



**Sudan University of Science and Technolog**

**College of Graduate Studies**

# Measurement Of Complete Blood Cell Count Of Sudanese Pregnant women During First Trimester at Omdurman Health Centers

# قياس تعداد الدم الكامل لدى السودانيات الحوامل خلال الثلاثة أشهر الاولي من الحمل في المراكز الصحية بامدرمان

Dissertation submitted in Partial Fulfillment of the Requirement for the M.Sc Degree in Medical Laboratory Science (Hematology and Immunohematology)

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# الايــه

اللَّهُ لاَ إِلَـهَ إِلاَّ هُوَ الْحَيُّ الْقَيُّومُ لاَ تَأْخُذُهُ سِنَةٌ وَلاَ نَوْمٌ لَّهُ مَا فِي السَّمَوَاتِ وَمَا فِي الأَرْضِ مَن ذَا الَّذِي يَشْفَعُ عِنْدَهُ إِلاَّ بِإِذْنِهِ يَعْلَمُ مَا بَيْنَ أَيْدِيهِمْ وَمَا خَلْفَهُمْ وَلاَ يُحِيطُونَ بِشَيْءٍ مِّنْ عِلْمِهِ إِلاَّ بِمَا شَاء وَسِعَ كُرْسِيُّهُ السَّمَاوَاتِ وَالأَرْضَ وَلاَ يَؤُودُهُ حِفْظُهُمَا وَهُوَ الْعَلِيُّ الْعَظِيمُ ﴿٢٥٥﴾

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## *Dedication*

***Lovely parent***

***Husband&children***

***Brothers, sisters***

***Teachers***

***Friends..***

***This is just showing yours how much we really appreciate that you have done and what yours are currently doing for us.***

***Yours are truly some ones who are so so so special to us and yours continue to help us in life with every thing that do.***

***That's why this dedication is to just tell yours plain and simple***

***Thank you.***

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# Abstract

This is a case control study, conducted in Omdurman locality from February to June 2015, to determine CBC values of pregnant women at first trimester. Eighty pregnant women as cases and forty non pregnant women as controls. Pregnant women were informed about the study and agreed for participation. A questionnaire was designed to collect demographic data about the study group, tow and half ml EDTA venous blood was taken and analyzed automatically (Sysmex KX – 21N) to measure CBC, the data was analyzed using SPSS computer programme.

The results indicated that: in pregnant woman the Hct(35.0±4.2%), MCV(81.1±6.90fl) increase significantly (p.value0.0,0.0 respectively) while MCHC(34.2±1.95%), MPV(9.5±1.20fl) decease significantly (p.value0.00, 0.03 respectively), RDWSD(40.5±5.93fl), TWBCs ($7.3\pm2.7\times10^9$/L), neutrophil absolute ($4.6\pm2.8\times10^9$/L), platelet count ($276\pm71.2\times10^9$/L), PDW(13.2±2.65) increase insignificantly (p.value 0.1, 0.6, 0.8, 0.8,0.4 respectively) Hb (12.0±1.41g/dl), RBCs ($4.36\pm0.53\times10^{12}$/L), MCH(27.4±2.51pg), lymphocytes percentage(33.5±12.9%),neutrophils percentage (58.6±13.6%) decease insignificantly (p.value0.7,0.9,0.9,0.6,0.4) but there is no difference in lymphocytes absolute ($2.2\pm0.86\times10^9$/L) compared to control.

Supplementation intake and regular clinical follow up during pregnancy significantly increase Hct, MCV, MCH, PDW and MPV ($p\leq 0.01$); however, history of abortion and duration of pregnancy did not significantly affect CBC.

We concluded that there was significant increased in Hct, MCV (P=0.00) and significant decreased in MCHC and MPV (P=0.00) in pregnant women when compared with non-pregnant control.

# مستخلص البحث


اجريت هذه الدراسة بطريقة الحالات الإفرادية المقترنة بحالات ضابطة في محلية امدرمان في الفترة من فبراير 2015 إلي يونيو2015 لقياس صورة الدم الكاملة عند النساء الحوامل خلال الثلاثة أشهر الأولى من الحمل. تم إختيار ثمانين من النساء الحوامل و اربعين امراه من غير الحوامل وفقا لنظام الاختيار المحدد بعد اخذ موافقتهن تم اخذ عينه دم وريديه (2.5 مل)من كل متبرعه ووضعت في اناء يحتوي علي مانع للتجلط(EDTA) وتم اختبارها لقياس صوره الدم الكامله باستخدام جهاز تحليل الدم الالي ثم تحليل النتائج .

اظهرت النتائج أن: هنالك زيادة ذات دلالة معنوية عند النساء الحوامل مقارنه بغير الحوامل في الدم المكدس (2.4± 35.0%)، متوسط حجم الخلية الحمراء (81.1±6.90 fl) ونقص ذات دلالة معنوية في تركيز خضاب الدم في 100 مل من الدم (% 1.95± 34.2 ) و متوسط حجم صفيحة الدم الواحدة( 9.5±1.20 fl) ، وزيادة غيرمعنوية في انتشار الخلايا الحمراء (5.93 ±40.5)، عدد كرات الدم البيضاء( $10^9$/L× 2.70 ±7.3) العدد المطلق للخلايا العدله($10^9$/L× 2.8 ± 4.6)، عدد صفائح الدم ($10^9$/L×71.2± 276) متوسط حجم صفيحة الدم الواحدة (13.2±2.65fl) ونقص ذات دلالة غيرمعنوية في متوسط خضاب الدم (1.41±12.0 g/dl)، عدد كرات الدم الحمراء($10^{12}$/L× 0.53 ±4.3) ، متوسط تركيز خضاب الدم في الخلية الواحدة (27.4±2.51pg) ، النسبة المئوية للخلايااللمفاوية (12.9%±33.5)، النسبة المئوية للخلايا العدلة( 13.6%±58.6) ، لايوجد فرق في العدد المطلق للخلايا اللمفاوية 0.86±($10^9$/L×2.2).

وزيادة غيرمعنوية في انتشار الخلايا الحمراء ، النسبة المئوية للخلايا اللمفاوية العدد المطلق للخلايا اللمفاوية ،عدد صفائح الدم، متوسط حجم صفيحة الدم الواحدة وانتشار صفائح الدم، عند النساء اللاتي تعرضن للإسقاط مقارنة باللاتي لم يتعرضن للاسقاط. وهنالك زيادة ذات دلالة معنوية في الدم المكدس و متوسط تركيز خضاب الدم في الخلية الواحدة ومتوسط حجم صفيحة الدم الواحدة وانتشار صفائح الدم عند النساء اللاتي يتابعن بطريقه منتظمه مقارنه بالاتي لا يتابعن بانتظام . و زيادة ذات دلالة معنوية في الدم المكدس ، متوسط حجم الخلية الحمراء و النسبة المئوية للخلايا العدلة عند النساء اللاتي يتناولن فيتامين مقارنه بالاتي لا يتناولن فيتامين.


# Abbreviations

| | |
|---|---|
| CD | Cluster of differentiation |
| CFU-GEMM | Colony forming unit that generates myeloid cells |
| CV | Coefficient of variation |
| DMT-1 | Divalent metal transporter |
| DVT | Deep venous thrombosis |
| DNA | Deoxyribonucleic acid |
| EDTA | Ethylene-diamine-tetra acetic acid |
| EPO | Erythropoietin |
| GM-CSF | Granulocyte macrophage colony stimulating factor |
| Hb | Hemoglobin |
| HCG | Human chorionic gonadotropin |
| HCP-1 | Haem carrier |
| Hct | Haematocrit |
| IF | Intrinsic factor |
| IL | Interlukin |
| MCH | Mean cell hemoglobin |
| MCHC | Mean cell hemoglobin concentration |
| MCV | Mean cell volume |
| MPV | Mean platelet volume |
| PCV | Packed cell volume |
| PE | Pulmonary embolism |
| RBC | Red blood cell count |
| RDWSD | Red cell distribution width by standard deviation |
| SCF | Stem cell factor |
| TC | Transcobalamin |
| TGF | Tumor growth factor |

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| TIBC | Total iron-binding capacity |
| WBC | White blood cell count |

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# Introduction and Literature Review

## 1.1 Introduction

Pregnancy is the time during which one or more offspring develops inside the uterus. A multiple pregnancies involve more than one offspring, such as with twins. It usually last around 40 from the last menstrual period (LMP) and ends in childbirth. This is about 38 weeks after conception. An embryo is the developing offspring during the first 8 weeks following conception after which the term fetus is used until birth (Abman , 2011).

