Addis Ababa University

College of Health science

School of Allied Health Science

Department of Medical Laboratory Science

Hematological profile of pregnant women at St. Paul‟s Hospital Millennium Medical College, Addis Ababa, Ethiopia.

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Approved by the Examining Board

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Abbreviations

ANC	Antenatal care
BMI	Body mass index
EDTA	Ethylene DiamineTetraaceticacid.
ESR	Erythrocyte sedimentation rate
Fl	Femto liter
g/ dl	Gram per deciliter
GT	Gestational thrombocytopenia
Hb	Hemoglobin
MCH	Mean cell hemoglobin
MCHC	Mean cell hemoglobin concentration
MCV	Mean cell volume
mg	Milligram
ml	Milliliter
MPV	Mean platelet volume
HCT	Hematocrit
PLT	Platelet
RBC	Red blood cell
RDW	Red cell distribution width
SPSS	Statistical Package for the Social Science
WBC	White blood cell
WHO	World health organization

µl Micro liter

Abstract

Background: In Pregnancy, the hematological system undergoes changes in order to meet the demands of the developing fetus and placenta, with major alterations in blood volume. Hemodilution during pregnancy contribute to majority of these changes.Although physiological in nature, but abnormal hematological profile affect pregnancy and its outcome. Anemia is the most common hematological problem in pregnancy, followed by thrombocytopenia.

Objective: To assess hematological profiles of pregnant women at St. Paul‟s Hospital Millennium Medical College.

Method:A cross sectional study was conducted on 284 pregnant women to assess hematological profiles of pregnant women at St. Paul‟s Hospital Millennium Medical College from June to August 2014. A pre-tested Structured and interviewer administered questionnaire was used to collect socio demographic data and venous blood was used to perform CBC and peripheral blood film. CBC was done using automated hematological analyzer Cell Dyn 1800. Data was analyzed using SPSS version 16.0statistical software. Dependent variable frequencies, mean, standard deviation and range were calculated. P values <0.05 was considered as statistically significant.

Result: The prevalence rates of anemia and thrombocytopenia were 11.62% and 7.7 %, respectively and were dominantly of mild type. The anemic pregnant women had microcytic hypochromic (51.5 %), normocytic hypochromic (27.3%), normocytic normochromic (18.2%), and dimorphic (3%). Gestational age (trimester), second and third trimesters compared to those in first trimester and those whodid not take iron folic/acid supplementation compared to those taking supplementation, were more likely to be anemic. The prevalence of thrombocytopenia was 4.2%, 6.1% and 9.4% at first, second and third trimester pregnant women, respectively.

Conclusion: The prevalence of anemia and thrombocytopenia was 11.62% and 7.7 %, respectively and were dominantly of mild type. The commonest type of anemia was microcytic-hypochromic and normocytic- hypochromic, which are mostly characteristic features of iron deficiency anemia. Thrombocytopenia where higher in pregnant women at third trimester.

Therefore, the pregnant women screening should include hematological parameters other than Hb determination alone to avoid adverse outcomes.

Key words: Pregnant women, Hematological profile, anemia, thrombocytopenia

1.Introduction

1.1Background information

In Pregnancy, the hematological system undergoes changes in order to meet the demands of the developing fetus and placenta, with major alterations in blood volume. Hemodilution during pregnancy contribute to majority of these changes. Maternal blood volume increases during pregnancy and this involves an increase in plasma volume as well as in red cell and white cell volume. The blood volume increase by 40% to 45 % on average, this increase occurs faster in the second trimester [1-3].

The alterations in the hematological status of pregnant women are profound. Modifications in the production of red cells and changes in plasma volume shift fundamental hematological parameters such as red blood cell (RBC) count, hemoglobin (Hb) concentration, platelet (PLT) count, and white blood cell (WBC) count. Some of these are decreased – for example, RBC and PLT counts partly as a result of the physiological hemodilution that occurs in pregnancy, while others are increased, such as the WBC count [4, 5].

RBC changes in pregnancy

During pregnancy, the total blood volume increases by about 1.5 litter, steadily from as early as 4 weeks of pregnancy to reach a maximum of 35-45 % above the non-pregnant level at 28 to 32 weeks. The plasma volume increases by 40-45 %. Red blood cell mass increases by 30- 33 %as a result of the increase in the production of erythropoietin. Erythropoietin levels increase throughout pregnancy, reaching approximately 150% of their pre pregnancy levels at term.Women who take iron supplements have less pronounced Hb changes, as they increase their red cell mass proportionately more than those without dietary supplements [6, 7].

The greater increase in plasma volume than the increase in red blood cell mass leads to physiological anemia. In late pregnancy, plasma volume increases at a slower rate, inducing a slight rise in hemoglobin and hematocrit level [5, 6, 8].

The World Health Organization (WHO) has suggested that anemia is present in pregnancy whenHb concentration is less than 11 g/dl. Anemia could be classified as mild, moderate and severe. The Hb level for each class of anemia in pregnancy are 10.0–10.9g/d1 (mild), 7–9.9g/dl (moderate) and less than 7g/ dl (severe) [9].

Iron requirements are greater in pregnancy than in non-pregnant state. Although iron requirements are reduced in the first trimester because of the absence of menstruation, they rise steadily thereafter from approximately 0.8 mg per day in the first month to approximately 10 mg per day during the last 6 weeks of pregnancy [10,11].

PLT changes in pregnancy

The PLT count is slightly lower in pregnant than in non-pregnant women, particularly in the third trimester. This is termed as „gestational thrombocytopenia.“ It is partly due to hemo dilution and partly due to increased platelet activation and accelerated clearance (destruction) (8). The normal level of platelets in pregnancy is 150–400 $x10^9$/L. Thrombocytopenia is classically defined as a platelet count of less than 150×10^9/L. Counts from 100,000 to 150,000/µL are considered mildly depressed, 50-100×10^9/L are moderately depressed, and less than 50×10^9/µL are severely depressed [12,13].

In pregnancy, the major causes of thrombocytopenia are gestational thrombocytopenia, idiopathic thrombocytopenic purpura, preeclampsia, hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome, and other infections such as malaria, dengue, folate deficiency, and diseases such as leukemia and aplastic anemia.Approximately 75% of these cases are due to a benign process of gestational thrombocytopenia; 15–20% can be attributed to hypertensive disorders; 3–4% to an immune process; and the remaining 1–2% are made up of rare constitutional thrombocytopenias, infections and hematological malignancies [13, 14].

WBC changes in pregnancy

WBC is increased in pregnancy with a typical reference range of 6.0 –16.0 $\times 10^9$/L. In the hours after delivery, healthy women have been documented as having WBC 9.0 –25.0 $\times 10^9$/L. By 4weeks post-delivery, typical WBC ranges are similar to those in healthy non-pregnant women (4.0 - 10.0 $\times 10^9$/L)Neutrophils are the major type of leucocytes on differential counts [7,8].

