Chapter One

Introduction and Literature Review

Introduction:

Children represent the future and ensuring their healthy growth and development ought to be prime concern of all societies children are vulnerable to malnutrition and infectious diseases many of which can be effectively prevented or treated.

Complete blood counts used to identify diseases and Monitor person's healthy, it give us a Idea a bout presence of Anemia, infection or blood disorders.

Anemia is a major public health problem in developing countries it having direct bearing on physical development, Immune competence, learning behavior.

Most cases of Anemia in children develop gradually and progressively and duoto Iron defecting. In early childhood habits especially during the weaning period, Anemia frequently develops as breast milk replaced by foods that are poor in Iron and other nutrients including vitamin b12 and folic Acid (Anemia in children under 2 years in Brazil(Rosemary 2010).

T here are many types of anemia's in clinical practical, Microcytic hypoehromic, (MCV, MCH, MCHC are low), Normoeytic normochromic, (MCV, MCH, MCHC are normal) Macrocytic normochromic, (MCV high, MCH normal, MCHC high)

(Frikin,1996).

Anemia is present when Hb level in the blood is bellow the lower extreme of normal range of the age and sex of individual, a common error leading to misdiagnosis of anemia is failure to refer to normal range(Frikin,1996). There

are many causes of anemia's, blood loss (main causes), impaired red cell production, inadequate supply of nutrition essential for erythropoietin, anemia associated with chronic disorder, anemia due to replacement of normal bone narrow by leukemia (Hoff brand 1993) Diagnosis of anemia, by measuring of complete blood count (CBC), thin blood film, Blood iron level and serum ferritin level, the best indicators of body's total iron .stores of vitamin B12 and folate, vitamins necessary for red blood cell production Special blood tests to detect rare causes of anemia, such as an immune attack on red blood cells, red blood cell fragility, and defects of enzymes, hemoglobin, and clotting Reticulocyte count, bilirubin, and other blood and urine tests to determine how quickly your blood cells are being made or if you have a hemolytic anemia, where your red blood cells have a shortened life span can be classify into two categories morphological classification which include (hypochromic microcytic anemia, normochromic normocytic anemia, macrocytic anemia) on basis of MCV, MCH and MCHC, and etiological classification. (Frikin, 1996).

1.2 Literature Review:

1.2.1Blood:

Blood is a bodily fluid in animals that delivers necessary substance such as nutrients and oxygen to the cells and transports metabolic waste products away from those same cells.

Blood performs many important functions within the body including, supply of oxygen to tissues (bound to hemoglobin, which is carried in red cells, supply of nutrients such as glucose, amino acids, and fatty acids (dissolved in the blood or bound to plasma proteins (e.g., blood lipids), removal of waste such as carbon dioxide, urea, and lactic acid, immunological functions, including circulation of white blood cells, and detection of foreign material by antibodies, coagulation, which is one part of the body's self- repair mechanism (blood clothing after an open wound in order to stop bleeding), messenger functions, including the transport of hormones and the signaling of tissue damage, regulation of body pH, regulation of core body temperature, hydraulic functions (Firkin, 1996).

Blood circulated a round the body through blood vessels by the pumping action of the heart. In animals with lungs, arterial blood carries oxygen from inhaled air to the tissues of the body, and venous blood carries carbon dioxide, a waste product of metabolism produced by cells, from the tissues to the lungs to be exhaled (Firkin ,1996).

Medical terms related to blood often begin with hemo- or hemato- (also spelled haemo- and haemato-) from the Greek word αἷμα (haima) for "blood". In terms of anatomy and histology, blood is considered a specialized from of connective tissue, given its origin in the bones and the presence of potential molecular fibers in the form of fibrinogen(Firkin, 1996).

1.2.2 Haemoposesis:

Formation of blood cells occurs at different anatomical sites during the course of development from embryonic to adult life, production of blood cells commences in the yolk sac of the embryo, but then shifts to the liver and to the lesser extent to the spleen, so that these organs become the dominant sites for production of blood between the second and the seventh month of gestation.

The liver and spleen are then superseded by the bone marrow, which serves as the only important site of the blood cell production after birth. And exception is lymphocyte production, which occurs substantially in other organs, in addition to the bone marrow in adult life (Firkin, 1996).

1.2.3. Erythropoiesis:

The cascade of differentiation the stem cell proceeds through multipotent progenitor cell identified in vitro as colony forming unite granulocyte erythroid macrophage megakaryocyte (CFU-GEMM). The first recognizable pure erythroid progenitor is the burst- forming unit erythroi (BFU-E). Which then mature in the colony forming unit erythroid (CFU-E) the erythropoietin is necessary for terminal maturation of the CFU. It also has antiapoptoti effect on progenitor cells. Early progenitors depend on several cytokines mixture for their proliferation and maturation. In utero hematopoietic is primary erythroid. The blood and bone marrow of fetus and newbons is rich in stem cells as well as erythroid progenitor their response to erythropoietin is normal. Embryonic erytheopoiesis give rise to large nucleated red cells endowed with embryonic hemoglobin.

Through gestation erythropoietin switches from this primitive erythropoing to defmitive mature erythropoiesis with smaller nuclear cells that contain adult type (Marshall,2001).

The proerythroblast is the least mature of the morphologically identifiable members of the erythroid series. It has a diameter of 14-20 m, and a basically round outline with minor peripheral protuberance. There are several nucleoli in the nucleus, which is round and occupies most of the cell. The chromatin in the nucleus consists of a network of fine red -purple stands. Characteristic feature is that peripheral cytoplasm is more basophilic than in the myeloblast, which is the corresponding member in the maturation sequence of the granulocytic series. Proerythroblast. Undergo rapid division and rise to basophil erythroblast. The basophil erythroblast" is round cell with a diameter of 12-16/ Im, and more basophilic cytoplasm than the Proerythroblast. It also undergoes rapid proliferation. The nucleus occupies a relatively large proportion of the cell, but differs form the nucleus of the Proerythroblast by having coarser and more basophilic chromatin strand. The polychromic erythroblast is round cell between 12-14/- I m in diameter, and is the next stage in the maturation sequence after the basophile erythroblast. The characteristic polychromatic appearance of the cytoplasm is derived form the mixture of the basophilic ribonucleic (RNA) and acidophilic hemoglobin. Nuclear chromatin is in coarse, deeply basophilic clump,and proliferative activity ceases after this stage. The polychromatic erythroblast occupies apposition in the pathway of maturation between the early, immature stage characterized by absence of proliferative activity and predominance of hemoglobin in the cytoplasm of the cell. Orthochromatic erythroblasts constitute the next and final stage of maturation of the nucleated red cell series. They are smaller than their predecessors are and have a diameter between 8-12/Im. The nucleus is relatively small and synthesis occurs in the cytoplasm, which contains mitochondria and ribosome. The Ribosomal RNA imparts a basophilic tint to the cytoplasm, although the cytoplasm is predominantly acidophilic due to presence of large amounts of hemoglobin. The nucleus is extruded from the orthochromatic erythroblast to form reticulocyte. Reticulocytes

have the same biconcave discoid shape as mature red cells, although they have as slightly greater volume and diameter than letter. Consequently, when the percentage of the reticulocytes in the blood is abnormally high, the mean corpuscular volume of the overall red cell population in blood increase, and can rise above normal. Red cells normally enter the blood at the stage of the reticulocyte or of the mature erythrocyte. It is currently not understood how these non-motile cells pass from the extra vascular space into the blood within the sinusoid of the bone marrow, in the view remarkable consistency with which red cells subsequently remain within the vascular compartment during their lifespan approximately 120 days (Ernest, 2001).