Normal pregnancy is characterized by profound changes in almost every organ and system to accommodate the demands of fetoplacental unit. A pregnancy is influenced by many factors, some of which include culture, environment, socioeconomic status, and access to medical care **(**Yip, 2000).

Most pregnant women experience a number of symptoms, which can signify pregnancy which include nausea and vomiting, excessive tiredness and fatigue, cravings for certain foods that are not normally sought out, and frequent urination particularly during the night **(**Yip, 2000).

During pregnancy, the woman undergoes many physiological changes, which are entirely normal, including cardiovascular, hematologic, metabolic, renal and respiratory changes that become very important in the event of complications. The body must change its physiological and homeostatic mechanisms in pregnancy. Levels of progesterone and oestrogens rise continually throughout pregnancy, suppressing the hypothalamic axis and subsequently the menstrual cycle (Ornoy and Ergaz , 2010).

There are many hematological changes during pregnancy such as; increases in plasma volume by 50% and the red blood cell volume increases only by 20-30%.Consequently, the hematocrit decreases due to the dilution. The white blood cell count increases and may peak at over 20 mg/mL in stressful conditions. Conversely, there is a decrease in platelet concentration to minimal normal values of 100-150 mil/mL (Guyton and hall, 2005).There is increase demand for $Fe^{++}$ and folic acid.

The result of the study could be a base line data about CBC of pregnant Sudanese woman at first trimester, since few data are available in Sudan

## 1.2 Literature Review

### 1.2. 1Hematopoiesis

All blood cells develop from haemocytoblasts the process is called haematopoiesis. Haemocytoblasts are also known as pluripotential stem cells. These cells can replicate themselves as well as differentiate into other cells, thus providing the constant supply of blood cells. The turnover of cells is very quick: Red blood cells have a lifecycle of about 120 days, platelets have a lifecycle of about 7 days and Granulocytes have a lifecycle of only about 7 hours (Kawamoto *et al*., 2010).

Approximately $10^{13}$ new myeloid cells (all blood cells excluding lymphocytes) are produced each day. Although the liver and spleen produce blood cells during gestation (from about 6 weeks to 7 months), the bone marrow is the only place in which production can occur in adults and children (Kawamoto *et al*., 2010).

Pathological circumstances can cause blood cell production to switch back to the liver and spleen. Such an occurrence is known as extra-medually haemopoiesis

Throughout production of the cells, the cells need to receive various growth factors at the right stage in their development. Cells at different stages of development will express different surface receptors for the different growth factors. These factors include IL-3, IL-6, IL-7, IL-11, and SCF. There are also some factors that inhibit growth, to keep it under control; these include TNF, TGF-β (Fernandez and Alarcon, 2013).

The development of the haemopoietic system is associated with the development of suitable microenvironments, which are colonized by migrating stem cells. These processes probably involve specific recognition and adhesive interactions between the stem cells and cells of the various microenvironments. Following the development of

the circulation, stem cells can migrate into the embryo where they sequentially seed the liver, spleen and bone marrow (Hoffbrand *et al.*,2005).

At birth, haemopoietic activity is distributed throughout the human skeleton but it gradually recedes with time so that in normal adult life haemopoiesis is found mainly in the sternum and pelvis, with small amounts in other bones like the ribs, skull and vertebrae, small number of stem cells are present in the circulation of normal adult humans. This number increases physiologically in some circumstances, such as following exercise and during infections, and may be increased pharmacologically by administration of haemopoietic growth factors and/or cytotoxic chemotherapy (Hoffbrand *et al.*, 2005).

#### 1.2.1.1 Red blood cell production (erythropoiesis)

This occurs entirely in the red bone marrow. Red marrow can be found in vertebrae, ribs, skull, sternum, scapula, and proximal ends of the limb bone. Red marrow is also known as myeloid tissue. It is not generally found in other areas of the long limb bones; which are instead filled with fatty yellow marrow. However, during extreme times, the marrow in these areas can switch to become red marrow. During childhood, red marrow is far more extensive (Fernandez and Alarcon, 2013).

The haemocytoblast, in the presence of Multi-CSF, will develop into a Progenitor cell. These cells will go on to form all types of blood cell, except Lymphocytes. In the presence of EPO, the progenitor cell will become a proerythroblast, basophilic erythroblast, polychromatophilic erythroblast, then a normoblast, which will then eject its nucleus, and become a reticulocyte which enters circulation just before their maturation occurs then finally becoming a fully formed RBC (Fernandez and Alarcon, 2013).

In the erythrocyte count test the number of red cells is given as an absolute number per litre , the red cell count was estimated visually in a haemocytometer on diluted samples of blood. (Dacie and Lewis ,2011).

Hemoglobin (HB) synthesis requires the coordinated production of heme and globin. Heme is the prosthetic group that mediates reversible binding of oxygen by hemoglobin. Globin is the protein that surrounds and protects the heme molecule. Heme is synthesized in a complex series of steps involving enzymes in the mitochondrion and in the cytosol of the cell. Deranged production of heme produces a variety of anemias such as Iron deficiency. A number of drugs and toxins directly inhibit heme production by interfering with enzymes involved in heme biosynthesis most commonly lead particularly in children. Two distinct globin chains combine to form hemoglobin. One of the chains is designated alpha. The second chain is called non-alpha. The fetus has a distinct non-alpha chain called gamma. After birth beta, pairs with the alpha chain. The combination of two alpha chains and two non-alpha chains produces a complete hemoglobin molecule. The hemoglobin tetramer, which is the functional form of hemoglobin have a complex biophysical characteristics that permit the control of oxygen uptake in the lungs and release in the tissues that is necessary to sustain life (Franklin and Bernard , 1987).

Various methods are available for estimation of hemoglobin in the laboratory; methods based on development of color, measurement of oxygen combining capacity and measurement of iron content. The amount of hemoglobin in the blood, expressed in grams per deciliter. A low level of Hemoglobin is a sign of anemia (David , 2012).

Hemoglobin concentration values in pregnancy: 1st trimester 124–135 g/l, 2nd trimester 110–117 g/l, 3rd trimester 106–109 g/l, 120 g/l or higher may be found when supplementary iron is being given (Dacie and Lewis, 2011).

Haematocrit or packed red cell volume refers to the proportion of the volume of red cells relative to the total volume of the blood. It is determined by multiplying the red cell count by the mean cell volume. The hematocrit is slightly more accurate as the PCV includes small amounts of blood plasma trapped between the red cells, Normal range 36-45% (Guyton and hall, 2005).

Red cell indices measure the size, shape, and physical characteristic of the red blood cell. They include MCV, MCH and MCHC.

Mean corpuscular volume (MCV) was formerly determined by dividing the total volume of red cells by the number of red cells in that particular sample of blood.

A subnormal MCV is indicative of microcytosis, and an elevated MCV indicative of macrocytosis, normal value is80-100FL. (Ciesla , 2007).

Mean corpuscular hemoglobin per red cell (MCH) is estimated by dividing the total amount of hemoglobin by the number of red cells in a sample of blood.

The normal value is 27 to 31 pg. (Ciesla , 2007).

Mean corpuscular hemoglobin concentration is derived by dividing the concentration of hemoglobin in g/ dl by the volume of red cells in mg/dl. The result is expressed in g hemoglobin/dl packed red cells, normal value is 32% to 36 %( Ciesla , 2007).

Red cell distribution width (RDW) is derived from pulse height analysis and can be expressed either as the standard deviation (SD) in fl or as the coefficient of variation (CV) (%) of the measurements of the red cell volume. The RDW SD is measured by calculating the width in fl at the 20% height level of the red cell size distribution histogram and the RDW CV is calculated mathematically as the coefficient of variation, i.e. RDW (CV) % ¼ 1SD/MCV 100%. The normal reference range is in the order of 12.8 ±1.2% as CV and 42.5 ±3.5 fl as SD. (Dacie and Lewis, 2011).

**1.2.1.2 Granulopoiesis**:

The white blood cells (leucocytes) may be divided into two broad groups: The phagocytes and the immunocytes. Granulocytes, which include three types of cell-

neutrophils (polymorphs), eosinophils and basophils-together with monocytes comprise the phagocytes.

Neutrophil (polymorph);This cell has a characteristic dense nucleus consisting of between two and five lobes, and a pale cytoplasm with an irregular outline containing many fine pink-blue (azurophilic) or grey-blue granules.