1.2. Statement of the problem

Many physiological hematological changes occur during pregnancy to accommodate the demands of the developing fetus. Although physiological in nature, but abnormal hematological profile does affect pregnancy and its outcome. One of the most important underlying cause of maternal mortality is due to underlying hematological complications. The most frequent hematologic complication during pregnancy are anemia and thrombocytopenia [15, 16].

Thrombocytopenia is one of the most common hematologic abnormality encountered during pregnancy. 8-10% of the pregnant women are affected by thrombocytopenia (platelet count <150x10^9/L), particularly in the third trimester. Approximately 75% of these cases are due to a benign process of gestational thrombocytopenia [13, 17, 18].

Anemia is a widespread public health problem associated with an increased risk of morbidity and mortality, especially in pregnant women and young children. Anemia is estimated to contribute to more than 115 000 maternal deaths and 591 000 perinatal deaths globally per year. In neighboring Sudan, 20.3% of maternal deaths are associated with anemia [19, 20].The economic effect of anemia on human capital results in the loss of billions of dollars annually. It is a disease with multiple causes, both nutritional (vitamin and mineral deficiencies) and non-nutritional (infection) that frequently co-occur. It is assumed that one of the most common contributing factors is iron deficiency, and anemia resulting from iron deficiency is considered to be one of the top ten contributors to the global burden of disease [21, 22].

The functional consequences of anemia are serious and include an increased risk of maternal, fetal, and neonatal mortality; poor pregnancy outcomes such as low birth weight and preterm birth; impaired cognitive development, reduced learning capacity, and diminished school performance in children; and decreased productivity in adults [23, 24].

Anemiaaffects1.62 billion (24.8%) people globally. Global prevalence of anemia in pregnant women is 41.8%. Africa and Asia are the most heavily affected regions. Africa has the highest prevalence of anemia among pregnant women, but the greatest number of people affected are in Asia (19, 20). In Asia 41.6% pregnant women are anemic. Among pregnant women, the total weighted prevalence of anemia in the Latin America and the Caribbean (32 countries) with nationally representative data is 30.9% [23, 25, 26].

Throughout Africa, about 56% of pregnant are anemic. According to the World Health Organization global database on anemia 2008 report, this hematological disorder is a sever public health problem in Ethiopian pregnant women and the estimated prevalence is 62.7 % [25, 26].

Several studies conducted in developed countries regarding hematological profiles of pregnant women. However, little is known about hematological profiles of pregnant women in resource limited settings like Ethiopia. Therefore, this study was conducted to assess hematological profile of pregnant women at St. Paul‟s Hospital Millennium Medical College, Addis Ababa, Ethiopia. The study provided information about the magnitude of anemia and its associated factors, morphological type of anemia, thrombocytopenia and change of hematological values at different trimester which is important todetect hematological complication early and to administer correct therapy.

2. Literature review

2.1 Hematological profiles during pregnancy

The alterations in the hematological status of pregnant women are profound.Modifications in the production of red cells and changes in plasma volume shift fundamental Hematologic parameters [4].

A longitudinal study done by James TR, et al. at the University Hospital of the West Indies, Kingston, Jamaica demonstratedHematological changes by trimester in all measured variables. For most of the Hematological indices (Hb, PCV, WBC, PLT, RBC, MCH, and MCV), the changes achieved levels of significance across trimesters. They conclude that the international standards for anemia (for 1st and 3rd trimester Hb<11g/dl, and 2nd trimester, Hb< 10.5) in pregnancy are applicable to the Jamaican primigravid woman.[27].

A study conducted by Agbai EO, et al. on evaluation of Hemoglobin and Packed Cell Volume at different trimesters of pregnancy among women in Elele, Rivers State revealed that PCV and Hemoglobin values showed statistically significant difference between non-pregnant compared to first trimesters, second trimesters and third trimesters. There was no statistically significant difference between first trimesters compared with third trimesters. They conclude that a decrease in PCV during first trimester and a decrease in Hb during the second trimester suggest that women at these groups are at risk of poor pregnancy outcome [28].

A study on the relationship between maternal hematocrit and pregnancy outcome investigating black-white differences in University of Alabama at Birmingham by Blankson ML, et al showed that in blacks, hematocrits of 27% to 30% were associated with lower but not significant reductions in the rates of intrauterine growth retardation and preterm delivery. Their major finding was that at 31 to 34 weeks, hematocrits ≥40% were associated with significantly higher odds ratios for intrauterine growth retardation for both blacks and whites. These findings should

prompt more attention to women who have high hematocrits in pregnancy while reducing concern for women of either race with low hematocrits [29].

Das S. et al. in their study conducted at Bankura` Samilani Medical College, Bankurashowed that Pregnant women exhibited statistically significant lower values of Hb, PCV, monocyte and lymphocyte while WBC, eosinophil and erythrocyte sedimentation rate (ESR) were significantly elevated compared to non-pregnant women [30].

In addition, study by Ichipi-Ifukor PC et al. found that PCV (32.58 ± 4.01), Hb (10.00 ± 1.28), granulocytes (59.91 ± 7.71) and PLT(202.177 ±48.75) were significantly decreased whereas lymphocytes increased (29.10 ± 8.2) significantly in pregnant women when compared to the controls (PCV 37.07 ± 3.19, Hb 11.71 ± 1.32, granulocyte 64.78 ± 11.45,PLT224.863 ±75.21, and lymphocyte 23.4 ± 6.9). WBC showed no significant difference. The study concluded that pregnancy in women has the tendency to alter hematological indices [31].

Evaluation ofthe values of some major hematological parameters at different trimesters of pregnancy was carried out by Osonuga IO et al. in southwest of Nigeria. The study revealed that pregnant women exhibited statistically significantly lower values of PCV (31.72±4.30), monocyte (1.41±0.80) and lymphocyte (35.68±14.50) while WBC (7.29±3.00)were not significantly changed compared to nonpregnant women (PCV 38.75±3.70, Monocyte 4.16±1.90, lymphocyte 44.86±12.50, and WBC 4.93±0.90). There was no significant difference in all hematological parameters among the three trimesters. They concluded that healthy pregnancy may have effect on hematological parameters [32].

On the other hand, another study in Nigeria by Ifeanyi OE, et al. showed significant changes in mean values of RBC, HCT, MCV, MCH, WBC, Lymphocytes, Monocytes, Eosinophils of the pregnant women relative to non-pregnant women. In contradiction to the study by Osonuga et al [32], there were significant changes between the trimesters in most of the parameters showing carefulness with the clinical management of pregnant women at any stage of the pregnancy [33].

In across-sectional study by Akinbami AA et al. on hematological profile of normal pregnant women in Lagos, Nigeria, a statistically significant relationship was found to exist between PCV (32.07% ± 6.80%, 29.76% ± 5.21%, 33.04% ± 3.88%) and WBC (7.31 ± 2.38 × 10^9, 7.88 ± 2.33 × 1 0^9, and 8.37 ± 2.15 × 1 0^9) count from 1st to 3rd trimester respectively. However, there was no statistically significant association between PLT(231.50 ± 79.10 × 1 0^9, 227.57 ± 63 × 1 0^9, and 200.82 ± 94.42 × 10^9)countand increase in gestational age [5].