1.2.4 Leukopoiesis:

Formation of WBCs begins in liver at 5 weeks gestation, although a few macrophages are produced in the yolk sac, followed by the thymus (8to9 weeks), spleen (11 weeks), and lymph nodes (12 weeks). Significant numbers are not produce until the myeloid period initially. Erythropoietin is greater than granulopoiesis, however, by 10 to 12 weeks, granulopoiesis predominates, and by 21 weeks the adult ratio of granulopoiesis to erythropoietin is seen. Circulating granulocyte in creased rapidly during the third trimester. At birth, number of WBCs is equal to or greater than those found in adults. Eosinophils appear by 10 weeks, increased to 5% of total marrow cells by 21weeks, Basophiles also appear by 10 weeks, but level remain low. Monocytes are found in the yolk sac by 3 to 4 weeks and initially are the most predominant cells in liver hematopoietic tissue, then decrease at birth. Circulating monocyte is seen 5-6 months of gestation. Macrophage level peak at 10 to 16 weeks, monocyte level peak in 12 to 16 weeks frikin,1996).

1.2.4.1 Granulocytes

Are a group of cells comprisied of basophils, eosinophils and neutrophils

1.2.4.1.1 . Neutropil

Acount for 70% of circulating WBC's. they have a very dense, segmented nucleus, with 2-5 lobes. As a result, these cells are referred to as polymorphonuclear leukocytes, or polymorphs. Their cytoplasm is packed with lysosomal enzymes, and bactericidal substances.

They are often the first WBC's to 'arrive at the scene' of an infection, and will attack substances that have been marked by complement.

They will engulf bacteria and ingest it, in the process releasing superoxide anions, and hydrogen peroxide. Whilst this process is going on, the neutrophils will release cytokines, prostaglandins and leukotrienes. The prostaglandins increase vascular permeability in the area, thus aiding inflammation, whilst the other chemicals attract other cells to the site.

Neutrophils only last about 10 hours in the bloodstream. They will only last about 30 minutes whilst actively engulfing bacteria. The neutrophils will die after engulfing about 25 bacteria.

1.2.4.1.2.Esinophils

Same as neutrophils, but always have a bilobed nucleus and deep red, obvious granules. They attack pathogens that have been marked by antibodies. They are capable of engulfing bacteria, but their main attack is through the release of toxic compounds. Thus, they are particularly useful against multicellular parasites. These are the cells responsible for an allergic reaction – because they are sensitive to allergens. Account for 2-4% of circulating WBC's. they are similar in size to.

1.2.4.1.3.Basophils

Have loads of granules that stain very darkly with various dyes. They are slightly smaller than eosinophils and neutrophils. They account for less than 1% of circulating WBC's. they migrate to inflamed areas, where they discharge their granules, releasing heparin and histamine into the interstitial space. They enhance the local inflammation that has already been started by mast cells. they also release chemotaxic agents to attract eosinophils and other basophils.-

1.2.4.2 AGanulocytes,

Also known as mononuclear leukocytes, are white blood cells with a one-lobed nucleus. They are characterised by the absence of granules in their cytoplasm, which distinguishes them from granulocytes. Normal hematologic blood values of MLs are about 35% of all white blood cells. An increased number of MLs is an indication of viral infections and chronic inflammatory conditions e.g. infectious mononucleosis.[1] The 2 types of a granulocytes in the blood circulation are lymphocytes and monocytes. A third type of agranulocyte, the macrophage, is formed in the tissue when monocytes leave the circulation and differentiate into macrophages.

1.2.4.2.1 Monocytes

Are spherical, and larger than neutrophils and eosinophils, and approximately twice as big as basophils. The nucleus is large and tends to be oval or kidney bean shaped. They account for 2-8% of circulating WBC's. they use the blood mainly for transportation**,** and remain in the blood only for a maximum of 24 hours, before migrating to tissues to become macrophages. Macrophages are aggressively phagocytotic. They also release chemotaxic agents for pretty much all other WBC's. they also release agents that are chemotaxic for fibroblasts, thus attracting fibroblasts to the area to begin forming scar tissue.

1.2.4.2.2.Lymphocytes

Are slightly larger than RBC's and do not generally contain visible granules. They generally have a large round nucleus, and a 'halo' of cytoplasm. They account for 20-30% of the circulating WBC's. they migrate from the blood to peripheral tissues, and are then able to migrate back to the blood again. Circulating lymphocytes represent only a tiny fraction of the total amount of lymphocytes, as a very large proportion are in your peripheral tissues and lymphatic system.
There are 3 types of lymphocyte, but these cannot be distinguished by light microscope.

T cells are responsible for cell-mediated immunity they can directly attack pathogens, or can co-ordinate other cells to do so,B cellswhichproduce antibodies, but only after they have been activated, and turn into plasma cells, which produce antibodies against a specific pathogen...NKcell (natural killer cells) : these detect and destroy abnormal native cells. They are important in protecting against cancer, and are sometimes called large granular lymphocytes. Dendritic cells are antigen presenting cells increases substantially in the allergic response, and studies in animals indicate that interaction between lymphocyte and eosinophil granulocyte precursors account for the link between the recognition of the allergen and the increase in production of eosinophil. (Emmanuel.*etal*,.1993)

1.2.5 Thrombopoiesis:

Platelet production is first observed toward the end of the first trimester and platelet levels are usually within normal adult range by the middle of the second trimester. Thrombocytopenia in both the term and preterm infant is there fore defined as platelet count .150.000 cumm.

Thrombopoietin (TPO is known to be the most important regular to platelet production in human. Platelets are formed in the bone marrow by megakaryocytic and are subsequently released into the vascular compartment where they play an essential role in homeostasis. the most immature stage of platelet development is the megakaryoblast, which resemble the myeloblast in its basic features. These cells amount less than, eight percent of the total megakaryocytic population (Frikin,1996).

The promegakaryocyte is next stage in the sequence of mature, and is large than its precursor because it has undergone endoreduplication. It is nuclear replication with out division of the cell, and is a characteristic feature of the more mature members of, the megakaryocytic series. Such replication leads ultimately to the formation of very large cells containing up to 32 times the normal diploid content of deoxyribonucleic acid (DNA).Promegakaryocytes make up about 25 percent of megakaryocytic, and have deeply basophilic cytoplasm containing some basophilic granules. The nucleus may be lobulated, and the chromatin is more deeply basophilic than in the megakaryoblast (Frikin,1996).

Mature megakaryocytic range from 30-90 pm in diameter, and contain 4-16 nuclear lobes with coarsely clumped chromatin and the cytoplasm stains light blue and contain many small red- purple granules (Firkin,1996). Platelets, also called "thrombocytes", are blood cells whose function (along with the coagulation factors) is to stop bleeding. Platelets have no nucleus: they are fragments of cytoplasm which are derived from the megakaryocytes of the bone marrow, and then enter the circulation. These unactivated platelets are biconvex discoid structures. Shaped like a lens, 2–3 μm in greatest diameter. Platelets are found only in mammals, an adaptation that may have evolved to offset the risk of death from hemorrhage at childbirth – a risk unique to mammals(.Hoffbrand ,2005)

On a stained blood smear, platelets appear as dark purple spots, about 20% the diameter of red blood cells. The smear is used to examine platelets for size, shape, qualitative number, and clumping. The ratio of platelets to red blood cells in a healthy adult is 1/10 to 1/20. The main function of platelets is to contribute to hemostasis: the process of stopping bleeding at the site of interrupted endothelium. They gather at the site and unless the interruption is physically too large, they plug the hole. First, platelets attach to substances outside the interrupted endothelium: adhesion. Second, they change shape, turn on receptors and secrete chemical messengers: activation. Third, they connect to each other through receptor bridges: aggregation. Formation of this platelet plug (primary hemostasis) is associated with activation of the coagulation cascade with resultant fibrin deposition and linking (secondary hemostasis). These processes may overlap: the spectrum is from a predominantly platelet plug, or "white clot" to a predominantly fibrin clot, or "red clot" or the more typical mixture. The final result is the clot. Some would add the subsequent clot retraction and platelet inhibition as fourth and fifth steps to the completion of the process and still others a sixth step wound repair.((.Hoffbrand ,2005)