The lifespan of neutrophils in the blood is only6-10h (Hoffbrand *et al*., 2006).

Lymphocytes; slightly larger than RBC's and do not generally contain visible granules. They generally have a large round nucleus, and a 'halo' of cytoplasm, account for 20-30% of the circulating WBC's.

There are 3 types of lymphocyte, T cells; are responsible for cell-mediated

B cells; produce antibodies.

NK; these detect and destroy abnormal native cells, protecting against cancer.

Dendritic cells; are antigen presenting cells (Kawamoto *e tal*., 2010).

Eosinophils; Account for 2-4% of circulating WBC's, capable of engulfing bacteria and responsible for an allergic reaction

Basophils; account for less than 1% of circulating WBC's, enhance the local inflammation that has already been started by mast cells and release chemotaxic agents to attract eosinophils and other basophil (Kawamoto, *et al*.2010).

Monocytes; They account for 2-8% of circulating WBC's remain in the blood only for a maximum of 24 hours, before migrating to tissues to become macrophages. Macrophages are aggressively phagocytotic (Kawamoto, *et al*.2010).

Differential WBC Counts are performed on diluted whole blood in which red cells are either lysed or are rendered transparent. A three-part differential count was categorized leucocytes as WBC-small cell ratio (equivalent to lymphocytes), WBC-middle cell ratio (equivalent to monocytes, eosinophils and basophils) and WBC-large cell ratio (equivalent to neutrophils), Normal differential count neutrophils 40-

80 %, lymphocytes 20-40 %, monocytes 2-10 %, eosinophils 1-6 % and basophils < 1-2% (Dacie and Lewis, 2011).

**1.2.1.3 Thrompopoiesis:**

Platelets are produced in the bone marrow by fragmentation of the cytoplasm of megakaryocytes, one of the largest cells in the body. The precursor of the megakaryocyte-the megakaryoblast-arises by a process of differentiation from the haemopoietic stem cell. The megakaryocyte matures by endomitotic synchronous replication enlarging the cytoplasmic volume as the number of nuclear lobes increase in multiples of two. Very early on invaginations of plasma membrane are seen, each megakaryocyte giving rise to 1000-5000 platelets. The time interval from differentiation of the human stem cell to the production of platelets averages approximately 10 days. Thrombopoietin is the major regulator of platelet production and is constitutively produced by the liver and kidneys. Thrombopoietin increases the number and rate of maturation of megakaryocytes via c-Mpl receptor. Platelet levels start to rise 6 days after the start of therapy and remain high for 7-10 days. The normal platelet count is approximately 250 x 109/L (range 150-400 x 109/L) and the normal platelet lifespan is 7-10 days (Hoffbrand *et al*., 2006).

Mean platelet volume and platelet distribution width; MPV is the average volume of individual platelets derived from the Plt histogram. It represents the mean volume of the Plt population under the fitted Plt curve multiplied by a calibration constant, and expressed in femtoliters. The MPV is lower than predicted when thrombocytopenia is caused by megaloblastic anemia or bone marrow failure an increase in MPV has been observed in patients at risk of and following myocardial infarction and cerebral infarction. PDW is a measure of platelet anisocytosis and the plateletcrit. It is the product of the MPV and platelet count which is seen as indicative of the volume of circulating platelets in a unit volume of blood. A high PDW may indicate peripheral immune destruction of platelets (Dacie and Lewis, 2011).

### 1.2.2 Pregnancy

Pregnancy is typically divided into three trimesters. The first trimester is from week one to twelve and includes conception. The second trimester is from week 13 to 28. The third trimester is from 29 weeks to 40 weeks. Obstetricians define each trimester as lasting for 14 weeks, resulting in a total duration of 42 weeks, although the average duration of pregnancy is actually about 40 weeks (Campbell and Klocke, 2001).

First trimester

The uterus changes in size over the duration of the trimesters Minute ventilation is increased by 40% in the first trimester .The womb will grow to the size of a lemon by eight weeks. Many symptoms and discomforts of pregnancy like nausea and tender breasts appear in the first trimester (Campbell and Klocke, 2001).

Second trimester

Second trimester is from weeks 13 to 28. Most women feel more energized in this period, and begin to put on weight as the symptoms of morning sickness subside and eventually fade away. The uterus, the muscular organ that holds the developing fetus, can expand up to 20 times its normal size during pregnancy (Kieler *et al.*, 1995).

Third trimester

The uterus expands making up a larger and larger portion of the woman's abdomen. During the final stages of gestation before childbirth the fetus and uterus will drop to a lower position (Kieler *et al.*, 1995).

Final weight gain takes place, which is the most weight gain throughout the pregnancy. The woman's abdomen will transform in shape as it drops due to the fetus turning in a downward position ready for birth. (Stacey *et al.*, 2011). Head engagement, where the fetal head descends into cephalic presentation, relieves pressure on the upper abdomen with renewed ease in breathing. It also severely reduces bladder capacity, and increases pressure on the pelvic floor and the rectum.

Also during the third trimester that maternal activity and sleep positions may affect fetal development due to restricted blood flow. For instance, the enlarged uterus may impede blood flow by compressing the lower pressured vena cava, with the left lateral positions appearing to providing better oxygenation to the infant. Trimester is from 29 weeks to 40 weeks (Stacey *et al.*, 2011).

### 1.2.2.1 Physiological change during pregnancy:

Cardiac output increases 30% to 50% in pregnancy. The increase begins at about the sixth week, reaches a maximum about the sixteenth week, declines slightly after the thirtieth week, and rapidly falls off after delivery. It returns to pre pregnancy level about the sixth week after delivery. The stroke volume of the heart increases, and the pulse rate becomes more rapid: Normal pulse rate in pregnancy is approximately 80 to 90 beats/min. Blood pressure may drop slightly after the twelfth week of gestation and return to its usual level after the twenty-sixth week(Ornoy and Ergaz ,2010).

Total blood volume also increases in pregnancy; plasma volume increases more than red cell volume, and these results in a drop in the hematocrit, caused by dilution. The number of white blood cells increases: The normal white blood cell count in pregnancy is often above 15,000/µl (Guyton and Hall, 2005).

Physiological variation in the blood count occurs during pregnancy, The Hb falls, the MCV rises slightly and the WBC and neutrophil count rise. Immature cells (myelocytes and occasional promyelocytes) appear in the blood and there may be ‘toxic 'granulation and Dohle bodies (Bain, 2004).

### 1.2.2.2 Hematological changes associated with pregnancy:

Plasma Volume

Plasma volume increases by 10–15% at 6–12 weeks of gestation, expands rapidly until 30–34 weeks, after which there is only a modest rise. The total gain of

plasma volume at term averages 1100–1600 mL and results in a plasma volume of 4700–5200 mL, 30–50% above that found in nonpregnant women. Plasma volume decreases immediately postpartum, then increases again 2–5 days after delivery, possibly because of a simultaneous rise in aldosterone secretion. Plasma volume then decreases; it is still elevated by 10–15% above nonpregnant levels at 3 weeks postpartum, but is usually at normal nonpregnant levels at 6 weeks postpartum (Bernstein *et al* .,2001).

Red Blood Cells

Red blood cell mass begins to increase at 8–10 weeks of gestation and steadily rises by 20–30% (250–450 mL) above non pregnant levels by the end of pregnancy in women receiving iron supplementation. Among women not on iron supplements, the red cell mass may only increase by 15–20%, erythrocyte life span is slightly decreased during normal pregnancy (Lurie and Mamet, 2000).

Erythropoietin levels increase by 50% in normal pregnancies and vary according to the presence of pregnancy complications .The increased plasma erythropoietin induces the rise in red cell mass, which partially supports the higher metabolic requirement for oxygen during pregnancy. Mean corpuscular volume decreases during pregnancy and averages 80–84 fL in the third trimester (Harstad *et al* .,1992).

White Blood Cells

Pregnancy is associated with leukocytosis, related to increased circulation of neutrophils. The neutrophil count begins to increase in the second month of pregnancy and plateaus in the second or third trimester, at which time the total white blood cell counts ranges from 9000 to 15,000 cells/_L. The white blood cell count falls to the normal non pregnant range by the sixth day postpartum. Dohle bodies (blue staining cytoplasmic inclusions in granulocytes) are a normal finding in pregnant women (Kuhnert *et al*.,1998).

In healthy women with normal pregnancies, there is no change in the absolute lymphocyte count and no significant changes in the relative numbers of T and B lymphocytes. The monocyte count is generally stable; the basophil count may slightly decrease and the eosinophil count may slightly increase. Normal pregnant women can have a small number of myelocytes or metamyelocytes in the peripheral circulation (Kuhnert *et al* .,1998).

