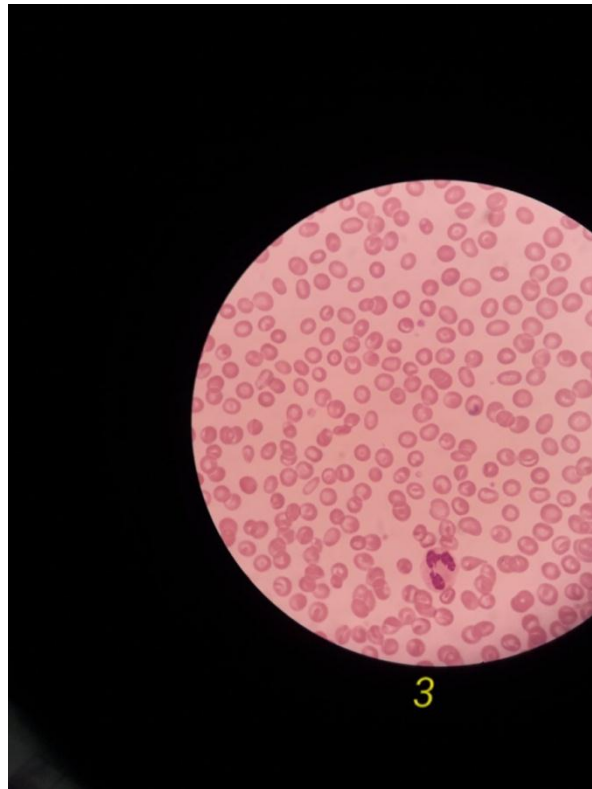
Michrocytic Hypochromic

Also found some target cells in slide number 3

Appendix IV
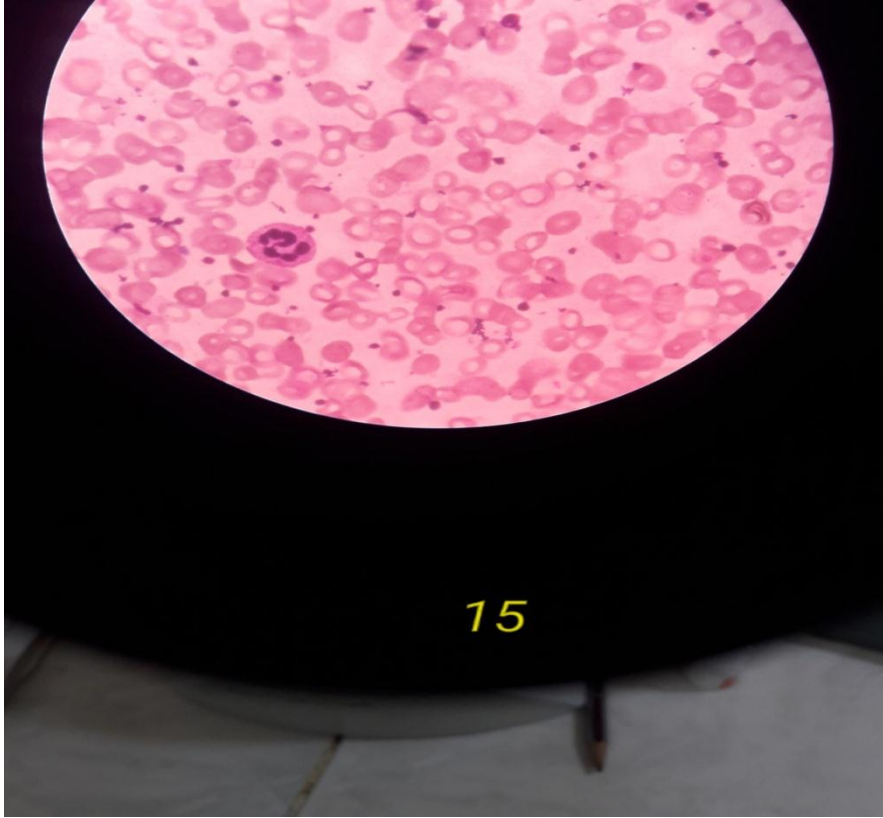
Severe Hypochromia

In each abnormal pictures I recommended for further investigation must be done to differentiate between iron deficiency and thalassemia

Appendix V

BC-3000Plus

Analizador automático para hematología

Appendix VI

بسم الله الرحمن الرحيم

Shandi University

Questionnaire Form:-

Date of enrolment:-

Record number ( )   Place of data collection: ……………………….

Sex: Male   ( )   Female ( )

Age: (   ) Years.   Tribe:…………………………………………..

Original residence: …………………………….....................................

Current residence: …………………………………………………………

Lifestyle:-

- Nutrition ……………….…..

-Exercise …………………………………………………......................

-Smoking: No (   ) ,   Yes (   ).

-Alcohol intake: No (   ),   Yes (   ).

-Surgery and previous transfusions No (   ), Yes (   ).

-Did you donate blood recently? No (   ), Yes (   ).

If yes last time of donate ………………………………………….

Lab diagnosis:

HB%: ...., PCV%: ……………...............%.

RBCs: ………………ul, WBC: ……………………ul.

MCV……..f l, MCH: …………pg, MCHC: …………g/dl.