Low platelet concentration is thrombocytopenia and is due to either decreased production or increased destruction. Elevated platelet concentration is thrombocytosis and is either congenital, reactive (to cytokines), or due to unregulated production: one of the myeloprolerative neoplasms or certain other myeloid neoplasms. A disorder of platelet function is a thrombocytopathy. Normal platelets can respond to an abnormality on the vessel wall rather than to hemorrhage, resulting in inappropriate platelet adhesion/activation and thrombosis:the formation of a clot within an intact vessel. These arise by different mechanisms than a normal clot. Examples are: extending the fibrin clot of venous thrombosis; extending an unstable or ruptured arterial plaque, causing arterial

thrombosis; and microcirculatory thrombosis. An arterial thrombus may partially obstruct blood flow, causing downstream ischemia; or completely obstruct it, causing downstream infarction.(Hoffbrand, 2005)

1.2.6 Haematopoietic growth factor:

The haemopoietic growth factors are glycoprotein hormones that regulate the proliferation and differentiation of haemopoietic progenitor cells and function of mature blood cells.The biological effects of the grow 4 factors are mediated through specific receptors on target cells. They may act locally at the site where they are produced by cell- cell contact or circulated in plasma. They may bind to extra cellular matrix to form niches to which stem and progenitor cells adhere. They share a number of common properties and act at different stages of haemopoietic. T lymphocyte, monocytes, macrophage and stromal cells are major sources of growth factors except for erythropoietin 90%of which is synthesized in kidney, and thrombopoietin made largely in liver. Antigen or endotoxins activate T lymphocytes or macrophages to release interleukin‘ -l(IL-) and tumor necrosis factor’ (TNF) which then stimulate other cells including endothelail cells, fibro blasts and other T -cells and macrophage produce granulocyte-macrophage to produce granulocyte -macrophage colony-stimulating factor (GM,, G-CSF, M—’CSF, IL-6 and other growth factor in an interacting network (Hoff brand, 2005).

1.2.7 Physiological variations in the blood count:

1.2.7.1Red Cell Count:

There is considerable variation in the red blood cell count (RBC) and haemoglobin concentration (Hb) at different periods of life and there are also transient fluctuations, the significance of which is often difficult to assess. At birth the Hb is higher than at any period subsequently The RBC is high immediately

after birth, and values for Hb >200g/l, RBC higher than 6.0×10^{12}/l and a haematocrit (Hct) over 0.65 are encountered frequently when cord clamping is delayed and blood from the placenta and umbilical artery re-enter the infant's circulation. After the immediate postnatal period, the Hb falls fairly steeply to a minimum by about the 2nd month. The RBC and Hct also fall, although less steeply, and the cells may become microcytic with the development of iron deficiency. The changes in the mean cell haemoglobin (MCH), mean cell haemoglobin concentration and mean cell volume (MCV) from the neonate. Posture there is a small but significant alteration in the plasma volume with an increase in haemoglobin and Hct as the posture changes from lying to sitting, especially in women conversely, changing from walking to lying down results in a 5–10% decrease in the Hb and Hct. Thus, subjects should rest for 5–10 min before their blood is collected. The difference in position of the arm during venous sampling, whether dependent or held at atrial level, can also affect the Hct. These aspects highlight the relevance of using a standardized method for blood collection, although this is not necessarily practicable in routine practice. This is discussed in and the differences between venous and capillary blood are described on(Dacie and Lewis,2006)

Changes in Hb and RBC during the course of the day are usually slight, about 3%, with negligible changes in the MCV and MCH. However, variation of 20% occurs with reticulocytes. Studies of diurnal variation of serum erythropoietin have shown conflicting results. Pronounced, but variable, diurnal variations are seen in serum iron and ferritin and in patients taking iron-containing supplements. It has been suggested that minor seasonal variations also occur, but the evidence for this is conflicting. The effect of altitude is to reduce plasma volume, increase the Hb and Hct and raise the number of circulating red cells with a lower MCV. The

magnitude of the polycythaemia depends on the degree of hypoxaemia. At an altitude of 2000 m (*c* 6500 ft), Hb is *c* 8–10 g/l and Hct is 0.025 higher than at sea level; at 3000 m (*c* 10 000 ft), Hb is *c* 20 g/l and Hct is 0.060 higher and at 4000 m (*c* 13 000 ft) Hb is 35 g/l and Hct is 0.110 higher. Corresponding increases occur at intermediate and at higher altitudes. These increases appear to be the result of both increased erythropoiesis which is secondary to the hypoxic stimulus and the decrease in plasma Volume that occurs at high altitudes.

1.2.7 .2Leucocyte Count

The effect of age is indicated at birth, the total leucocyte count is high; neutrophils predominate, reaching a peak of *c* 13.0 × 10^9/l within 6–8 h for neonates of >28 weeks' gestation and 24 h for those delivered at <28 week

The count then falls to *c* 4.0 × 10^9/l over the next few weeks and then to a level at which the count remains steady. The lymphocytes decrease during the first 3 days of life often to a low level of *c* 2.0–2.5 × 10^9/l and then rise up to the 10th day; after this time, they are the predominant cell (up to about 60%) until the 5th to 7th year, when they give way to the neutrophils. From that age onwards, the levels are the same as for adults There are also slight sex differences; the total leucocyte count and the neutrophil count may be slightly higher in girls than in boys, and in women than in men. After the menopause, the counts fall in women so that they tend to become lower than in men of similar age. People differ considerably in their leucocyte counts. Some tend to maintain a relatively constant level over long periods; others have counts that may vary by as much as 100% at different times. In some subjects, there appears to be a rhythm, occurring in cycles of 14–28 days and in women this may be related to the menstrual cycle or to oral contraception. There is no clearcut diurnal variation, but minimum counts are found in the morning with

the subject at rest and during the course of a day there may be differences of 14% for the total leucocyte count, 10% for neutrophils, 14% for lymphocytes and 20% for eosinophils; in some cases this may result in a reversed neutrophil:lymphocyte ratio. Random activity may raise the count slightly; strenuous exercise causes increases of up to 30×10^9/l, partly because of mobilization of marginated neutrophils and changes in cortisol levels. Large numbers of lymphocytes and monocytes also enter the bloodstream during strenuous exercise. However, there have also been reports of neutropenia and lymphopenia in athletes undergoing daily training sessions.

Epinephrine (adrenaline) injection causes an increase in the numbers of all major types of leucocytes (and platelets), possibly reflecting the extent of the reservoir of mature blood cells present not only in the bone marrow and spleen but also in other tissues and organs of the body. Emotion may possibly cause an increase in the leucocyte count in a similar way. A transient lymphocytosis with a reversed neutrophil:lymphocyte ratio occurs in adults with physical stress or trauma. The effect of ingestion of food is uncertain. Cigarette smoking has an effect on the leucocyte count (Dace and Lewies,2006).

A moderate leucocytosis of up to 15×10^9/l is common during pregnancy, owing to a neutrophilia, with the peak in the 2nd trimester. The count returns to non-pregnancy levels a week or so after delivery .In individuals of African ancestry there is a tendency for the neutrophil:lymphocyte ratio to be reversed primarily due to a reduction in neutrophil count. This is thought to be due to genetic rather than environmental factors because significantly lower leucocyte counts, especially neutrophil counts, have also been observed in Africans and Afro-Caribbean's living in Britain.(Indu, 2008)

‘Benign ethnic neutropenia’ occurs in up to 5% of African Americans and is defined as a neutrophil count $<1.5 \times 10^9$/l without overt cause or complications. region on chromosome, possibly the Duffy Null polymorphism, has recently been associated with the difference in WBC and neutrophil count between African Americans and European Americans(Indu, 2008)

1.2.7.3 Platelet Count

There is a slight diurnal variation in the platelet count of about 5%; this occurs during the course of a day as well as from day-to-day. Within the wide normal reference range, there are some ethnic differences and in healthy West Indians and Africans platelet counts may on average be 10–20% lower than those in Europeans living in the same environment. There may be a sex difference; thus, in women, the platelet count has been reported to be about 20% higher than in men A decrease in the platelet count may occur in women at about the time of menstruation. There are no obvious age differences; however, in the 1st year after birth the platelet count tends to be at the higher level of the adult normal reference range.(Indu, 2008)

1.2. 8 Anemia:

Anemia is presented when the hemoglobin level in the blood is bellow the lower extreme of the normal range or the age and sex of the individual. (Firkin, 1996).