Platelet Count

Although platelet counts remain in the normal non pregnant range in most women during uncomplicated pregnancies, mean platelet counts of pregnant women may be slightly lower than in healthy non pregnant women. Serial platelet counts during uncomplicated pregnancies may or may not decrease, but the mean values in these groups do not necessarily reflect both increases and decreases in individual women. The lower limit of normal platelet counts in pregnancy has been reported to be 106,000–120,000 platelets/L (Verdy *et al*., 1997).

The platelet volume distribution width increases significantly and continuously as gestation advances. Thus, with advancing gestation, the mean platelet volume becomes an insensitive measure of the platelet size (Chandra *et al.* 2012).

A pregnant woman will also become hypercoagulable, leading to increased risk for developing blood clots and embolisms, due to increased liver production of coagulation factors, mainly fibrinogen and factor VIII ; this hypercoagulable state along with the decreased ambulation causes an increased risk of both DVT and PE. Women are at highest risk for developing clots, or thrombi, during the weeks following labor. Clots usually develop in the left leg or the left iliac venous system. The left side is most affected because the left iliac vein is crossed by the right iliac artery. The increased flow in the right iliac artery after birth compresses the left iliac vein leading to an increased risk for thrombosis which is exacerbated by the aforementioned lack of ambulation following delivery (McCrory, 2010).

### 1.2.3 Anemia:

Anemia defined as a reduction in the hemoglobin concentration less than 13.5 g/dl in adult males, less than 11.5 g/dl in adult females and less than 14.0 g/dl in newborn. Reduction of hemoglobin is usually accompanied by a fall in red cell count and packed cell volume (PCV). An increase in plasma volume may cause anemia even with a normal total circulating red cell and hemoglobin mass (Hoffbrand *et al*., 2006).

#### 1.2.3.1 Causes of anaemia:

Causes may be classified as impaired red blood cell (RBC) production, increased RBC destruction (hemolytic anemias), blood loss and fluid overload (hypervolemia). Several of these may interplay to cause anemia eventually. Indeed, the most common cause of anemia is blood loss, but this usually does not cause any lasting symptoms unless a relatively impaired RBC production develops, in turn most commonly by iron deficiency (Kumar *et al.*,2007).

#### 1.2.3.2 Clinical feature of anemia:

Symptoms can be related to the underlying cause or the anemia itself. Most commonly, people with anemia report feelings of weakness, or fatigue, general malaise, dyspnea , and sometimes poor concentration. In very severe anemia, the body may compensate for the lack of oxygen-carrying capability of the blood by increasing cardiac output. The patient may have symptoms related to this, such as palpitations, angina (if pre-existing heart disease is present), intermittent claudication of the legs, and symptoms of failure. There may be signs of specific causes of anemia, e.g., koilonychia (in iron deficiency), jaundice (when anemia results from abnormal break down of red blood cells — in hemolytic anemia), bone deformities (found in thalassemia major) or leg ulcers (seen in sickle-cell disease). In severe anemia, there may be signs of a hyperdynamic circulation: tachycardia (a fast heart rate), flow murmurs, and cardiac ventricular hypertrophy (enlargement). There may be signs of

heart failure. Pica, the consumption of non-food items such as ice, but also paper, wax, or grass, and even hair or dirt, may be a symptom of iron deficiency, although it occurs often in those who have normal levels of hemoglobin (Saimak and Nabili, 2009).

### 1.2.3.3 Classification of anemia:

The most useful classification is that based on red cell indices and divides the anemia into microcytic, normocytic and macrocytic As well as suggesting the nature of the primary defect, this approach may also indicate an underlying abnormality before overt anemia has developed.

In normal pregnancy there is a slight rise in MCV, even in the absence of other causes of macrocytosis (e.g. folate deficiency) (Hoffbrand *et al*., 2006).

### 1.2.3.4 Laboratory finding of anemia:

Anemia is typically diagnosed on a complete blood count. Apart from reporting the number of red blood cells and the hemoglobin level, the automatic counters also measure the size of the red blood cells by flow cytometry, which is an important tool in distinguishing between the causes of anemia. Examination of a stained blood smear using a microscope can also be helpful. In modern counters, four parameters (RBC count, hemoglobin concentration, MCV and RDW) are measured, allowing others (hematocrit, MCH and MCHC) to be calculated, and compared to values adjusted for age and sex (Guyton and Hall, 2005).

### .2.4 Common types of anemia associated with pregnancy:

The most commonly experienced types of anemia during pregnancy are:

### 1.2.4.1 Iron deficiency Anemia:

Iron deficiency is the most common cause of anemia in the world. It is the most important cause of a microcytic hypochromic anemia, in which the two red cell

indices MCV and MCH are reduced and this appearance is caused by a defect in haemoglobin synthesis (Hoffbrand *et al*., 2005).

The majority of pregnant women with hemoglobin values of less than 10 g/ dl are suffering from iron deficiency anemia, although frequently there is definite iron deficiency in patients with hemoglobin values above this figure. The demands of previous pregnancies render women especially prone to iron deficiency, particularly when the interval between pregnancies is short. It is not uncommon for multiparous women or women with heavy menstrual loss to become pregnant with either pre-existing iron deficiency anemia or no Iron stores (Firkin *et al*., 1989).

Iron amount and distribution ;The total body iron content of the normal adult varies from 3 to 5 g, depending on the sex and weight of the individual. It is greater in males than in females, and it increases roughly in proportion to body weight. Iron is distributed in the body in several distinct forms (Hoffbrand *et al*., 2005).

Hemoglobin iron; constitutes approximately 60-70 per cent of the total body iron, the absolute amount varying from 1.5 to 3.0 g. Nearly all the iron derived from the breakdown of hemoglobin is released into the circulation bound to the iron binding protein, transferrin, and is re-utilized for hemoglobin synthesis.

Tissue iron; subdivided into: storage or available iron; tissue iron can be readily mobilized from the body tissues for hemoglobin synthesis; and non-available iron, which in general is not available for hemoglobin synthesis.

Storage iron; has been estimated to be about 1000-2000 mg in the healthy adult male, and less in the female (Hoffbrand *et al.*, 2005).

**Iron absorption**

Organic dietary iron is partly absorbed as haem and partly broken down in the gut to inorganic iron. Absorption occurs through the duodenum. Haem is absorbed through a specific receptor, HCP-I (Haem carrier) and then digested to release

iron.The protein DMT-I (divalent metal transporter) is involved in transfer of iron. In iron deficiency less iron is delivered to the crypt cell from transferring which is largely unsaturated with iron. Hepcidin is also a major regulator by affecting ferroportin concentration. Low hepcidin levels in iron deficiency increase ferroportin levels and allow more iron to enter portal plasma (Hoffbrand *et al.*, 2006).

**Causes of iron deficiency anemia**

It can be caused by increased iron demand, loss or decreased iron intake, and can occur in both children and adults. The cause of chronic blood loss should all be considered, according to the patient's sex, age, and history. In babies and adolescents, rapid growth may outpace dietary intake of iron, and result in deficiency without disease or grossly abnormal diet. In women of childbearing age, heavy or long menstrual periods can also cause mild iron-deficiency anemia (Rangarajan *et al.*,2007).

**Clinical features of iron deficiency anemia**

Sign of pallor (reduced oxyhemoglobin in skin or mucous membranes), symptoms of fatigue, lightheadedness, and weakness. Pallor of mucous membranes (primarily the conjunctiva) in children indicates anemia with best correlation to the actual disease. Iron-deficiency must be diagnosed by laboratory testing because iron deficiency tends to develop slowly, adaptation occurs and the disease often goes unrecognized for some time. (Janz *et al.*,2013).

**Laboratory findings in iron deficiency anemia**

Anemia may be diagnosed from symptoms and signs, but when it is mild, it may not be diagnosed from mild nonspecific symptoms.

It can be diagnosed by routine blood tests, include a complete blood count (CBC).A sufficiently low hemoglobin (Hb) by definition makes the diagnosis of anemia, and a

low hematocrit value is also characteristic of anemia If the anemia is due to iron deficiency, the body's iron stores begin to depleted, and red blood cell distribution width (RDW)increased, reflecting an increased variability in the size of red blood cells (RBCs). A low MCV, a low mean corpuscular hemoglobin and/or mean corpuscular hemoglobin concentration, and the appearance of the RBCs on visual examination of a peripheral blood smear narrows the problem to a microcytic anemia (Stephen and Maxine ,2009 ).