A case control study conducted by Elgari MM. on Sudanese pregnant women attending at Omdurman Al Saudi Maternity Hospital revealed a significantly decreased RBCs count, Hb, PCV, MCV, MCH and mean MCHC in pregnant women compared to non-pregnant women (3.7±0.6 vs. 4.2 ±0.3×10^9, 9±1.6 Vs. 12.0±0.7 g/dl,27.7±5 Vs. 35.0±2.3 %,73.8±9.2 vs. 83.5±3.1fl,24.4±3.4 Vs. 28.6±1.6pg, and 33±2.8 Vs. 34.1±1.2g/dl, respectively). Total WBC count was significantly higher in contrast platelets count was significantly lower than controls. On the bases of blood picture 37 (37%) of anemia of pregnancy were normocytic normochromic, microcytic hypochromic 52(52%), and dimorphic picture11 (11%) [34].

Many studies have identified the hematological profile of the pregnant women as one of the factors affecting pregnancy and its outcome [28, 29, 32, and 20]. Low hemoglobin (Anemia) is a widely identified hematological abnormality followed by thrombocytopenia in pregnant women [25].

2.2 Anemia during pregnancy

A descriptive case series study was conducted to determineprevalence of anemia and its epidemiological determinants among pregnant women in Belgaum, Karnataka, India. The result showed a high prevalence (82.9%) of anemia (Hemoglobin < 11.0gm/dl) among 228 pregnant women. Majority (50.4%) had moderate degree of anemia (Hemoglobin 7.0 to 10.0 gm/dl) and 7.0% had severe anemia (Hemoglobin <7.0 gm/dl).Anemia was more severe in those who are 26 years of age, from nuclear families, educated up to secondary level, having vegetarian diet, parity two or more and those in third trimester with two or more abortions, although statistically not significant [35].

A hospital based cross-sectional study was conducted among 104 pregnant women to determine the prevalence of anemia in the first trimester of pregnancy in rural population of Krishna district

in Andhra Pradesh, India. The study revealed that 93.26 % of pregnant women were anemic. Among them, 73.07% had mild anemia, 20.19 % had moderate anemia and none had severe anemia. Anemia in 1st trimester of pregnancy was endemic and microcytic hypochromic anemia was most common in this region [36].

Another hospital based study was conducted in Nepal to determine prevalence of anemia amongpregnant women. The result showed that 41.02% pregnant women were anemic. Among these anemic pregnant women, majority (67.14 %) of them were mildly anemic, whereas 28.57% were moderately and 4.29% were severely anemic. Moreover, higher prevalence of anemia was recorded in those in the second trimester (51.1%) and 20 -35 years age group (62.79%) [37].

Similarly, a hospital-based study was conducted to evaluate Hemoglobin levels and anemia during pregnancy in the highlands of Tibet by Xing Y, et al. on pregnant women. The study revealed that prevalence rate of anemia in this study was 70.0%, 77.9% and 41.3%, respectively for three altitude-correction methods for hemoglobin (Centers for Disease Control (CDC), Dirren et al. and Dallman et al).Gestational age, ethnicity, residence and income were significantly associated with the hemoglobin concentration and prevalence of anemia in the study population. Specially, the hemoglobin concentration of pregnant women decreased with increase in gestational age [38].

A cross-sectional study aimed to investigate the predictors of anemia among 204pregnant women in Westmoreland, Jamaica revealed an overall anemia prevalence of 34.8%. Bivariate analysis showed that pregnant women with a Body Mass Index below 25 and a Mid-Upper Arm Circumference less than 25 cm were more likely to be anemic [39].

An overall prevalence of anemia (Hb<11g/dl) of 40.08 % was also reported from a cross sectional study in West Algeria. When classified in each trimester, the prevalence was 17.3%, 23.8% and 50.0% in the first, second and third trimester, respectively. According to severity of anemia, 36.08% had mild 49.48% moderate and 14.43% severe anemia. The study showed that 46.39% of the participants had MCV values less than standard value of 75fl suggesting microcytic anemia [40].

Various cross-sectional and case control studies were conducted during the years 2003-2010 to investigate the epidemiology of malaria and anemia and their impact on maternal and perinatal outcomes in Sudan. The result showed that anemia was present in 52.5%, 62.6% and 80.2% of pregnant women in Medani, New Halfa, and Gadarif Hospitals, respectively. Anemia was a risk factor for low birth weight in Al -Fashir, for fetal anemia in New Halfa, and for stillbirth in Kassala Hospital [41].

Varying reports exist regarding anemia of pregnancy in Ethiopia [42, 43, 44, 45, 46, 47, 48, 49, 50, 51].

For example, anemia prevalence rate as high as 56.8% was observed in a study conducted on pregnant women in an Urban Area of Eastern Ethiopia. Among the anemic pregnant women 1.2% were severely anemic, 26.7% were moderately anemic, and 28.9% were mildly anemic. Trimester of current pregnancy, iron supplementation during pregnancy, and number of pregnancies, were significantly associated with anemia in the study population [42].

Similarly, high prevalenceof anemia (53.9%) was also observed in a cross-sectional community based study which was conducted on pregnant women in Gilgel Gibe dam area, Southwest Ethiopia [43].

On the other hand, a prospective study which was carried out on prevalence of anemia in pregnancy in Jima town, southwestern Ethiopia revealedan overall prevalence of anemia of 41.9%. The mean hemoglobin level was 10.9 g/dl and 6.4 g/dl for the whole group and anemic women respectively. The majority (74.3%) had moderate anemia; 2.5% had severe anemia.The rate of anemia was higher among the illiterate and in those who did not practice family planning of any sort and in the third trimester, and increased with parity[44].

From the above two community based [43] and health institution based (44) studies from south West Ethiopia, in relatively close localities [43, 44],the observed differences in anemia prevalence rates which is higher in the community based study can suggest among others, the

heterogeneity of the Ethiopian population and the need for further studies in different localities and settings.

A study conducted in Southern Ethiopia by Gibson RS et al. showed that 29% of the pregnant women had anemia and 13% had iron deficiency anemia. The study also revealed that Zinc, Gravida, Infection, and Iron, but Not Vitamin B-12 or Folate Status predict Hemoglobin during Pregnancy [45].

A 36.6% prevalence rate of anemia was reported in pregnant women attending antenatal care in Shallaworeda, West Arsi Zone, Oromia Region, Ethiopia. The mean hemoglobin concentration of the participants was 12.05 ±1.5 g/dl.Less frequent meat and vegetable consumption, parity ≥5 were identified as risk factors for anemia [46].

Alem et al in theircross-sectional study determined prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Azezo Health Center Gondar town, Northwest Ethiopia.The study revealed that the prevalence of anemia was 21.6%. Majority, 97.1% of the pregnant women had normocytic normochromic red cell morphology. The majority of anemic cases (49 %) were having mild type followed by 46% cases of moderate type of anemia and 5% had severe anemia. Pregnant women with age>34, rural residence, and absence of iron supplements were significantly associated with increased risk of anemia [47].