A common error leading to misdiagnosis of anemia is failure to refer to the normal range appropriate for the age and sex of the individual, as an acceptable level in a one-year-old child could represent moderately severe anemia in an adult male. The hemoglobin level is employed as the prime arbiter in the diagnosis of

anemia. The red cell count does provide an alternative means of assessment, but it can be in the normal range in people who are anemic on the basis of hemoglobin level when the red cells are microcytic, as in thalassaemia minor or iron deficiency (Firkin., 1996).

Abnormal great cell indices can exist in subject even where under ling disorder is not sufficiently sever to cause anemia. This is not uncommon in thalassaemia minor or iron deficiency where the MCV, MCH and MCHC can be low and in megloblastosis where the MCV and MCH are elevated (Firkin ,1996).

1.2.8.1 Classification of anemia:

Once anemia has beeen detected classifiing it is usually beneficial as it assists in estabishment of definitive diagnosis **.**

Anemia can be classified into two categories:

1. Morphological classification:

2. Etiological classification:

1.2.8.1.1Morphological classification of anemia:

Three main types of anemia are recognized on the basis of the mean (MCV), mean hemoglobin content (MCH), and mean HB concentration (MCHC) of the red cells. (Firkin,1996).

1.2.8.1.1 Microcytic hypochromic Anemia:

Microcytic anemia,in it the red blood cells (erythrocytes) are usually also hypochromic, meaning that the red blood cells appear paler than usual. This is reflected by a lower-than-normal mean corpuscular haemoglobin concentration (MCHC), a measure representing the amount haemoglobin per unit volume of fluid

inside the cell; normally about 320-360 g/L or 32-36 g/dL. Typically, therefore, anemia of this category is described as microcytic, hypochromic anaemia" Typical causes of microcytic anemia include:childhood iron deficiency anemia, by far the most common cause of anemia in general and of microcytic anemia in particular thalassemia and in adulthood iron deficiency anemia.sideroblastic anemia, congenital or acquired anemia of chronic disease lead poisoning ,deficiency

(Steven ,1996)

1.2.8.1.2 Norm chromic Normocytic Anemia's:

Forms of anemia in which the average size and hemoglobin content of the red blood cells are within normal limits are called normocytic normochromic anemias. Usually microscopic examination of the red cells shows them to be much like normal cells. In other cases there may be marked variations in size and shape, but these are such as to equalize one another, thus resulting in normal average values. The normocytic anemias are a miscellaneous group, by no means as homogeneous as the megaloblastic anemias. Anemia caused by the sudden loss of blood is necessarily normocytic at first, since the cells that remain in the circulation are normal. The blood loss stimulates increased production, and the young cells that enter the blood in response are larger than those already present in the blood. If the young cells are present in sufficient number, the anemia temporarily becomes macrocytic (but not megaloblastic). anemia caused by sudden blood loss includes. haemolysis,or where the rate of red cell destruction is accelerated. It also occurs when red cell production is impaired by bone marrow failure, when bone marrow is replaced by infiltrating neoplastic tissue, and as a result of the effects of renal failure and Chronic inflammation or infection (Robert,2005)

1.2.8.1.3 Macrocytic anemia

An anemic state characterized by the presence of abnormally large RBCs in the peripheral blood. The cause of macrocytic anemia may be due to a variety of illnesses and demands further clinical and laboratory assessment. Macrocytic anemia can usually be divided into two categories, megaloblastic and nonmegaloblastic, based on the examination of the bone marrow. This classicffication is important aids in determining the etiology of the anemia. some of etiologies associated with macrocytic anemia includes nutritional deficiencies (e.g., vitamin B12 and folate), drugs(-Pyrimethaminend) primary bone marrow disorders (e.g., myelodysplasia a leukemia) nd other chronic illnesses as Alcoholism. Reticulocytosis Nonalcoholic and alcoholic liver disease

Macroytosis due to vitamin B12 or folate deficiency is a direct result of ineffective or dysplastic erythropoiesis. These important vitamins and cofactors are required for normal maturation of all cells.(Florence *etal,*2006)

1.2.8.2Etiological classification:

Blood loss, Impaired red cell production, inadequate supply of nutrients essential for eythropoiesis, such as: iron deficiency vitamin B12 deficiency folic acid deficiency protein-calorie malnutrition, depression of erythropoietin activity, anemia associated with chronic disorders, such as: infection, connective tissue disorders inflammatory disorders, anemia associated with renal failure, anemia due to replacement of normal bone marrow by: leukemia, lymphoma, anemia due to inherited disorders , such as thalassaemia, excessive red cell distinction, due to intrinsic defects in red cells, due to extrinsic effects on red cells (Dacie and Lewis, 2006).

Based on the ability of the bone marrow to respond to anemia with increased erythropoietin, it involved assessing erythrocyte production using the reticulcyte count and calculated RPI. When anemia occurs, if the bone marrow is capable of responding increased number of young nucleated red enter the circulation. These young polychromatophihic red cell, released prematurely from the bone marrow because of erythropoietin stimulation, are called shift reticulocytes, a term refracting their premature shift from the bone marrow to peripheral blood.Thus reticulocyte may be significantly increased in the circulation without an in marrow red cell production (Stiene *et al* ,1998).

1.2.10 Physiological Adaptations in Anemia:

Tissue hypoxia develops when compensatory physiological adjustments that enhance release of oxygen from hemoglobin, and increase the flow of blood to the tissues, fail to counteract the effects of the decreased oxygen carrying capacity of the blood caused by the subnormal level of hemoglobin. Hypoxia causes impairment of function ill many tissues, and the symptoms and signs of anemia are therefore referred to many systems increased release of oxygen from red cells a greater proportion of the oxygen attached to hemoglobin is released when the red cell passes through the tissues in anemic subjects. This results from the increase in concentration of 2,3 -diphosphoglyccrate which takes Place in the red cell in anemia; the oxygen dissociation Curve is shifted to the right.

Increased blood flow and cardiac output in anemia, the volume is maintained within approximately normal limits by an increase in the volume of the plasma to counteract the decrease in volume of red cells. Redistribution of blood flow, some deviation of blood flow occurs from tissues with lesser oxygen requirement to those with greater requirements (Firkin ., 1996).

1.2.11 Causes of Anemias:

Anemia caused by blood loss, an important cause of anemia and although history should be taken to establish weather epistaxis, rectal bleeding or recurrent bleeding from other site has occurs, also caused by decreased or faulty red blood cell production, and caused by destruction of red blood cells, and caused due to inadequate diet as iron deficiency anemia and megaloblastic anemia (Adamson ., 2008)

1.2.12 Symptoms and Signs of Anemias:

If the patient does have symptoms, these are usually shortness ‘of breath particularly on exercise), weakness, lethargy, palpitation and headaches. In older subjects symptoms of cardiac failure, angina pectoris or intermittent claudicating or confusion may be present. Visual disturbances due to retinal hemorrhages may complicate very severe anemia, particularly of rapid onset (Hoff brand, 1993)

These may be divided into general and specific. General signs include pallor of mucous membranes which occurs if the hemoglobin level is less than l0g/dl. Skin color, on the other hand, is not a reliable sign of anemia; the state of the skin circulation rather than the hemoglobin Content of the blood largely determines skin color. A hyper dynamic circulation may be present with tachycardia, a bounding pulse, cardioinegaly and a systolic flow murmur especially at the apex. Particularly in the elderly, features of congestive heart failure may be present. Retinal hemorrhages’ are unusual (Firkin., 1996)

Specific signs are associated with particular types of anemia, e.g. koilonychias (spoon nails) with iron deficiency, jaundice with hemolytic megaloblastic anemia, leg ulcers with sickle cell and other hemolytic anemia, bone

deformities with thalassaemia major and other sever congenital haemolytic anaernias (Firkin 1996), (Hoff brand, 1993)

1.2.13 Diagnosis of Anemia:

The medical history of patient is source of information and can give important which may assist in diagnosis.