A dimorphic blood film is also seen in patients with iron deficiency anemia who have received recent iron therapy and produced a population of new haemoglobinized normal-sized red cells .The platelet count 1t is often moderately raised (Hoffbrand *et al*., 2006).

A definitive diagnosis requires a demonstration of depleted body iron stores obtained by bone marrow aspiration, with the marrow stained for iron give result of low serum ferritin, low serum iron level, an elevated serum transferrin and high total iron binding capacity (Stephen and Maxine ,2009).

**1.2.4.2 Megaloblastic anaemias :**

This is a group of anaemias in which the erythroblasts in the bone marrow show a characteristic abnormality-maturation of the nucleus being delayed relative to that of the cytoplasm. The underlying defect accounting for the asynchronous maturation of the nucleus is defective DNA synthesis (Hoffbrand *et al*., 2006).

Megaloblastic anaemia is characterized by the appearance of morphologically abnormal nucleated red cell precursors called megaloblasts in the bone marrow. Megaloblasts are abnormal in function as wen as in appearance, with the result that the mature red cells formed from them are abnormal in size and shape, the most prominent abnormality being macrocytosis (Firkin *et al* ., 1989).

Vitamin B12, cobalamin absorption and Transport; this vitamin is synthesized in nature by microorganisms; animals acquire it by eating other animal foods, by

internal production from intestinal bacteria (not in humans) or by eating bacterially contaminated foods. The vitamin is found in foods of animal origin such as liver, meat, fish and dairy produce. A normal diet contains a large excess of B12 compared with daily needs. Bl2 is combined with the glycoprotein intrinsic factor (IF) which is synthesized by the gastric parietal cells.

The IF-B12 complex can then bind to a specific surface receptor for IF, cubilin, which then binds to a second protein, amnionless which directs endocytosis of the cubilin. IF-B12 complex in the distal ileum where Bl2 is absorbed and IF destroyed . Vitamin Bl2 is absorbed into portal blood where it becomes attached to the plasma-binding protein transcobalamin (TC, previously called transcobalaminII) which delivers Bl2 to bone marrow and other tissues. Although TC is the essential plasma protein for transferring Bl2 into the cells of the body, the amount of Bl2 on TC is normally very low<50 ng/L). TC deficiency causes megaloblastic anemia because of failure of B12 to enter marrow (and other cells) from plasma but the serum B12.level in TC deficiency is normal. This is because most B12 in plasma is bound to another transport protein, haptocorrin (previously called transcobalamin I).This is a glycoprotein largely synthesized by granulocytes and macrophages. In myeloproliferative diseases where granulocyte production is greatly increased, the haptocorrin and B12 levels in serum both rise considerably. B12 bound to haptocorrin does not transfer to marrow; it appears to be functionally 'dead'. Closely related glycoproteins to plasma haptocorrin are present in gastric juice, milk and other body fluids (Hoffbrand *et al*., 2006).

Folate absorption, transport and function; Folic (pteroylglutamic) acid is the parent compound of a large group of compounds, the folates, which are derived from it. Humans are unable to synthesize the folate structure and thus require preformed folate as a vitamin. Dietary folates are converted to methyl THF (tetra hydro folate) during absorption through the upper small intestine. Once inside the cell they are

converted to folate polyglutamates. Folate binding proteins are present on cell surfaces including the enterocyte and facilitate entry of reduced folates into cells. There is no specific plasma protein that enhances cellular folate uptake. Folates are needed in a variety of biochemical reactions in the body (Hoffbrand *et al*., 2006).

Megaloblastic anemia of pregnancy is one of the acquired nutritional anemias that may complicate pregnancy. It is most often secondary to folic acid deficiency because folate requirements are increased during gestation. When the diagnosis of megaloblastic anemia is confirmed, appropriate therapy will initiate a rapid reversal of the anemia process. Because of the association between neural tube defects and folate deficiency, it is recommended that women of reproductive age take folic acid supplementation (Hoffbrand *et al.*, 2011).

Clinical feature of megaloblastic anemia of pregnancy tends to occur more frequently after multiple pregnancies than in first and second pregnancies. Onset is usually gradual in late pregnancy.Anorexia, excessive vomiting, and moderate weight loss are common, and glossitis and diarrhea are features in some cases. Breast milk contains folate and occasional cases occurring during prolonged lactation in a poorly nourished mother. Spontaneous remission following delivery is usual .Vitamin $B_{12}$ deficiency causes a demyelinization of the peripheral nerves, the spinal column, and the brain, which can cause many of the more severe neurological symptoms such as spasticity or paranoia. Jaundice may be seen, because the average red cell life span in megaloblastic anemia is 75 days (Firkin *et al*., 1989).

Diagnosis is suspected in anemic pregnent with macrocytic indices. Diagnosis is usually based on peripheral smear. When fully developed, the anemia is macrocytic, with MCV > 100 fL/cell. The smear shows macro-ovalocytosis, anisocytosis, and poikilocytosis. The RBC distribution width (RDW) is high, Howell-Jolly bodies

(residual fragments of the nucleus) are common and Reticulocytopenia is present. Hypersegmentation of the granulocytes develops early; neutropenia develops later. Thrombocytopenia is often present in severe cases, and platelets may be bizarre in size and shape. If the diagnosis is questionable, a bone marrow examination may be needed (Oberley and Yang.2013).

The degree of anemia and abnormalities of red cell morphology vary with marked oval macrocytosis. However, in some cases these features are much less marked, and the anemia may be normocytic rather 'than macrocytic· and the MCV within normal range and the film is that of a 'dimorphic' anemia and hypersegmented neutrophils. Megaloblastic anemia of pregnancy, although relatively uncommon, should be considered in any pregnant patient who is anemic without obvious cause, especially in the third trimester or puerperium (Firkin *et al*., 1989).

### 1.2.5. Complete blood count CBC:

A complete blood count (CBC), is a blood panel that gives information about the cells in a patient's blood, such as the cell count for each cell type and the concentrations of various proteins and minerals (David ,2012).

This evaluation consists of nine components and offers the clinician a variety of hematological data to interpret and review that directly relate to the health of the bone marrow, represented by the numbers and types of cells in the peripheral circulation, the 17 components of the CBC are WBC count, RBC count, HB, Pcv, MCV ,MCH ,MCHC , pLT count, and RDW, DLC(Neutrophil , Lymphocyte ,Monocyte, Eosinophil , Basoplil), PMV, PDW Depending on the type of automated instrumentation used (Ciesla ,2007)

### 1.2.6. Previous study:

Determined CBC of Sudanese pregnant woman, the result show that; Evaluation of Hematological Parameters of Sudanese Pregnant Women attending at Omdurman Al Saudi Maternity Hospital by Mahmoud Mohamed Elgari (2013) , the result revealed that there were significant decreased in RBCs count, hemoglobin (Hb) and packed cell volume (PCV) of pregnant women compared to non pregnant women (P value <0.05) and significant decreased in mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) of pregnant women (P value <0.05). TWBCs count increased significantly (P. value < 0.05) but platelets count significantly decrease than the normal control (P. value <0.05). Normocytic normochromic anemia was found as 37%, microcytic hypochromic as 52% and dimorphic picture as 11%.

Another study about hemoglobin level, RBCs Indices, and iron status in pregnant females in Sudan by Abdelgader *et al.*, (2014) ,showed that out of 80 pregnant females, 10% of them had low Hb level, while 90% had normal Hb level. RBC indices showed 77.5% mothers had normal MCV, while 22.5% mothers had low MCV. 78.8% had normal MCH, while 21.2% had low MCH, 97.5% had normal MCHC, while 2.5% had low MCHC. Biochemical finding in the studied anemic pregnant females showed that 25% had normal serum ferritin, while 75% had low serum ferritin, 62.5% had normal serum iron, while 37.5% had low serum iron, and 50% had normal TIBC, while 50% had low TIBC (Abdelgader *et al*., 2014).

In Nigeria, hematological profile of normal pregnant women was assessed and the result indicated that: hematocrit 30.16 % ± 5.55 % ; hemoglobin 10.94 ± 1.86 g/dl; white blood cells, 7.81 ± 2.34 ×109/L; platelets, 228.29 ±65.6×109/L; cell volume 78.30 ±5.70 fl, corpuscular hemoglobin, 28.57 ±2.48 pg; and corpuscular hemoglobin concentration, 36.45 ±1.10 g/dl. A statistically significant relationship was found to

exist between packed cell volume and white blood cell count with increase in gestational age (P = 0.010 and 0.001, respectively). However, there was no statistically significant association between platelet count and increase in gestational age (P = 0.296) (Akinbami *et al.*, 2013).