Another institutional based cross-sectional study in Gondar revealed an anemia prevalence of 16.6%. Majority were of mild type (64%) and morphologically normocytic normochromic (76%) anemia. Anemia prevalence was high at third trimester (18.9%). Low family income, large family size, hookworm infection, and HIV infection were associated with anemia [48].

Relatively lower prevalence rate of 9.7% was documented by an institution based cross sectional study in DebreBerhanhealth Institutions. When categorized by severity, 64.3%, 32.1% and 3.6% of the pregnant women were with mild, moderate and severe anemia, respectively. Knowledge of mothers about anemia in general and nausea and vomiting on the other hand were identified as factors significantly associating with anemia [49].

Another health institutional based cross-sectional study conducted at TikurAnbessa Specialized Hospital, Addis Ababa Ethiopia revealed that the overall prevalence of anemia was 21.3%. Out of the anemic pregnant mothers, 80.95% were mildly anemic, 17.86% were moderately anemic

and 1.19% were severely anemic.Factors like age (39-45 years), education status (illiterate), family size (greater than four), gestational age (third trimester), birth intervals (less than two years), history of blood loss, no ANC, multigravida, and multiparous were significantly associated with anemia [50].

2.3 Thrombocytopenia during pregnancy

Comparative study of mild versus moderate to severe thrombocytopenia in third trimester of pregnancy in a tertiary care hospital conducted by Vyas R, et al showed that 7.67%prevalence of thrombocytopenia. Out of them, 2.3% women had moderate to severe thrombocytopenia and 5.5% had mild thrombocytopenia. Major causes were gestational thrombocytopenia (GT), idiopathic thrombocytopenic purpura (ITP), preeclampsia, hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome, malaria, dengue and other etiologies of viremia [14].

Nisha S et al in their analytical prospective observational study documented 8.8% prevalence rate of Thrombocytopenia in Indian pregnant Women. When further characterizing it,gestational thrombocytopenia was seen in 64.2%, obstetric in 22.1% and medical in 13.68% of thrombocytopenic cases [51].

Another study conducted in New Delhi byDwivedi P et al revealed that among1150 pregnant women with term gestation in labor, ninety-four subjects (8.17%) were found to have thrombocytopenia [52].

Shamoon RP et al by studying a group of pregnant women in Erbil City, Iraq found that the mean platelet count in pregnant women was significantly lower than in non-pregnant women ($221\pm59.9 \times10^9$/l vs. $273\pm66.9\times10^9$/l). Thrombocytopenia affected 8% of cases, with peak incidence during the third trimester. Gestational thrombocytopenia was found to be the principal cause (73.8%); hypertensive disorders caused thrombocytopenia in 23% of cases and two cases (4%) were due to immune thrombocytopenic purpura [53].

An earlier study by Mercelina-Roumansetal studied platelet count and platelet indices at various stages of normal pregnancy in smoking and non-smoking women. In the non-smoking group, the platelet count showed a significant decrease with gestational age ($287x10^9$/L to $258x10^9$/L) .This was not the case in the smokers group [54].

A retrospective case-control study comparing pregnant women with moderate to severe thrombocytopenia (platelet count below $100x10^9$/L) with pregnant women without thrombocytopenia was conducted at Soroka University Medical Center, Israel by Parnas M et al. The study revealed gestational thrombocytopenia (59.3%), immune thrombocytopenic purpura(11.05%), preeclampsia (10.05%) and HELLP syndrome (12.06%)were the main cause of thrombocytopenia [55].

A cross-sectional study conducted among 270 pregnant women and 70 non pregnant women in Lagos, Nigeria by Ajibola et al found that 37(13.5%) pregnant women were thrombocytopenic compared with three (4.3%) non-pregnant women. Out of the 37 pregnant women who were thrombocytopenic, most of them (78%) had mild thrombocytopenia, only 6% had severe thrombocytopenia. They concluded that although majority of the pregnant women had mild thrombocytopenia, healthcare providers should screen all pregnant women routinely for thrombocytopenia to avoid excessive bleeding during or after childbirth [56].

Olayemi E and Akuffo FW, Showed that 15.3% of Ghanaian pregnant women compared to 4% of controls had thrombocytopenia.Most cases of thrombocytopenia were mild (76%), only 4% of the women with thrombocytopenia had severe thrombocytopenia [57].

3. Significance/Rationale of the study

Pregnancy complications may lead to health problems in both mothers and fetus. Hematological indices of pregnant woman are one of the factors affecting pregnancy.Anemia (Low hemoglobin) is a widely identified hematological abnormality followed by thrombocytopenia. Some studies have been conducted in the area of effect of anemia and its associated factors in pregnancy in our country Ethiopia. However, to my knowledge, there is no previous study about hematological profile in pregnant women in the study area. Therefore, this study was designed to assess hematological profiles of pregnant women at St.Paul‟s Hospital Millennium Medical College. Understanding of hematological changes accompanied by normal pregnancy is important to avoid both over and under-diagnosing abnormalities and it also enable us to set appropriate strategy for control of pregnancy complications. It also enforces to establish local hematological reference value of pregnant women. Morphological characterization of anemia is important to know the etiology of anemia, type of anemia and helpful to administer the correct therapy.

4. Objective

4.1. General objective

- To assess hematological profiles of pregnant women at St. Paul‟s Hospital Millennium Medical College from June to August2014.

4.2. Specific objectives

- To determine hematological values of Pregnant women by trimester
- To determine the prevalence and severity of anemia among pregnant women
- To classify anemia by morphology in pregnant women
- To identify risk factors of anemia in pregnant women
- To determine the prevalence and severity of thrombocytopenia among pregnant women

Hypothesis

- Anemia and thrombocytopenia are expected to be higher in pregnant women
- Microcytic hypochromic type of anemia will be dominant in pregnant women
- Risk factors in the study population will be similar with those reported by other African studies

5. Method and material

5.1. Study area

The study was conducted at St. Paul‟s Hospital Millennium Medical College (St. Paul‟s Hospital). St. Paul‟s Hospital is the second largest public hospital in Ethiopia, which is located in Gullele sub city in Addis Ababa and built by Emperor Haile Selassie in 1961.An estimated 1800 clinical and non-clinical staff provide care to approximately 150,000 people each year. St. Paul's Hospital receives referrals from around the country and is under the guidance of the Ethiopian Federal Ministry of Health. In 2007, St. Paul's Hospital added Medical College which is called St. Paul's Hospital Millennium Medical College. Around 220 pregnant women per month start antenatal care in this Hospital

5.2. Study period

The study was conducted from June to August 2014.

5.3. Study design

A cross sectional health facility based study was conducted to assess hematological profiles in pregnant women at St. Paul‟s Hospital Millennium Medical College from June to August 2014.

5.4. Source population

The source populations were all pregnant women who visited St. Paul‟s Hospital MillenniumMedical College, Addis Ababa, Ethiopia during the study period.