1.2.14 Laboratory investigation of Anemia:

Complete blood count **(CBC)** A CBC helps doctor check any symptoms, such as weakness, fatigue, or bruising, you may have. A CBC also helps him or her diagnose conditions, such as anemia infection, and mary other disorders. A complete blood count (CBC) gives important information about the kinds and numbers of cells in the blood especially red blood cell, white blood cell , and platelets.(Dace & Lewis, 2006).

1.2.14.1 Complete blood count include:

A).Hemoglobin: Also spelled hemoglobin and abbreviated Hb or Hgb) is the iron-containing oxygen- transport metalloproteinase in the red blood cells of vertebrates. In animals, the protein makes up about 97% of the red cell's dry content, and around 35% of the total content (including water). Hemoglobin transport oxygen from the lungs or gills to the rest of the body, such as to the muscles, where it releases the oxygen for cell use. It also has a Varity of other roles of gas transport and effect-modulation which vary from species to species, and are quite diverse in some invertebrates (Maton, 1993).

B) Rbcs Count: Can be count manually by using hemocytometer(chamber) or automatically (RBCs counted in system based on either aperture impedance or light scattering technology) (Dace and Lewis, 2006).

C) Hematocrit or PCV: Can be used as simple screaming test for anemia as reference method or calibrating automated blood count system and the rough guide to the accuracy of hemoglobin measurement, the haematocrit is about three time Hb. express in g\dl, it can he used in calculation of red cell indices.

D).Red cell indices: Traditionally have been the derived parameter of MCV, MCH and MCHC, these indices are basis for classifying anemia's and in various combination they have been used to distinction between iron deficiency anemia and thalassaemias (Dace and Lewis, 2006).

E) White blood cells count: Is determined in whole blood in which red cell has been lysed. The lytic agent is required to destroyed the red cell and reduce red cell stoma to residue that cause no detectable response in count system without affecting leucocytes in such a manner that ability of system to count them is altered (Dace and Lewis Lewis, 2006).

F).Platelet Count: Can be counted in whole blood using the same techniques of electrical or electro-optical detection are use for counting red cell. (Dace and Lewis, 2006).

1.2.14.2 White blood cell types (WBC differential):

The major types of white blood cells are neutrophil, lymphocytes, monocytes, eosinophils, and basophiles. Immature neutrophils, called band neutrophils, are also part of this test. Each type of cell plays a different role in protecting the body. The numbers of each one of these types of white blood cells give important information about the immune system. Too many or too few of the different types of white blood cells can help find an infection, an allergic or toxic reaction to medicines or chemicals, and many conditions, such as leukemia.(Dace and, Lewis 2006)

1.2.15 Previous Studies:

This study In Senegal,. This was carried out in s, 2010 among apparently healthy children aged 9-15 months s to study the diet, and risk factors of anemia. They considered children as anaemic if the haemoglobin rate was below 11g/dl. Of the 245 children, 212 were anaemic, which was a prevalence of 86.5%. This anemia, frequently of the microcytic hypochromic type (68. 86%) was significantly ($p < 0.0003$) observed among the children of housewives compared with those whose mothers were employed. Among anemic children, 60.8% were only taking breast milk with or without cereal porridge as a food supplement. The absence of consumption of protein, vegetables, fruits and dairy products was a risk factor for the occurrence of anemia ($p <0.0001$).(*Diouf et al,2014*)

Second study was done to determine the prevalence of anemia, and some of its determinants, in preschool children in a rural village in the Northern State of Sudan. All children aged 3–6 years taken for haemoglobin measurement. Out of 163 children, 131 had anaemia (haemoglobin level < 11 g/dL), a prevalence of 80.4%.. The prevalence of anemia was not significantly associated with any of the studied demographic and socioeconomic factors (sex, economic status of the family, mother's literacy or family size) or health of the child (history of pica or number of attacks of malaria in the last year.(. Hussein and, Mohamed,2014)

1.2.16 Rationale:

Anemia is global health problem and it is one of major causes of childhood mortality and morbidity (De Benoist, 2008).

There as few data available about anemia frequencies in normal children in Sudan, complete blood count reflect child health status. So this study was conducted to find out measurement of complete blood count for less than five years children.

1.2.17 Objectives:

General objective:

- To measure complete blood counts in normal in under five years children in Khartoum state.

Specific objectives:

1. To measure Hb, PCV, MCV,MCH, MCHC- Rbcs ,Wbcs and Plt count.
2. To examine morphology of red blood cells among children.
3. To compare CBC parameters in children according to iron supplement.
4. To compare mean of CBC parameters according to education level of mothers
5. .To compare CBC parameters in children according to breast feeding practice
6. .To compare CBC parameters in children according food content.

Chapter Tow

Methods and Materials

2.1 Study Design:-

This is cross sectional study was conducted to measure complete blood count among under five years children in Khartoum state. During March to June 2014

2.2 Study Population:

2.3 Inclusion Criteria:

All children in age 1-5 years who appear health and their parent s agree to participate in the study.

2.4 Exclusion Criteria:

Any child more than 5 years. or child suffers from bleeding disorder.orHistory of blood transfusion or .History of surgery within two month

2.5 Sample size

Two hundred from apparently healthy children under five Random selected (114) male (86) female living inAlhaj yousif and Omdurman (-march –June 2014).

2.6 Data collection:

Data was collected using designed questionnaire to obtain data of name. Age education of mother level .iron supplement .food balance include CBC measurements(Hb-Pcv-Mcv-MCHC-MCH-Rbcs RBcs count-wbcs count-and plt count. and comment of thin blood film was done to all participate

2.7 Equipments:

Automated hematological analyzer (sysmex KX21N)for complete blood count (as seen in appendixNo1)

Microscope. leishman stain to stain thin blood films .clean slides. Cover glass and oil . buffer saline PH7.4. 70% Alcohol (Ethanol) and cotton. (Dacie & Lewis 2006)

2.8Collection of blood samples:

Avenous blood sample (2.5) ml was taken from all particepente using disposabl plastic syringe and blood poured in potassium ethylene tetra acidic acid (K2EDTA) container mixed gentele before analyzed.

- **2.9.0 Measurement of complete blood count by using** sysmex KX21N CBC was done using **of sysmex :**

2.9.1Principle and method of instrument (sysmex) measurement of blood cells (RBcs.WBcs.Platlets) and HB concentration obtained by aspiration of small volume of well mixed K2EDTA blood by sample probe and mixed with isotonic diluents in nebulizer .Diluted mixture aspiration delivered to RBcs aperture path for providing information about RBcs and platelet based on size .particles of 2 to 20 fl counted platelet above 36 fl counted as Red cells. Some portion of aspirated mixture induced into wbcs path in which hemolytic reagent (stromatolyzer)was added to automatically to measure Hb concentration in abuild calorimeter .based on cyanomethemoglobin (HiCN)blood cell counted and size information generated in triplicate pulses according to electronic conductivity and translated into digital number using in build calculater programmed and designed for RBcs .WBcs count hence three values were directily measured (RBcs- .WBcs –HB)and displayed on (LCD)other values of red cell indices .platlet lecuocyte differential and absolute

count calculated from given information and automated constructed histograms .The result printed out according to setting mode.(Sysmex manual)

2.10 complete blood count

(A)Principle:

Peripheral blood smears are evaluated to determine cell morphology, verify automated cell counts, and determine the percentage of each type of WBC. Today's lab focuses on identifying red blood cell inclusions and abnormal RBC morphology.