Plt count: ……………..ul , RDW-CV …………….

Peripheral blood picture:

…………………………………………………………………………………

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………………………………………………………………………………...

Final report:

…………………………………………………………………………………

…………………………………………………………………………………

Appendix VII

بسم الله الرحمن الرحيم

موافقة المتبرع:-

Donor Consent:-

أنا ....

Donor Name ....

I have answered all questions accurately , and I understand ,confirm the blood donation process accomplish in safe and clean ,sterile environment and equipment

I consider my blood safe for transfusion to patient.

تم الإجابة على كل الأسئلة التي تخصني كمتبرع بالدم وأؤكد أن عملية التبرع بالدم تتم بصورة آمنة في بيئة آمنة ونظيفة ومعقمة واقر بان الدم امن للنقل للمتبرع.

Iam aware that my blood will be screened for , among other HIV, Hepatitis B, Hepatitis C and Syphilis . If any of these tests give reactive result I will be contacted using the information I have provided and offered counseling.

أنا مدرك أن دم المتبرع يخضع لاختبارات فيروس الايدز وفيروس الكبد الوبائي بي وفيروس اليرقان سي والزهري وعند وجود أي تفاعل في احدي هذه الاختبارات يجب أن أقدم نفسي لقسم الإرشاد النفسي .

توقيع المتبرع.. Donor Signature ....

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بسم الله الرحمن الرحيم

موافقة المتبرع:-

Donor consent:-

أنا ....

Donor Name ....

I have answered all questions accurately , and I understand ,confirm the blood donation process accomplish in safe and clean ,sterile environment and equipment

I consider my blood safe for transfusion to patient.

تم الإجابة على كل الأسئلة التي تخصني كمتبرع بالدم وأؤكد أن عملية التبرع بالدم تتم بصورة آمنة في بيئة آمنة ونظيفة ومعقمة واقر بان الدم امن للنقل للمتبرع0

Iam aware that my blood will be screened for , among other HIV, Hepatitis B, Hepatitis C and Syphilis . If any of these tests give reactive result I will be contacted using the information I have provided and offered counseling.

أنا مدرك أن دم المتبرع يخضع لاختبارات فيروس الايدز وفيروس الكبد الوبائي بي وفيروس اليرقان سي والزهري وعند وجود أي تفاعل في احدي هذه الاختبارات يجب أن أقدم نفسي لقسم الإرشاد النفسي .

توقيع المتبرع:-.. Donor Signature ....

Appendix VIII

بسم الله الرحمن الرحيم

جامعــــــة شـــــندي

كلية الدراسات العليا والبحث العلمي

مركز الخرطوم

| التاريخ : ٢٠١٨/٣/١م | النمرة : ج ش/ك د ع /م خا/١ |

إلى من يهمهم الأمر ببنك الدم المركزي -دنقلا – الولاية الشمالية

المحترمين

السلام عليكم ورحمة الله وبركاته

<u>الموضوع : الطالبة/اكرام عبدالغفار صديق عائم</u>

بالإشارة إلى الموضوع أعلاه نفيدكم بأن الطالبة المذكورة من ضمن طلاب الكلية بالفصل الدراسي الرابع – ببرنامج ماجستير علوم المختبرات الطبية –أمراض الدم، وهي بغرض توزيع استبانة لدراسة الحالة لبحث التخرج والذي عنوانه :

Evaluation of RBCs count & indicies in Doner refered to central blood bank in Dongola city in north of Sudan .

نرجو منكم تيسير مهمتها البحثية ،

ولكم فائق الشكر والتقدير،،،،

الصادق أحمد عبدالقادر

مسجل المركز

Appendix IX

بسم الله الرحمن الرحيم

الولاية الشمالية وزارة الصحة

الإدارة العامة للتخطيط الصحي

إدارة البحوث

التاريخ: 2018/3 26

شهادة موافقة

1/ اسم الباحث .... ابراهيم سيد العقاب ....

2/ عنوان البحث :

Evaluation of full blood count in Donors
Referred to central blood bank in dangola

3/ الجامعة .... جامعة شندي ....

4/ الكلية .... المختبرات الطبية ....

بعد الإطلاع على ال ـتندات المقدمة من الباحث تمت الموافقة الأخلاقية من لجنة أخلاقيات البحوث بالوزارة علي البحث المقدم .

رئيس اللجنة :. خالد عبد الرحيم عبد الكريم   مقرر اللجنة :. د.هيام د.أ.عبد الواحد عام

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Appendix X

بِسْمِ اللهِ الرَحْمنِ الرَحِيم

الولاية الشمالية – وزارة الصحة

الإدارة العامة للتخطيط الصحي

إدارة البحوث

التاريخ 26/7/2018م

الأخ/............ جرجس بتل المرم المركزي كي ....

السلام عليكم ورحمة الله

الموضوع/ بحث بعنوان Evaluation of full blood counts in donors Referred to central blood bank

إشارة إلى الموضوع أعلاه نرجو التكرم بمد الباحث :-
....

بالمعلومات المطلوبة لمساعدته في إكمال البحث

وجزاكم الله خيراً

خالد عبد الغني حكم المكر
مدير الإدارة العامة للتخطيط الصحي

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