5.5. Study population

The study population was pregnant women who visited St. Paul‟s Hospital Millennium Medical College for antenatal care during the study period and fulfilling the inclusion criteria.

5.6. Sample size determination

The required sample size for this study was calculated based on theprevalence of anemia among pregnant women attending antenatal care at TikurAnbessa Specialized Hospital, Addis Ababa Ethiopia which was 21.3 % [51], and the 95% confidence interval and 5%

marginal error. Thus, the sample size (n) was determined using the following statistical formula.

$$n = (Z_{\alpha/2})^2 \frac{P(1-P)}{d^2}$$

D = margin of error between the sample and the population.

n = sample size

Z = 95% confident interval

P = prevalence rate of 21.3% based on the previous study

$$n = 1.96^2 \times \frac{.213(1-.213)}{(0.05)^2} = 258$$

By adding 10% for none response rate, the final sample size is 284.

5.7. Sampling techniques

All Pregnant women who came for antenatal care follow up and who met the inclusion criteria were included in this study. Participants were recruited only once on their first visit during the study period**.**

5.8. Inclusion criteria

- Pregnant womenwho gave written informed consent
- Age greater than 18 years old

5.9. Exclusion criteria

- Pregnant women who were seriously sick (unable to give socio demographic data) at time of data collection were excluded from the study.Hemolyzed, clotted, insufficient samples of the pregnant women also excluded.

5.10. Data collection tool

5.10.1.socio-demographic data

A structured and interviewer administered questionnaire was used to obtain data on demographic and socio-economic variables and other relevant possible risk factors. The questionnaire was developed in English and then translated into Amharic language. The questionnaire was filled by trained two nurses.

5.10.2. Specimen collection and processing

Threeml of venous blood was collected from each pregnant woman into a di potassium EDTA anticoagulant tube under sterile condition to perform Complete blood count (CBC) and peripheral blood film. Complete blood count was done by senior laboratory technologists using automated hematological analyzer Cell Dyn 1800. Peripheral blood films wereprepared and stained by Wright's stain for red cells morphological study. The red blood cell morphology were examined by a senior laboratory technologist and principal investigator independently.

5.11. Study variables

5.11.1. Dependent variable

- Hematological profiles of pregnant women

5.11.2. Independent variables

- Age
- Residence
- Occupation
- Educational status
- Gestational period
- Weight
- Gravid
- Number of Child
- Iron and folic acid supplementation
- Blood loss during current pregnancy
- Spacing
- Abortion
- Diet

5.12. Quality assurance

To ensure reliable data collection

- The questionnaire was pre-tested before the actual data collection.
- Training was given on data collection procedures for interviewers (nurses).
- Filled questionnaires were collected after checking for consistency and completeness.
- There was continuous supervision of senior laboratory technicians to ensure that they apply standard operational diagnostic procedures.
- The data collection, application of standard procedure, accuracy of test results was supervised by principal investigator.
- Three level hematology controls were utilized.

5.13. Data Analysis

Data analysis was performed using SPSS(Statistical Package for the Social Science) version 16.0 statistical software. Dependent variable, percentage, mean, standard deviation and range were calculated. Binary logistic regression and one-way analysis of variance were used for analytic assessment. P values <0.05 were considered as statistically significant.

5.14. Operational Definition

- **Anemia**: Hbconcentration less than 11 g/dl for pregnant women.
- **Hematological profile**: Red blood cells, Red blood cell indices, Hematocrit, Hemoglobin, White blood cells, and platelets value of pregnant women and it also includes morphology of cells.
- **Hypochromic:**Red cell with a more pronounced central pallor (i.e. greater than 1/3 the diameter of the cell)
- **Macrocytic:**erythrocytes having large size (RBCs larger than the small lymphocyte nucleus).
- **Microcytic:** an abnormally small erythrocytes (Red cells smaller than the small lymphocyte nucleus).

- **Mild anemia**: when the hemoglobin concentration of pregnant women is between 10.0-10.9g/dl.
- **Mild thrombocytopenia:** when the platelet countof pregnant women between100,000 to 150,000/µl.
- **Moderate anemia**: when the hemoglobin concentration of pregnant women is between 7.0-9.9g/dl.
- **Moderate thrombocytopenia:** platelet count between 50,000 to 100,000/µl.
- **Normochromic:** normally staining red blood cells (RBC with about 1/3 central pallor)
- **Normocytic**: when red blood cells have normal size (RBC similar to size of small lymphocyte nucleus).
- **Severe anemia**: when the hemoglobin concentration of pregnant women is less than 7g/dl.
- **Severe thrombocytopenia:** platelet count less than 50,000/µl.
- **Thrombocytopenia:** platelet count less than 150,000/µl.

5.15. Ethical Considerations

The study was approved by Departmental Research and Ethics Review Committee (DRERC)of theDepartmentof Medical Laboratory Sciences, Addis Ababa University. After a letter of cooperation sent to St Paul's Hospital Millennium Medical College from theDepartment of Medical Laboratory Sciences the Institutional Review Board also approved the study. Thena letter informing the hospital administrators was written from the Institutional Review Board (IRB) and Permission obtained from St. Paul‟s Hospital Millennium Medical College to conduct the study.Individual consent was obtained before the questionnaires were administered and bloodsamples were collected.To ensure confidentiality, participants‟ data werelinked to a code number. Any abnormal test results of participants were communicated to their attending physician.

6. Result

6.1 Characteristics of the study participants

A total of 284 pregnant women were included in the study. The mean age of the Participants was 27.3 ± 4.48 years (ranges from 18-40). Majority of the study groups 118 (41.5%) were in the age range of 26-30 years and 102(35.9%) were in the weight group 60-69 Kg. Most of the respondents 261(91.9%), 164 (57.7%), and 115 (40.5%) were urban dwellers, house wives, and elementary school education level, respectively (Table 1).

Concerning obstetrical history and dietary habit, 170 (59.9%) were in their third trimester, 194 (68.3%) of the women had previous pregnancy, 166 (58.5%) were multigravida (2-4 pregnancy), 124 (43.7%) had no child, 28 (9.9%) had blood loss during the current pregnancy, 77 (27.1%) experienced abortion and 166 (58.8%) had taken iron/folic acid supplementation. Out of the 284 participants 160 (56.3%) had the habit of eating animal and animal products and 120 (42.3%) had the habit of eating fruit and vegetables once in week (Table 1).

Table 1. Socio-demographic, obstetric and other characteristics of Pregnant women (N=284) at St. Paul's Hospital Millennium Medical College Addis Ababa, Ethiopia,June to August 2014.