(B)Reagents, material and method:

Prepared slides.

Microscope, immersion oil and lens paper .

Small drop of blood was placed near end of the slide brought the adage of another slide in contact with drop and allowed the drop to bank evenly behind the spreader the angles between two slide was 45 degrees. Now we pushed spreader to the left in smooth quick motion, the smear should cover about the half of slide. Then fixed with alcohol and left to air dry.

2.10.1 Staining:

The slide filled with Leishman stain on the staining rack after 3 minutes double volume of buffer added to slide for 7 minutes and then washed with tape water and left air.

2.10.2 Examing of Blood film

Place a lishmans stained slide on stage Using the 10X objective, find an area where 50% of the RBCs are slightly overlapping and 50% of the RBCs are not touching (toward the feathered edge). The red blood cells should have a central pallor.Using the turret, switch to the 100X oil objective, add oil, and focus on the red blood cells. In at least 10 consecutive fields, observe the number of inclusions, and examples abnormal RBC morphology.(Davidson,1974).

2.11 Ethical consideration:

Informed consent was explained to participant's mother before recruitment into the study followed by a signed an Informed consent all information regarding the patient remain confidentially.

2.12 Data processing:

Data was computerized by medical statistic and Spss program used for data entry analysis.

2.13 Data presentation:

Data was presented in form of tables .

Chapter Three

Results:

Table (3.1) Distribution of children by gender were 200 sample (114 male 57.0% and 86 43.0%female

Table (3.2)Distribution of anemia in children 50.5% were anemic and 49.5% were normal .

Table (3.3) Type of anemia according to morphology of Rbcs Microcytic hypochromic anemia is 77.5% .Normocytic normochromic anemia is 21.5% and Macrocytic normochromic is only 1%.

Table(3.4).of hematological parameter according to educational level of their mother's Hb =8.8g/dl, for illetrate,9.6 g/dl for children with mother's primary level, 10.7 g/dl for children with mother's secondary level,11.8g/dl for children with mother's collage level. RBcs count for children with mother's illiterate level, =. 3.800 $x10^{12}$ cell/l, RBcs count for children with mother's primary =4 $x10^{12}$ cell/l RBcs count for children with mother's secondary =4.2 $x10^{12}$ cell/l, and RBcs count for children with mother's collage =4.4 $x10^{12}$ cell/l with p value (.000), pcv for children with mother's illiterate = 26%, pcv for children with mother's primary = 30%, pcv for children with mother's secondary = 32%, pcv for children with mother's collage = 35%, Wbcs for children with mother's illiterate = $8.100x10^{3cumm}$, Wbcs for children with mother's primary = $7.800x10^{3cumm}$, Wbcs for children with mother's secondary = $8.200x10^{3cumm}$, Wbcs for children with mother's university = $8.100x10^{3cumm}$ With p value(0,921)

Mean of hematological parameter according to food content Hb in children whom take balanced food =12.6g/dl and in children take unbalanced food =10g/dl with p value (0.00).Rbcs in children who take balanced food = and in children take unbalanced food = $4.0x10^{12}$ with p value (0.00), pcv in children who take balanced food= 37% and in children take unbalanced food =31% with p value (0.00), Mcv in children who take balanced food= 76fl and in children take unbalanced food= 72fl with p value (0.12), MCH in children who take balanced food= 26 and in children take unbalanced food= 24 with p value(,001), MCHC in children who take balanced food= 33pic and in children take unbalanced food= 31pic with p value (0.00), WBCS in children who take balanced food= $7.800x10^{3cumm}$ and in children take unbalanced food = $8.200x10^{3cumm}$ with p value((,0280),Plt in children who take balanced food= $290x10^{9\ cell/l}$ and in children take unbalanced food= = $290.6x10^{9\ cell/l}$ with p value (0.959 Table (3.5).

Table (3.6)mean of heamatolgical parameter according to breast feeding practice Hb in children who take breast feeding = 11.4g/dl and 9.5 g/dl in children who not take breast feeding, with p value (0.00), Rbcs in children who take breast feeding= $4.3x10^{12}$ And = $3.9x10^{12}$ in children who not take breast feeding, with p value (0.00), Pcv in children who take breast feeding= 34% and 29% in children who not take breast feeding, with p value (0.00), MCV in children who take breast feeding= 75 fl and 68 fl in children who not take breast feeding, with p value (0.00), MCH in children who take breast feeding= 25 and 22 in children who not take breast feeding, with p value (0.00), MCHC in children who take breast feeding = 32 pic and 30 pic 22 in children who not take breast feeding, with p value (0.00), WBcs in children who take breast feeding = $8.200x10^{3cumm}$

And 7.500x10^{3cumm} in children who not take breast feeding with p value (0.121), Plt in children who take breast feeding =286 x10^{9} and 303 x10^{9} in children who not take breast feeding (0.238)).

table (3.7)mean of heamatolgical parameter according to taking Iron supplement in children who.take Iron Hb = 12.4g/dl and in children not take Iron Hb= 10.5g/dl with P.value (0.00). Rbcs in children who take Iron = 4.5x10^{12} and in children not take Iron = 4.1x10^{12} with P.value (0.00). Pcv in children who take Iron =37% and in children not take Iron = 32% with P.value (0.00), Mcv in children who take Iron =75.7 fl and in children not take Iron =73 with P.value (0.031), MCH C in children who take Iron = 33pic and in children not take Iron = 32 pic with P.value (0.052), WBCS in children who take Iron = 7.900x10^{3cumm} and in children not take Iron =8100x10^{3cumm} with P.value (0.645),PLT in children who take Iron = 280 x10^{9} and in children not take Iron = 293 x10^{9} with P.value (0.323),

Table(3-1) Distrbution of children according to gender

Options	Frequency	Percentage
Male	114	57.0
Female	86	43.0
Total	200	100%

Percentage of anemia

Options	Frequency	Percentage
Anima	101	50.5
Normal	99	49.5
Total	200	100%

(Anemia consider if hemoglobin below 11g/dl)

Table (3-3) show Frequency of different type anemia mong children

Options	Frequency	Percentage
Microcytic hypochramic	155	77.5
Normocytic normocromic	43	21.5
Macrocytic normochromic	2	1.0
Total	200	100%

Table (3-4) show the mean of hematological parameter in children according to educational level of their mothers

Test	Levels	N	Mean ± SD		P.value
HBg/dl	None	1	8.80	.	0.000
	Primary	26	9.65	1.73	
	Secondary	92	10.75	1.44	
	university	81	11.84	1.78	
RBCs×10^{12}/l	None	1	3.80	1.70 .	0.014
	Primary	26	4.03	0.576	
	Secondary	92	4.18	0.55	
	university	81	4.40	0.62	
PCV%	None	1	26.00	2.75	0.000
	Primary	26	30.11	4.31	
	Secondary	92	32.58	3.75	
	university	81	35.61	5.32	
MCV fl	None	1	70.00	.	0.021
	Primary	26	69.15	13.13	
	Secondary	92	73.53	8.18	
	university	81	76.02	10.54	