## 1.3 Rationale:

Pregnancy is often associated with physiological changes, which may lead to pregnancy complication so, routine measurement of hematological parameter of pregnant woman is important to detect complication earlier, also few published studies concerns CBC of Sudanese pregnant woman is available. This study is a part of a project to establish baseline data of CBC of pregnant woman at first trimester.

## 1.4 Objectives:

### 1.4.1 General objective:

To measure complete blood cell count of Sudanese pregnant women at the first trimester in Omdurman locality.

### 1.4.2 Specific objectives:

-To compare between red blood cells count, white blood cells count and platelets count in pregnant and non pregnant woman.

-To compare between regular visits to clinic, abortion, and supplemental medication used on pregnant women in first trimester.

-To compare the hematological parameter of pregnant woman according to regular visits to clinic, abortion, and supplemental medication used.

# Chapter two

# Materials and Methods

# Chapter tow

# Materials and Methods

## 2.1 Study design

This study is case control study conducted in period from January to June 2015 to determine the CBC of pregnant women at the First trimester.

## 2.2 Study population

One hundred and twenty women were enrolled in the study. Eighty were pregnant woman at the first trimester and forty non pregnant as control.

## 2.3 Inclusion criteria

Pregnant women at first trimester with different age groups were included.

## 2.4 Exclusion criteria

Presence of any diagnostic diseases such as anemia, previous blood transfusion, and typhoid or other disease that may affect the parameter under study were excluded.

## 2.5 Ethical consideration

An informal consent of selected individuals study was taken after being informed with all detailed objectives of the study.

## 2.6 Data collection

A designed questionnaire was used to collect demographic data; clinical data was obtained for clinical records.

## 2.7 Data analysis

Data were analyzed by SPSS using independent t test. The significant P value was set at $P \leq 0.05$.

## 2.8 Method of samples collection

### 2.8.1 Requirement

1- Automated hematological analyzer Sysmex KX2IN with reagent provided by manufacture (cell pack, stromatolyzer, detergent and cell cleaner) for CBC estimation (principle appendix 3).

2-EDTA tube container.

3- Alcohol swab (70% ethanol).

4- Syringe, cotton, tourniquet and blister.

### 2.8.2 Procedure

1- The skin was cleaned with 70%ethanol and allowed to dry.

2-A tourniquet was applied to the arm, tight sufficiently to distend the vein.

3- 2.5 ml of blood sample were taken from the superficial vein.

4-Blood was drawn to the EDTA container then analyzed using Sysmex KX21N and give the result.

## 2.9 CBC measurement

1-the instrument was checked up for the sufficient of the solution also checked electric power supply, machine has full battery and earthed connected then power key was pressed on.

2-sample was well mixed and entered to probe then the start switch was pressed, when LCD screen was displayed analyzing the sample removed, 30 sec and then the result were printed out.

# Chapter three

# Results

# Chapter three

## Results

This study was carried out at Omdurman healthy center during the period from January to June 2015 to measure CBC of pregnant woman at the first trimester.

The results showed that there was a significant increase in HCT, MCV of pregnant women compared to non pregnant, a significant decrease in MCHC and MPV in pregnant women when compared with control. Insignificant increase in RDW, TWBC, Neutrophil Absolute, Plt and PDW of pregnant women compared to control and insignificant decrease in Hb, RBCs, MCH, lymphocytes and neutrophil percentage in pregnant women when compared with control. No significant difference in lymphocyte absolute (Tables 3.1, 3.2, and 3.3).

-There was a significant increase in MPV of study group with history of abortion when compared to those without history of abortion. Insignificant increase in MCH ,RDW, lymphocyte percentage and absolute, Plt, PDW and MPV between test group with and without history of abortion, insignificant decrease in HCT, MCV,TWBC and Neutrophil percentage and Absolute of those with history of abortion when compared to those without history of abortion. No significant difference in Hb, RBCs count and MCHC (Tables 3.4, 3.5, and 3.6).

-There was A Significant increase in HCT, MCH, PDW and MPV of pregnant whose regular clinical follow up when compared with irregular clinical follow up , Significant decrease in MCHC of pregnant visit clinic when compared with irregular clinical follow up, insignificant increase in Hb, RBCs, MCV, TWBC ,Neutrophil percentage and absolute and Plt of pregnant whose regular clinical follow up when compared with irregular clinical follow up and Insignificant decrease in RDW,

lymphocyte percentage and absolute of pregnant whose regular clinical follow up when compared with irregular clinical follow up (Tables 3.7, 3.8, and 3.9).

There was a significant increase in HCT, MCV and Neutroplil percentage of pregnant take supplementation when compared with those not take supplementation, significant decrease in MCHC and Lymphocyte percentage of pregnant take supplementation when compared with those not take supplementation and insignificant increase in mean of Hb, RBC, MCH, TWBC, Neutrophil percentage, Plt, PDW and MPV of pregnant take supplementation when compared with those not take supplementation Insignificant decrease in mean of lymphocyte absolute and no significant difference in RDW between pregnant take supplementation and those not take supplementation (Tables 3.10, 3.11, and 3.12).

-There was an insignificant increase in Hb, RBC, HCT, MCV, MCH, RDW,Neutrophil percentage and absolute, Plt, PDW of pregnant at second month when compared with pregnant at third month. Insignificant decrease in MCHC, TWBC, Lymphocyte percentage of pregnant at second month when compared with pregnant at third moth and no significant difference in mean of Lymphocyte absolute and MPV (Tables 3.13, 3.14, and 3.15).

**Table (3.1) Comparison between pregnant women and non pregnant woman (Hb, Hct, RBCs count and indices):**

| Test | Sample | No | Mean +SD | P value |
|---|---|---|---|---|
| Hb g/dl | Pregnant | 80 | 12.0 ± 1.41 | 0.76 |
| | non pregnant | 40 | 12.1 ± 0.92 | |
| Hct % | Pregnant | 80 | 35.0 ± 4.2 | 0.00 |
| | non pregnant | 40 | 33.2 ± 2.7 | |
| RBCs $\times 10^{12}$ /l | Pregnant | 80 | 4.36 ± 0.53 | 0.92 |
| | non pregnant | 40 | 4.37 ± 0.32 | |
| MCV fl | Pregnant | 80 | 81.1 ± 6.90 | 0.00 |
| | non pregnant | 40 | 76.9 ± 5.63 | |
| MCH pg | Pregnant | 80 | 27.4 ± 2.51 | 0.93 |
| | non pregnant | 40 | 27.5 ± 2.28 | |
| MCHC % | Pregnant | 80 | 34.2 ± 1.95 | 0.00 |
| | non pregnant | 40 | 35.7 ± 1.28 | |
| RDWSD fl | Pregnant | 80 | 40.5 ± 5.93 | 0.16 |
| | non pregnant | 40 | 39.0 ± 5.39 | |

**Table (3.2) Comparison between pregnant women and non pregnant woman (TWBCs count, differential and absolute):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| TWBCs $\times 10^9$ /l | Pregnant | 80 | 7.3 ± 2.70 | 0.6 |
| | non pregnant | 40 | 7.0 ± 2.79 | |
| Lymph % | Pregnant | 80 | 33.5 ± 12.9 | 0.6 |
| | non pregnant | 40 | 34.7 ± 12.9 | |
| Neutr % | Pregnant | 80 | 58.6 ± 13.6 | 0.4 |
| | non pregnant | 40 | 60.6 ± 13.1 | |
| Lymph $\times 10^9$ /l | Pregnant | 80 | 2.2 ± 0.86 | 0.9 |
| | non pregnant | 40 | 2.2 ± 0.66 | |
| Neutr $\times 10^9$ /l | Pregnant | 80 | 4.6 ± 2.80 | 0.8 |
| | non pregnant | 40 | 4.5 ± 2.85 | |

**Table (3.3) Comparison between pregnant women and non pregnant woman (platelet count and indices):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Plt $\times 10^9$ /l | Pregnant | 80 | 276.0 ± 71.2 | 0.8 |
| | non pregnant | 40 | 273.5 ± 74.2 | |
| PDW | Pregnant | 80 | 13.2 ± 2.65 | 0.4 |
| | non pregnant | 40 | 12.9 ± 1.98 | |
| MPV | Pregnant | 80 | 9.5 ± 1.20 | 0.03 |
| | non pregnant | 40 | 9.9 ± 1.01 | |