Variables		Frequency	Percentage (%)
Age group (years)	≤20	16	5.6
	21-25	93	32.7
	26-30	118	41.5
	31-35	43	15.1
	≥36	14	4.9
weight group (kg)	40-49	28	9.9
	50-59	89	31.3
	60-69	102	35.9
	70-79	40	14.1
	≥80	25	8.8
Occupation	Farmer	16	5.6
	Housewife	164	57.7
	Government	24	8.5
	Student	8	2.8
	Private	72	25.4
Educational status	Illiterate	42	14.8
	Elementary	115	40.5
	Secondary	54	19.0
	Preparatory	23	8.1
	University/college	50	17.6
Residence	Rural	23	8.1
	Urban	261	91.9
Trimester	1st trimester	48	16.9
	2nd trimester	66	23.2
	3rd trimester	170	59.9
Previous Pregnancy	No	90	31.7
	Yes	194	68.3
Gravidity	1	90	31.7
	2-4	166	58.5
	≥5	28	9.9
Number of child	None	124	43.7
	1	85	29.9
	2	51	18.0
	≥3	24	8.5

Space b/n the current pregnancy and the last child	<1 year	122	43.0
	1 year	12	4.2
	2 year	21	7.4
	3 year	33	11.6
	4 year and above	96	33.8
Blood loss	No	256	90.1
	Yes	28	9.9
Abortion	No	207	72.9
	Yes	77	27.1
Number of abortion	None	207	72.9
	Once	56	19.7
	Two and above	21	7.4
Iron/folic acid Supplementation	No	117	41.2
	Yes	167	58.8
Animal Product	No	12	4.2
	Yes	272	95.8
Frequency eating Animal product	none	12	4.2
	every day	37	13.0
	every 2 days	22	7.7
	once in week	160	56.3
	once in month	53	18.7
Fruit and Vegetable	No	3	1.1
	Yes	281	98.9
Frequency eating fruit and vegetable	none	3	1.1
	every day	100	35.2
	every 2 days	58	20.4
	once in week	120	42.3
	once in month	3	1.1

6.2 Hematological profiles of the study participants

The overall mean (±SD) hematological profiles for the study participants were as follows:WBC count 7.93 ± 2.68 x 10^9/L, RBC count 4.58 ± 2.34x 10^{12}/L, Hb13.01 ± 1.64 g/dL, HCT 40.07 ± 4.15%, MCV 90.60 ± 6.59fL, MCH 29.32 ± 2.72pg, MCHC 32.33 ± 1.35%, and PLT 249.36 ± 80.08 x 10^9/L(**Table-2**).

When hematological parameters were analyzed by trimester, the mean ±SDWBC values for the respective first, second and third trimester pregnant women were 7.02 ± 2.61, 7.83 ± 2.62, and 8.22 ± 2.68(x10^9/L), respectively. The difference was statistically significant between the 1st and 3rd trimester pregnant women (P<0.05).The Mean Hb value in first trimester pregnant women (13.65 ± 1.59) was significantly higher compared to values in second trimester (12.62 ± 1.72), and in third trimester (12.97 ± 1.58) pregnant women. Mean HCT value in the three pregnancy groups were 41.59 ± 4.47, 38.92 ± 4.47, and 40.08 ± 3.79 (%), with a statistically significant difference between those pregnant women in 1st and 2nd trimesters (P<0.05). Whereas the mean red cell indices (MCV, MCH and MCHC) and mean PLT values did not differ between pregnant women in the three trimesters: (**Table-2**).

Moreover, the mean RDW values of those in the 2nd and 3rd trimesters are higher than those in the 1st trimester. The neutrophil counts also follow the same pattern while the lymphocyte counts in the 2nd and 3rd trimesters are significantly lower than those pregnant women in the 1st trimester(P<0.05). Whereas, the difference in mean mixed WBC counts between all trimesters were not statistically significant (P>0.05)(**Table-2**).

Table 2. Hematological Profiles of pregnant women based on trimesters (Mean ± SD) in St. Paul's Hospital Millennium Medical College Addis Ababa, Ethiopia, June to August 2014.

Complete blood count result	Trimester				P-Value		
	Overall	1st trimester PW	2nd trimester PW	3rd trimester PW	1st&2nd	1st&3rd	2nd&3rd
WBC x 10^9/L	7.93 ± 2.68	7.02 ± 2.61	7.83 ± 2.62	8.22 ± 2.68	.246	.018	.580
RBC x 10^{12}/L	4.58 ± 2.34	4.61 ± 0.51	4.86 ± 4.78	4.46 ± 0.47	.836	.927	.475
Hb, (g/dl)	13.01 ± 1.64	13.65 ± 1.59	12.62 ± 1.72	12.97 ± 1.58	.002	.031	.275
HCT (%)	40.07 ± 4.15	41.59 ± 4.47	38.92 ± 4.47	40.08 ± 3.79	.002	.061	.126
MCV (fl)	90.60 ± 6.59	90.26 ± 5.68	91.24 ± 7.29	90.45 ± 6.56	.712	.982	.689
MCH (pg)	29.32 ± 2.72	29.58 ± 2.41	29.53 ± 3.16	29.16 ± 2.62	.995	.615	.618
MCHC %	32.33 ± 1.35	32.72 ± 1.42	32.30 ± 1.51	32.23 ± 1.24	.229	.070	.934
RDW (%)	13.99 ± 1.71	13.25 ± 1.22	14.51 ± 2.09	14.01 ± 1.59	.000	.017	.099
PLT x 10^9/L	249.36± 80.08	267.62± 100.89	254.02 ± 68.06	242.39 ± 77.29	.641	.131	.575
MPV (fl)	9.62 ± 1.37	9.48 ± 1.32	9.60 ± 1.61	9.66 ± 1.28	.888	.708	.957
Lymphocyte (%)	24.31 ± 8.64	28.42 ± 10.68	24.22 ± 8.16	23.18 ± 7.84	.025	.001	.674
Mixed WBC (%)	7.57 ± 2.34	8.07 ± 2.5	7.11 ± 2.12	7.61 ± 2.35	.986	.863	.707
Neutrophil (%)	67.72 ± 9.17	63.52 ± 11.27	67.91 ± 8.33	68.82 ± 8.52	.028	.001	.766

PW: pregnant women

6.3 Prevalence of Anemia and its risk factors

Using the WHO criterion of hemoglobin less than 11.0 g/dl as indicative of anemia, 33 (11.62%) pregnant mothers were anemic. Out of the anemic pregnant mothers, 23 (69.70 %)were mildly anemic (**Table 3**). Based on red blood cell morphologic classification of anemia, most of the anemic pregnant women had microcytic hypochromic 17 (51.5 %)type of anemia (**Figure 1**).

Table 3: Distribution of anemia by severity among the anemic pregnant women (n= 33), St. Paul‟s Hospital Millennium Medical College Addis Ababa, Ethiopia, 2014.