Test	Levels	N	Mean ± SD		P.value
MCH pg	None	1	23.00	.	0.004
	Primary	26	22.42	5.93	
	Secondary	92	24.60	4.16	
	university	81	26.01	4.06	
MCHC%	None	1	32.00	.	0.000
	Primary	26	30.30	3.67	
	Secondary	92	32.52	2.18	
	university	81	33.03	1.90	
WBCs×10^{3cumm}	None	1	8.10	.	0.921
	Primary	26	7.8000	2.32	
	Secondary	92	8.22	2.83	
	university	81	8.10	2.84	
PLT×10^{9}/l	None	1	293.00	.	0.534
	Primary	26	305.19	82.72	
	Secondary	92	294.54	89.07	
	university	81	280.92	71.04	

Table (3-5) show mean of hematological parameter in children according(content of food taking)

Test	Treatment	N	Mean ± SD		P.value
HBg/dl	Yes	157	11.4510	1.65	0.000
	No	43	9.5698	1.47	
RBCs×10^{12}/l	×10/l	157	4.30	0.54	0.000
	No	43	3.98	0.69	
PCV%	Yes	157	34.42	4.74	0.000
	No	43	29.93	3.80	
MCV fl	Yes	157	75.51	9.13	0.000
	No	43	68.25	11.40	
MCH pg	Yes	157	25.59	4.18	0.000
	No	43	22.27	4.75	
MCHC%	Yes	157	32.89	1.97	0.000
	No	43	30.79	3.27	
WBCs×10^{3}/l	Yes	157	8.27	2.72	0.121
	No	43	7.54	2.83	
PLT×10^{9}/l	Yes	157	286.85	81.78	0.238
	No	43	303.37	78.50	

The following table (3-6) show mean of hematological parameter in children according (to breast feeding practice).

	Tretment	N	Mean ± SD	p.value
HBg/dl	Yes	157	11.45 1.65	0.000
	No	43	9.56 1.47	
RBCs×10^{12}/l	Yes	157	4.33 .54	0.000
	No	43	3.98 .69	
PCV%	Yes	157	34.42 4.74	0.000
	No	43	29.93 3.80	
MCV fl	Yes	157	75.51 9.13	0.000
	No	43	68.25 11.40	
MCH pg	Yes	157	25.59 4.18	0.000
	No	43	22.27 4.75	
MCHC%	Yes	157	32.89 1.97	0.000
	No	43	30.79 3.27	
WBCs×10^{3}/l	Yes	157	8.27 2.72	0.121
	No	43	7.54 2.83	
PLT×10^{9}/l	Yes	157	286.85 81.78	0.238
	No	43	303.30 78.50	

Table(3-7)mean of hematological parameter in children according to treatment (iron supplement).

	Treatment	N	Mean ± SD	p.value
HBg/dl	No	149	32.22 4.36	0.000
	Yes	51	12.48 1.51	
	No	149	10.55 1.60	
RBCs×10^{12}/l	Yes	51	4.54 .476	0.000
	No	149	4.15 .602	
PCV%	Yes	51	37.05 4.68	0.000
MCVfl	Yes	51	75.76 11.42	0.138
	No	149	73.33 9.55	
MCH pg	Yes	51	26.05 3.94	0.031
	No	149	24.48 4.63	
MCHC?%	Yes	51	33.01 1.65	0.052
	No	149	32.24 2.66	
WBCs×10^{3}/l	Yes	51	7.96 2.70	0.645
	No	149	8.17 2.78	
PLT×10^{9}/l	Yes	51	280.68 80.53	0.323
	No	149	293.73 81.40	

Chapter four

Discussion & Conclusion & Recommendation

4.1 Discussion:

Anemia is global health problem and it is one of major causes of childhood mortality and morbidity (Benoist; 2008).

Anemia is presented when Hb level in blood is bellow the lower extreme of the normal range of the age and sex of the individual (Firkin; 1996).

this study carried out to measure complete blood count for children under five years to reflect their health status in (200)child with healthy appearance 1-5 years in Khartoum state in period between March- May 2014. Which was nearly study done in Senegal which detected prevalence of Anemia in apparently healthy a children 2013) In Sudan few studies conducted in this health problem. Study done in Northern Sudan in 2013 to determine the prevalence of anemia in preschool children.

In this study confirms significant decreased in Hb level less than 11g/dl comparining with that done in sudan (Hussin and Mohmmed; 2014) and sengal (Diuof; 2014) said heamoglobin level was sigfcantly decreased in children under five . prevalence of anemia among children under five years in Khartoum state was 50.5% this is lower percentage when we compare with results from studies conducted in Northern Sudan (80%)and in Senegale (86.5%)(Diuof etal; 2014) (the high prevalence of anemia in those studies is therefore not surprising at the Sudan is one of poorest Countries in the World. But on comparing with the other Countries as Senegale percentage of anemia is better than it.. For instance

prevalence of anemia in United State of America is only 16% (De Benoist 2008). It is well known that is prevalence of anemia rises with increasing poverty.

In this study of the 200 child 101 were anemic 77.5% is the percentage of microsytic hypochromic this agree with the study in Sengale microsytic hypochromic is 86% . The study observe that Mcv, McH were lower than normal while McHc within normal value that agree with study in Senegale in the study Mcv (73fl) McH (25) and McHc (32pic) with p (0.00)..

Social economic factors (educational level of mother, eating habits , breast feeding,)was risk factors in occurrence of anemia p(0.00) agree with study in Senegal with significant p(0.00) (Diuof etal; 2014)

in constract our finding socioeconomic factors would have great impact on children in study in northern Sudan because people living in rural community where families are extended and share cultures and eating habits not affect by education level in rural area complete breast feeding more than in towns in or study no feeding practice represent risk factor in anemia in infants (Hussien and Mohmmed; 2014)

This study is first study done in iron supplement taking affect result is there great impact of iron supplement taking in preventing anemia with significant p(0.00).

The limitation of the study include further investigation to determine the etiology of anemia in these children beyond the scope of the study however having more data as to the type and cause of anemia would be informative.

4.2 Conclusion:

Study carried out that is:

1. The study show that 77%of children have microcytic hypochromic anemia .21%have normocytic normchromic anemia while only 1% and macrocytic normchromic .
2. have Heamglobin, Mean cell volume, Mean Cell Heamoglobin below normal but McHC, Red blood cells and Platelet are normal values
3. The study released that breast feeding , iron supplement and high level of mother education reduce incidence of *an*emia among children
4. White blood cell and platelet not affected by sociecnomic factor s

4.3 Recommendation:

The study recommends the following :-

1. Periodic medical check up for children should be taken by primary health care to detect and prevent anemia.
2. Health education program for mothers to know about healthy and benefit food for their children.
3. Learn mothers about complication of Anemia to avoid occurrences of it.
4. Recommended further studies to measure Iron status and observe other cultural habits and effect of it on Anemia.

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Hematological Values for Normal Children:

*Red cell count:		
	Children1 year	4.4+0.8 x10^{12} /L
	Children 3-6 year	4.8+0.7x10^{12} /L
*Hb:		
	Children1 year	12+1.5 g/d /L
	Children 3-6 year	13+1.0g/d/L
*Pcv (Heamatocrit):		
	Children1 year	0.38=0.06 (L/L)
	Children 3-6 year	0.40+0.04 L/L
Mcv:		
	Children1 year	78+8 FL
	Children 3-6 year	84+8FL
MCH:		
	Children1 year	27+4 Pg
	Children 3-6 year	27+3 pg
*MCHc:		
	Children1 year	32+5 g/L
*TwBcs:		
	1 years	12+6x10^{9}/L
	4-7 year	10+5x 10^{9}/L
*PLt:	Children1-5year	150-400x10^{9} /L
	(Dace 2006)	

Sudan University of science and Technology

College of Graduate Studies

Msc Program in Hematology

Measurement of complete blood count among

Healthy children under five years in Khartoum stat

Questionnaire:-

1. Address:-…….
2. Name of child:
3. Age …….years
4. Sex:

   Male ☐ Female ☐
5. Breast feeding practice:

   yes ☐ No ☐
6. Content of food taken:

   Balanced ☐ Unbalanced ☐
7. Mother education level

   None ☐ primary ☐ Secondary ☐ Collage ☐
8. Child take Iron supplement:

   Yes ☐ No ☐

   Sig……..