**Table (3.4) Comparison between pregnant women with and without abortion (Hb, Hct, RBCs count and indices):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Hb g/dl | Yes | 7 | 12.1 ± 1.32 | 0.22 |
| | No | 73 | 12.1 ± 1.13 | |
| Hct % | Yes | 7 | 34.8 ± 3.17 | 0.21 |
| | No | 73 | 35.0 ± 2.90 | |
| RBCs $\times 10^{12}$ /l | Yes | 7 | 4.38 ± 0.33 | 0.44 |
| | No | 73 | 4.38 ± 0.36 | |
| MCV fl | Yes | 7 | 80.2 ± 5.39 | 0.65 |
| | No | 73 | 81.2 ± 5.76 | |
| MCH pg | Yes | 7 | 27.4 ± 5.65 | 0.43 |
| | No | 73 | 27.2 ± 2.42 | |
| MCHC % | Yes | 7 | 34.2 ± 1.72 | 0.89 |
| | No | 73 | 34.2 ± 1.37 | |
| RDWSD fl | Yes | 7 | 43.1 ± 3.78 | 0.23 |
| | No | 73 | 40.3 ± 3.95 | |

**Table (3.5) Comparison between pregnant women with and without abortion (TWBCs count, differential and absolute):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| TWBCs $\times 10^9$ /l | Yes | 7 | 6.9 ± 2.46 | 0.69 |
| | No | 73 | 7.3 ± 2.44 | |
| Lymph % | Yes | 7 | 37.6 ± 7.77 | 0.38 |
| | No | 73 | 33.1 ± 10.76 | |
| Neutr % | Yes | 7 | 57.9 ± 11.59 | 0.88 |
| | No | 73 | 58.7 ± 11.29 | |
| Lymph $\times 10^9$ /l | Yes | 7 | 2.6 ± 0.62 | 0.93 |
| | No | 73 | 2.1 ± 0.69 | |
| Neutr $\times 10^9$ /l | Yes | 7 | 4.4 ± 2.26 | 0.70 |
| | No | 73 | 4.5 ± 2.11 | |

**Table (3.6) Comparison between pregnant women with and without abortion (platelet count and indices):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Plt $\times 10^9$ /l | Yes | 7 | 287.0 ± 77.0 | 0.67 |
| | No | 73 | 274.9 ± 71.1 | |
| PDW | Yes | 7 | 14.6 ± 3.73 | 0.16 |
| | No | 73 | 13.1 ± 2.57 | |
| MPV fl | Yes | 7 | 10.3 ± 1.51 | 0.04 |
| | No | 73 | 9.4 ± 1.51 | |

**Table (3.7) Comparison between pregnant women visits and not visit clinic (Hb, Hct, RBCs count and indices):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Hb g/dl | Yes | 58 | 12.1 ± 17.4 | 0.44 |
| | No | 22 | 11.8 ± 1.50 | |
| Hct % | Yes | 58 | 35.6 ± 4.40 | 0.03 |
| | No | 22 | 33.3 ± 4.56 | |
| RBCs $\times 10^{12}$ /l | Yes | 58 | 4.56 ± 0.45 | 0.18 |
| | No | 22 | 4.23 ± 0.71 | |
| MCV fl | Yes | 58 | 81.5 ± 7.08 | 1.2 |
| | No | 22 | 80.2 ± 6.47 | |
| MCH pg | Yes | 58 | 27.5 ± 2.71 | 0.04 |
| | No | 22 | 27.4 ± 1.92 | |
| MCHC % | Yes | 58 | 33.9 ± 1.87 | 0.01 |
| | No | 22 | 35.1 ± 1.95 | |
| RDWSD fl | Yes | 58 | 40.4 ± 4.53 | 0.84 |
| | No | 22 | 40.7 ± 8.75 | |

**Table (3.8) Comparison between pregnant women visits and not visit clinic (TWBCs count, differential and absolute):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| TWBCs $\times 10^9$ /l | Yes | 58 | 7.3 ± 2.77 | 0.70 |
| | No | 22 | 7.1 ± 2.54 | |
| Lymph % | Yes | 58 | 32.2 ± 13.7 | 0.28 |
| | No | 22 | 35.8 ± 11.8 | |
| Neutr % | Yes | 58 | 60.3 ± 14.2 | 0.13 |
| | No | 22 | 55.0 ± 13.1 | |
| Lymph $\times 10^9$ /l | Yes | 58 | 2.2 ± 1.0 | 0.67 |
| | No | 22 | 2.3 ± 0.71 | |
| Neutr $\times 10^9$ /l | Yes | 58 | 4.8 ± 2.96 | 0.31 |
| | No | 22 | 4.0 ± 2.31 | |

**Table (3.9) Comparison between pregnant women visits and not visit clinic (platelet count and indices):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Plt $\times 10^9$ /l | Yes | 58 | 277.7 ± 73.6 | 0.72 |
| | No | 22 | 271.4 ± 66.0 | |
| PDW | Yes | 58 | 13.6 ± 2.68 | 0.04 |
| | No | 22 | 12.3 ± 2.38 | |
| MPV | Yes | 58 | 9.7 ± 1.18 | 0.01 |
| | No | 22 | 9.0 ± 1.14 | |

**Table (3.10) Comparison between pregnant women takes supplementation and not takes (Hb, Hct, RBCs count and indices):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Hb g/dl | Yes | 43 | 12.1 ± 1.94 | 0.46 |
| | No | 37 | 11.9 ± 1.32 | |
| Hct % | Yes | 43 | 36.1 ± 4.29 | 0.01 |
| | No | 37 | 33.7 ± 3.97 | |
| RBCs $\times 10^{12}$ /l | Yes | 43 | 4.62 ± 1.32 | 0.17 |
| | No | 37 | 4.29 ± 0.57 | |
| MCV fl | Yes | 43 | 82.5 ± 7.05 | 0.04 |
| | No | 37 | 79.5 ± 6.43 | |
| MCH pg | Yes | 43 | 27.7 ± 2.69 | 0.24 |
| | No | 37 | 27.1 ± 2.26 | |
| MCHC % | Yes | 43 | 33.8 ± 2.06 | 0.04 |
| | No | 37 | 34.7 ± 1.73 | |
| RDWSD fl | Yes | 43 | 40.5 ± 4.96 | 0.99 |
| | No | 37 | 40.5 ± 6.97 | |

**Table (3.11) Comparison between pregnant women takes supplementation and not takes (TWBCs count, differential and absolute)**

| Test | Sample | No | Mean± SD | P value |
|---|---|---|---|---|
| TWBCs $\times 10^9$ /l | yes | 43 | 7.5 ± 2.46 | 0.34 |
| | no | 37 | 7.0 ± 2.44 | |
| Lymph % | yes | 43 | 30.3 ± 7.77 | 0.03 |
| | no | 37 | 36.7 ± 10.76 | |
| Neutr % | yes | 43 | 62.2 ± 11.59 | 0.02 |
| | no | 37 | 55.1 ± 11.29 | |
| Lymph $\times 10^9$ /l | yes | 43 | 2.2 ± 0.62 | 0.64 |
| | no | 37 | 2.3 ± 0.69 | |
| Neutr $\times 10^9$ /l | yes | 43 | 5.1 ± 2.26 | 0.06 |
| | no | 37 | 3.9 ± 2.11 | |

**Table (3.12) Comparison between pregnant women takes supplementation and not takes (platelet count and indices)**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Plt $\times 10^9$ /l | yes | 43 | 279.9 ± 79.9 | 0.59 |
| | No | 37 | 271.3 ± 60.5 | |
| PDW | yes | 43 | 13.6 ± 2.79 | 0.18 |
| | no | 37 | 12.8 ± 2.46 | |
| MPV | yes | 43 | 9.6 ± 1.14 | 0.34 |
| | No | 37 | 9.3 ± 1.28 | |