Severity of anemia	Number	Percentage (%)
Mild anemia	23	69.7
Moderate anemia	10	30.3
Severe anemia	0	0
Total	33	100

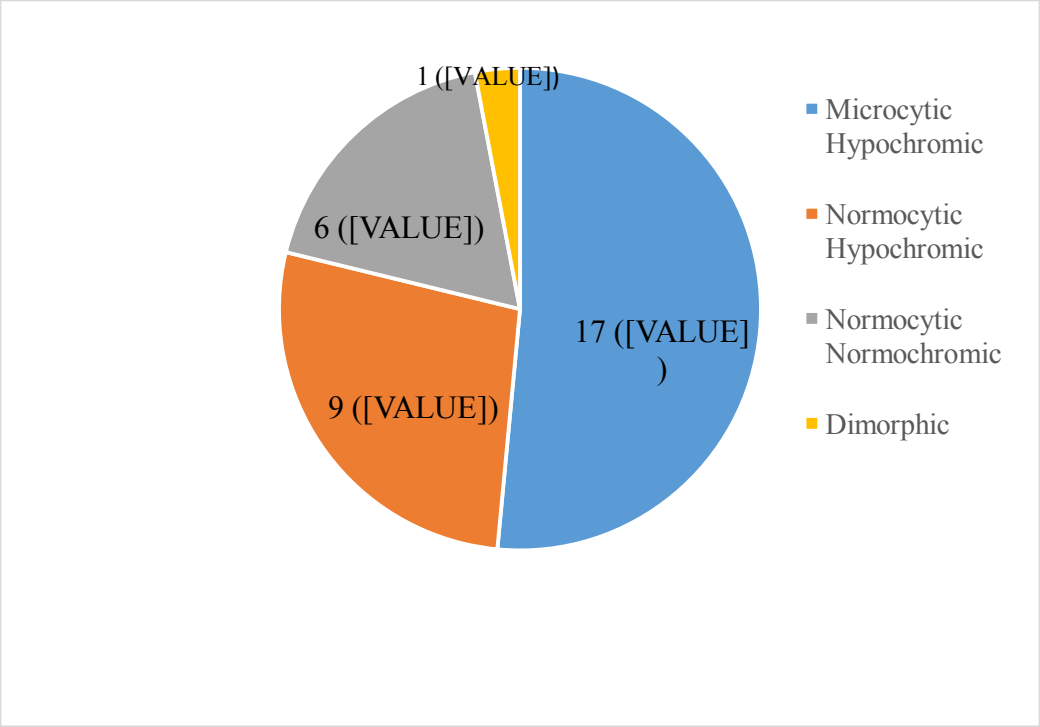

Figure 1. Distribution of Morphologic Type of Anemia among the anemic pregnant women (n=33), St. Paul"s Hospital Millennium Medical College Addis Ababa, Ethiopia, 2014.

The rate of anemia was high in pregnant women who were in 26-30 year age range (15.3%), 60-69 weight group (17.6%), house wives (14.0%), elementary school (14.8%) and urban residents (12.6%) (**Table 4**).

Based onobstetric history and dietary habit, the prevalence of anemia was higher in pregnant women who were at the second trimester (16.7%), had previous history of pregnancy (12.4%), multigravida (12.7%), had one child (17.6%), who had ≥ 4 years gap between the current and last child (16.7%), had history of abortion (14.3%), and did not take iron/folic acid supplementation (14.5%). The prevalence of anemia was also higher in those pregnant women who did not have a habit of eating animal and animal products (16.7%) and fruits and vegetables (33.3%) (**Table 4**).

Table 4. Prevalence of anemia among pregnant women by socio demographic, obstetric and other characteristics of pregnant women (N=284) at St. Paul‟s Hospital Millennium Medical College Addis Ababa, Ethiopia, 2014.

Variables		Anemia status		AOR (95% CI)	P value
		Non-Anemic (%)	Anemic (%)		
Age group	≤20	15 (93.8%)	1 (6.2%)	1	
	21-25	86 (92.5%)	7 (7.5%)	1.53 (.159-14.70)	0.71
	26-30	100 (84.7%)	18 (15.3%)	4.47 (.466-42.83)	0.19
	31-35	37 (86.0%)	6 (14.0%)	5.58 (.457-68.10)	0.18
	≥36	13 (92.9%)	1 (7.1%)	3.55 (.13-100.17)	0.46
weight group	40-49	27 (96.4%)	1 (3.6%)	1	
	50-59	81 (91.0%)	8 (9.0%)	2.34 (.252-21.85)	0.45
	60-69	84 (82.4%)	18 (17.6%)	5.14 (.573-46.17)	0.14
	70-79	36 (90.0%)	4 (10.0%)	1.38 (.117-16.30)	0.80
	≥80	23 (92.0%)	2 (8.0%)	1.47 (.101-21.47)	0.78
Occupation	Farmer	16 (100.0%)	0 (.0%)		
	Housewife	141 (86.0%)	23 (14.0%)		
	Government	22 (91.7%)	2 (8.3%)		
	Student	7 (87.5%)	1 (12.5%)		
	Private	65 (90.3%)	7 (9.7%)		
Educational status	Not educated	40 (95.2%)	2(4.8%)		
	Elementary	98(85.2%)	17 (14.8%)		
	Secondary	48(88.9%)	6(11.1%)		
	Preparatory	21 (91.3%)	2(8.7%)		
	University/college	44 (88.0%)	6 (12.0%)		
Residence	Rural	23 (100.0%)	0 (.0%)		
	Urban	228 (87.4%)	33 (12.6%)		
Trimester	1st trimester	46 (95.8%)	2(4.2%)	1	
	2nd trimester	55(83.3%)	11(16.7%)	6.72 (1.17-38.45)	0.03**
	3rd trimester	150 (88.2%)	20(11.8%)	8.31 (1.24-55.45)	0.03**
Previous Pregnancy	No	81 (90.0%)	9 (10.0%)		
	Yes	170(87.6%)	24(12.4%)		
Gravidity	1	81 (90.0%)	9 (10.0%)		
	2-4	145 (87.3%)	21 (12.7%)		
	≥5	25 (89.3%)	3 (10.7%)		
Number of child	None	112 (90.3%)	12 (9.7%)	1	
	1	70 (82.4%)	15 (17.6%)	2.4938 (.000)	0.99
	2	47 (92.2%)	4 (7.8%)	6.8107 (.000)	0.99
	≥3	22 (91.7%)	2 (8.3%)	6.9997 (.000)	0.99

Space b/n the current pregnancy and the last child	0 year	110(90.2%)	12(9.8%)	1	
	1 year	11(91.7%)	1(8.3%)	.00(.00)	0.99
	2 year	20(95.2%)	1 (4.8%)	.00(.00)	0.99
	3 year	30(90.9%)	3(9.1%)	.00(.00)	0.99
	4 year and above	80 (83.3%)	16 (16.7%)	.00(.00)	0.99
Blood loss	No	224(87.5%)	32(12.5%)	1	
	yes	27 (96.4%)	1(3.6%)	.293 (.034-2.519)	0.26
Abortion	No	185(89.4%)	22 (10.6%)	1	
	yes	66 (85.7%)	11(14.3%)	2.056 (.82-5.15)	0.12
Number of abortion	None	185 (89.4%)	22 (10.6%)		
	Once	48 (85.7%)	8 (14.3%)		
	Two and above	18 (85.7%)	3 (14.3%)		
Iron/folic acid Supplementation	No	100 (85.5%)	17(14.5%)	4.03(1.49-10.92)	0.01**
	yes	151 (90.4%)	16 (9.6%)	1	
Animal Product	No	11(84.6%)	2(15.4%)		
	yes	240 (88.6%)	31(11.4%)		
Frequency eating Animal product	every day	33 (89.2%)	4(10.8%)		
	every 2 day	19(86.4%)	3(13.6%)		
	once in week	139 (86.9%)	21 (13.1%)		
	once in month	50 (94.3%)	3 (5.7%)		
	none	10 (83.3%)	2 (16.7%)		
Fruit and Vegetable	No	2 (66.7%)	1 (33.3%)		
	yes	249 (88.6%)	32 (11.4%)		
Frequency eating fruit and vegetable	every day	89 (89.0%)	11 (11.0%)		
	every 2 day	51 (87.9%)	7 (12.1%)		
	once in week	106 (88.3%)	14 (11.7%)		
	once in month	3(100.0%)	0 (.0%)		
	none	2 (66.7%)	1 (33.3%)		