جامعة السودان للعلوم والتكنولوجيا

كلية علوم المختبرات الطبية

Informed Consent

السيدة والدة الطفل / .....

سوف يؤخذ من الطفل عينه بحجم ml2.5 من الدم لإجراء فحص دم شامل وذلك لاغراض بحثية علما بان كل الادوات المستخدمه لاخذ العينه ادوات معقمه ومتبع فيها جميع وسائل السلامه المعمليه . لن يكون هناك اي أذى أو مضاعفات. تسلم نتيجة الفحص بعد إجراءه مع شرح النتائج.

اوافق انا المذكور اعلاه علي اخذ عينه لاجراء الدراسه

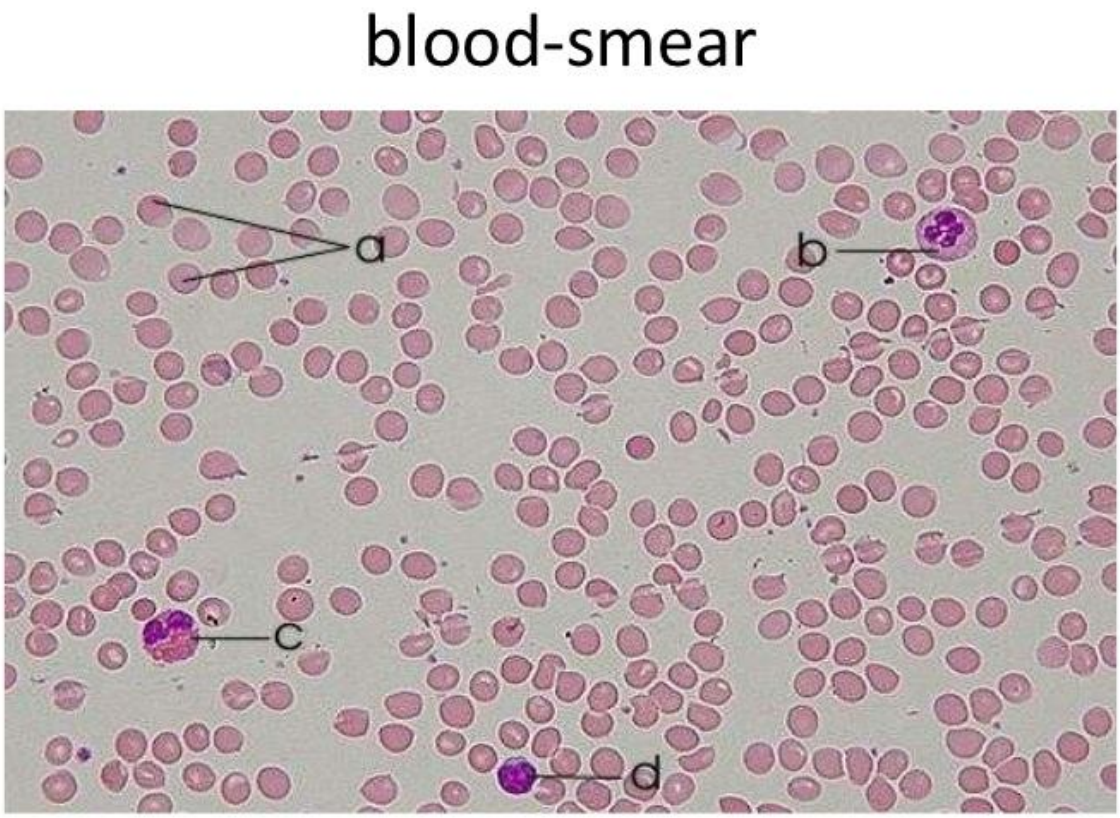
التوقيع :.....

Figure (4.1)

Sysmex KX-21N Automated Hematology Analyzer

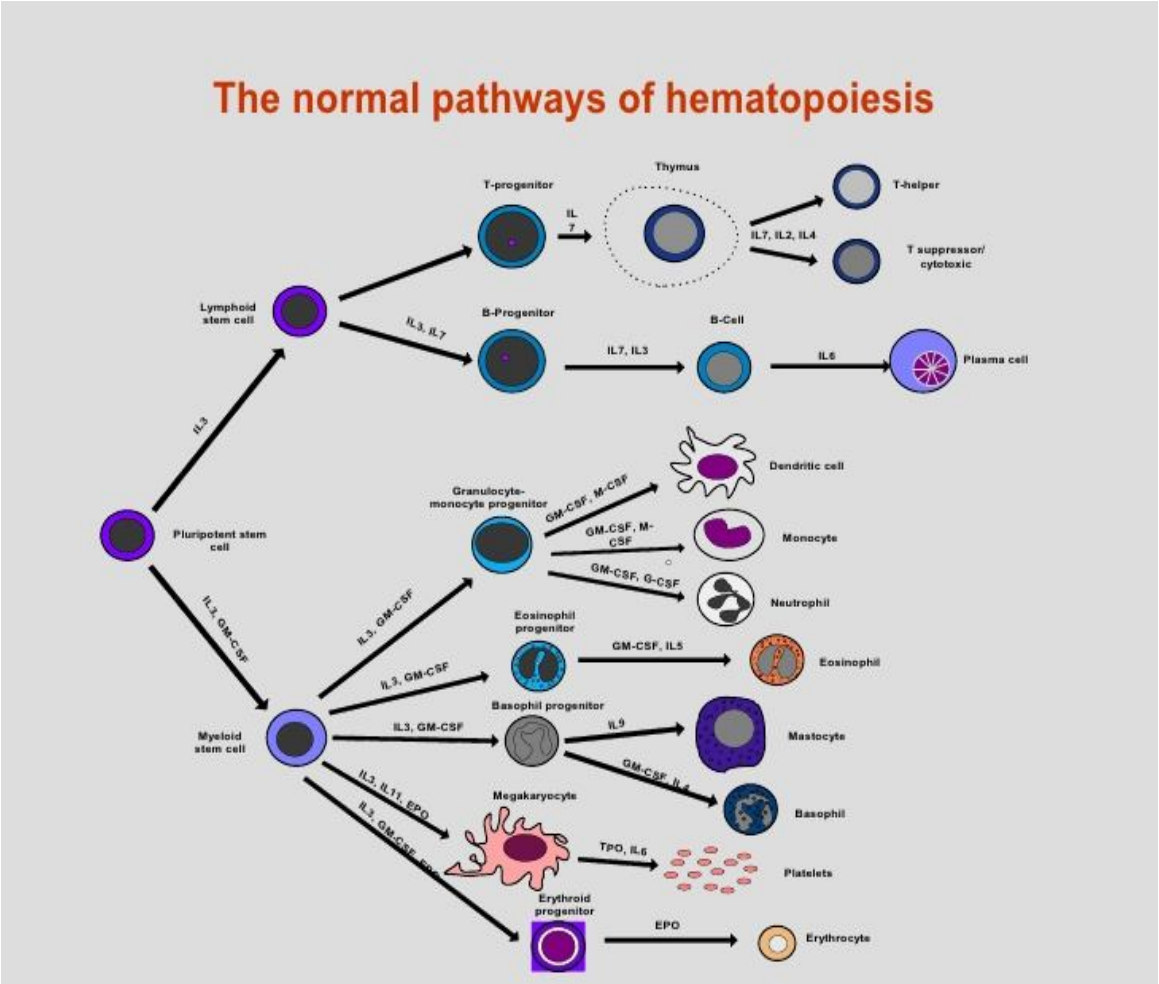
(Sysmex manual 2014)

Figure 4.2)



(Renu saxena2008)

Figure (4.3)



Heamopesies

(Renu saxena2008)