**Table (3.13) Comparison between pregnant women at second and third month (Hb, Hct, RBCs count and indices):**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Hb g/dl | Second | 58 | 12.3 ± 1.31 | 0.12 |
| | Third | 22 | 11.7 ± 1.60 | |
| Hct % | Second | 58 | 35.5 ± 4.04 | 0.08 |
| | Third | 22 | 33.6 ± 4.70 | |
| RBCs $\times 10^{12}$ /l | Second | 58 | 4.38 ± 0.48 | 0.56 |
| | Third | 22 | 4.30 ± 0.67 | |
| MCV fl | Second | 58 | 81.7 ± 6.34 | 0.24 |
| | Third | 22 | 79.6 ± 8.18 | |
| MCH pg | Second | 58 | 27.7 ± 2.30 | 0.09 |
| | Third | 22 | 26.7 ± 2.91 | |
| MCHC % | Second | 58 | 34.1 ± 1.89 | 0.39 |
| | Third | 22 | 34.5 ± 2.13 | |
| RDWSD fl | Second | 58 | 40.3 ± 4.10 | 0.75 |
| | Third | 22 | 41.0 ± 9.29 | |

**Table (3.14) Comparison between pregnant women at second and third month (TWBCs count, differential and absolute)**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| TWBCs $\times 10^9$ /l | Second | 58 | 7.2 ± 2.70 | 0.8 |
| | Third | 22 | 7.3 ± 2.79 | |
| Lymph % | Second | 58 | 33.1 ± 12.9 | 0.8 |
| | Third | 22 | 33.6 ± 12.9 | |
| Neutr % | Second | 58 | 58.9 ± 13.9 | 0.9 |
| | Third | 22 | 58.8 ± 13.1 | |
| Lymph $\times 10^9$ /l | Second | 58 | 2.2 ± 0.86 | 0.9 |
| | Third | 22 | 2.2 ± 0.66 | |
| Neutr $\times 10^9$ /l | Second | 58 | 4.6 ± 2.80 | 0.9 |
| | Third | 22 | 4.5 ± 2.85 | |

**Table (3.15) Comparison between pregnant women at second and third month (platelet count and indices)**

| Test | Sample | No | Mean ± SD | P value |
|---|---|---|---|---|
| Plt $\times 10^9$ /l | Second | 58 | 276.9 ± 71.2 | 0.8 |
| | Third | 22 | 273.5 ± 74.2 | |
| PDW | Second | 58 | 13.4 ± 2.65 | 0.3 |
| | Third | 22 | 12.8 ± 1.98 | |
| MPV | Second | 58 | 9.5 ± 1.20 | 0.9 |
| | Third | 22 | 9.5 ± 1.01 | |

# Chapter four

# Discussion, Conclusion, and Recommendations

# Chapter four

# Discussion, Conclusion, and Recommendations

## 4.1. Discussion

The current study aimed to determine the hematological parameter of the pregnant female during the first trimester to diagnose or monitor illness pregnant woman. The results showed that there was significant increase in Hct, MCV (P=0.00) and significant decrease in MCHC and MPV (P=0.00) of test group when compared with control. These findings agreed with Elgari, (2013) who applied significant decrease in MCHC. On the contrary, Akinbami *et al*., (2013) applied that significant increase in white blood cells with increase in gestational age.

Regarding the regular clinical follow up, there was significant increase in mean of Hct (P = 0.03), MCH (P= 0.04), PDW (P=0.04) and MPV (P= 0.01) of pregnant woman who regularly follow up when compared with those irregular follow up. Also there was significant decrease in mean of MCHC (P 0.01) of pregnant woman who regularly visit clinic comparing with those not visit clinic which may result from increase iron utilization in infancy and growth of infant or insufficient iron intake.

There was significant increase in mean of Hct (P=0.01), MCV (P=0.04) and Neutrophil percentage (P=0.02) of pregnant woman take supplementation when compared with those who didn't take supplementation. However, there was a significant decrease in mean of MCHC (P=0.04) and Lymphocyte percentage (P=0.03) of pregnant take supplementation when compared with those who didn't takes supplementation may be due to poor diet or variation in economic status of study group.

This study showed that there was an insignificant change in MCH, Hb, RBCs, lymphocytes and neutrophil percentage ($p \geq 0.05$) between pregnant and non pregnant

women, the decreases in hemoglobin and red cell indices concentration are common findings during pregnancy and results from increased plasma volume combined poor iron intake. Beside that there was also insignificant difference in the measured hematological parameters in the pregnant women with history of abortion or not. Insignificant difference in Hb, RBCs, MCV, RDW, TWBC, Neutrophil percentage and absolute, Plt, lymphocyte percentage and absolute of pregnant woman who's regularly follow up when compared with those irregular follow up. Moreover, insignificant changes in Hb, RBC, MCH, TWBC, Neutrophil percentage, Plt, PDW, lymphocyte absolute and MPV ($p \geq 0.05$) of pregnant woman who take supplementation when compared with those not take supplementation.

The study also showed insignificant changes in Hb, RBC, Hct, MCV, MCH, RDW, Neutrophil percentage, absolute, Plt, PDW, MCHC, TWBC, and Lymphocyte percentage ($p \geq 0.05$) of pregnant woman at second month when compared with pregnant woman at third month, this result agreed with Khalil, (2012) who showed that WBC of pregnant women at third trimester increased insignificantly (p.value 0.08) when compared to those in first and second trimesters. This may be as a result of the body building the immunity of the fetus.

## 4.2. Conclusions

1-There was significant increased in Hct, MCV (P=0.00) and significant decreased in MCHC and MPV (P=0.00) in pregnant women when compared with non-pregnant control.

2- There was a significant increase in MPV and insignificant decrease in HCT, MCV,TWBC and Neutrophil percentage and Absolute of pregnant women with history of abortion when compared to those without history of abortion,

2-Significant increase in Hct (P = 0.03), MCH, PDW and MPV (P= 0.01) and Significant decrease in MCHC of pregnant follow up at clinic when compared with those not follow up at clinic.

3-According to supplementation intake there was significant increase in Hct (P=0.01), MCV(P=0.04) and Neutroplil percentage of pregnant take supplementation when compared with those didn't take supplementation, significant decrease in MCHC and Lymphocyte percentage of pregnant take supplementation when compared with those didn't take supplementation.

4- No significant difference in CBC of pregnant woman at second and third trimester.

### 4.3. Recommendations

1- Regular checking of Complete blood count must be done for pregnant woman and when there is any abnormality in any parameter further investigation should be done like iron status or blood film .

2- Regular supplementation during early pregnancy because it affects the hematological parameter of them.

3- Further studies should be done to establish data base for pregnant women.

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# Appendix

## Appendix (1)

## Sudan University of Science and Technology

## College of Graduate Studies

## Questionnaire to measure CBC of pregnant women at first trimester attended in omdurman locality

NO ( )

Personal data Name……..

Age…….

Occupation…….……

Husband occupation……

Residence……

Month of pregnancy……

NO of pregnancy…….

Abortion: yes ( ) how many times ( ) No ( )

Supplementation intake yes ( ) No ( ) Regular ( ) Irregular ( )

Visit to clinic yes ( ) No ( )

Suffer from disease: Malaria ( ) Anemia ( ) Typhoid ( )

Other……

Previous blood transfusion: yes ( ) When ( ) No ( )

Result: WBC….....RBC…….HGB……..……..

HCT…….....MCV……....MCH……..……

MCHC……..PLT……...LYM%.....

NEUT%..... LYM#.....

NEUT#..... ……..RDW…...…...…….

PDW…….....MPV……..

## Appendix (2)

## Informed consent

بسم الله الرحمن الرحيم

**جامعة السودان للعلوم والتكنولوجيا**

**كلية الدراسات العليا**

**ماجستير مختبرات طبية**

**تخصص علم امراض الدم ومبحث المناعة الدموية**

**براءة اخلاقية**

الإسم :.....

سوف يتم أخذ عينة من الدم (3 مل) من الوريد بواسطة حقنة طعن وذلك بعد مسح منطقة العينة بواسطة مطهر.

كل الأدوات المستخدمة لأخذ العينة معقمة و متبع فيها وسائل السلامة المعملية

أوافق أنا المذكور اعلاه أخذ عينة لإجراء الدراسة

الإمضاء.....

التاريخ:.....

## . Appendix (3)


Figure (2.1) Sysmex KX -21N

Principle of sysmex:

There are two transducer chambers one used to count WBCs and Hb together and other used to count RBCs and platelet.

Apportion of blood separated aspirated whole blood and mixed with diluents in pre-test ratio. A defined amount of this dilution is sent to detection chamber and passed through a small opening known as aperture. There are also electrodes on each side of aperture- and direct current pass through these electrodes. The direct current resistances between the electrodes changes as the blood suspension pass through

aperture. This resistance cause an electrical pulse change proportional to the size of blood cell. These electrical data are converted into graphical displays of volume distribution curve, or histogram.