**P< 0.05 (statisticallysignificant association) for the Adjusted Odds Ratio (AOR)

As shown in the above table (**Table 4**), all variables were analyzed using bivariate analysis to assess the association between the variables and anemia; however, none of the associations reach to a statistically significant level. Then, variables that show P value less than 0.5 in bivariate analysis were taken to multivariate analysis. Out of those variables treated under multivariate analysis, trimester and iron/folic acid supplementations were statistically significantly associated with anemia. Pregnant women in the second [AOR (95% CI) 6.72 (1.17-38.45), P=0.03] and third trimester [AOR (95% CI), 8.31 (1.24-55.45), P=0.029] were more likely to be anemic when compared to pregnant women in their first trimester. Pregnant women who did not receive iron/folic acid supplementation [AOR (95%CI), 4.03(1.49-10.92), P=0.01] were more likely to be anemic when compared to pregnant women who did take supplementations.

6.4 Prevalence of Thrombocytopenia among the study participants

Out of 284 pregnant women, 22 were found thrombocytopenic (Platelet count $<150\times10^9/L$), giving a prevalence of 7.7 %. Among the thrombocytopenic pregnant mothers, most of them 20 (90.91%) had mild thrombocytopenia (**Table 5**). The prevalence of thrombocytopenia was 4.2%, 6.1% and 9.4% at first, second and third trimester, respectively (**Table 6**).

Table 5. Distribution of thrombocytopenia by severity among thrombocytopenic pregnant women (n=22), St. Paul‟s Hospital Millennium Medical College Addis Ababa, Ethiopia, 2014.

Severity	Number	Percentage (%)
Mild thrombocytopenia	20	90.91
Moderate thrombocytopenia	2	9.09
Severe thrombocytopenia	0	0
Total	22	100

Table 6.Distribution of thrombocytopenia among pregnant women at different trimesters (N=284), St. Paul‟s Hospital Millennium Medical College Addis Ababa, Ethiopia, 2014.

Characteristics		Thrombocytopenia status		Total
		Thrombocytopenic (%)	Non-Thrombocytopenic (%)	
Trimester	1st trimester	2 (4.2%)	46 (95.8%)	48
	2nd trimester	4 (6.1%)	62 (93.9%)	66
	3rd trimester	16 (9.4%)	154 (90.6%)	170

7. Discussion

7.1 Hematological parameters of pregnant women

The study reported herein aimed to determine the hematological profile of pregnant women visiting St. Paul"s Hospital Millennium Medical College in Addis Ababa from June to August 2014.

Mean white blood cells were progressively increased from those in their first (7.02 ± 2.61) to those in their third (8.22 ± 2.68) trimesterand the dominant type of leukocyte was neutrophil. Our finding is consistent with findings of Akinbamiet al (from 7.37 ±2.38 to 8.31 ±2.15) [5], Das et al (from 6.14 ± 1.76 to 8.09 ± 4.12) [30], Osonugaet al (from 6.22±1.79 to 8.11±4.13) [32] and Ifeanyiet al (from4.8+/-2.6 to 7.81+/-1.7) [33]. The increase of white blood cells during pregnancy might be due to the physiologic stress induced by the pregnant state [8] or as a result of the body building immunity of the fetus which involves a state of selective immune tolerance, immunosuppression and immunomodulation in the presence of a strong anti-microbial immunity [58].

The finding of a significantly higher number of neutrophils in the second and third trimester pregnant women compared to the first trimester pregnant women in our study concurs with this scientific explanation.Neutrophils are the major type of leucocytes on differential counts; this is likely due to impaired neutrophilic apoptosis in pregnancy.Neutrophil counts during pregnancy can double up twice to its postpartum values [8, 15].

In thepresent study,hemoglobin concentration and hematocrit were highest in the first trimester (13.65 ± 1.59 vs.41.59 ± 4.47), reachtheirlowest point in the second trimester (12.62 ± 1.72 vs.38.92 ± 4.47) and begin to rise again in the third trimester (12.97 ± 1.58 vs.40.08 ± 3.79). It is consistent with a study conducted by James et al (Hb 12.73 ± 1.14,11.41 ± 1.16, & 11.67 ± 1.18 Vs. HCT 37.05 ± 2.96, 33.12 ± 3.00 &34.03 ± 2.97 for 1^{st} , 2^{nd} and 3^{rd} trimester respectively) [27] and Akinbami et al (32.07 ±6.80, 29.76 ±5.21, &33.04 ±3.88) [5] for hematocrit. While it contradicts with a study conducted by Ifeanyi et al [33] and Osonuga et al [32] in Nigeria which showed Hb and HCT were low in the first trimester (Hb 11.6 ± 2.1, HCT30.2 ±1.8, and 30.8±2.6 HCT), highest in the second trimester (14.7+/-1.9, 40.9+/-2.3 and 32.4±4.4)and drop in the 3^{rd} trimester (12.0±3.1, 31.1±3.0 and 31.7±5.5).

Hemoglobin concentration and packed cell volume were decreased from first trimester to second trimester may be due to hemodilution, hormonal changes that increases fluid retention, and increased iron demand [5, 15, 30].Hormonal changes during pregnancy cause a release of renin from the kidneys. The increase in plasma volume is relatively greater than the increase in red cell mass, which results in a fall in maternal Hb and PCV (physiological anemia). In late pregnancy, plasma volume increases at a slower rate, inducing a slight rise in hemoglobin and hematocrit that may account for the slight rise in Hb and PCV in the third trimester [5, 8].

Our study also reported a gradual reduction in PLT count as pregnancy advanced but the mean difference between the three trimesters was not statically significant (P>0.05). Our finding is similar with study conducted by Ajibola et al [57], Akinbami et al [5] and James et al [27]. The reduction of platelet count as pregnancy advanced may be due to an increase in blood volume, increased platelet activation, and decreased life span in the uteroplacental circulation [8, 15, 16]. The present study also found anincrement of mean platelet volume as the pregnancy advanced. This result is in agreement with a study conducted in Port Harcourt, Nigeria (59).

7.2 Anemia (Hb<11g/dl)

The prevalence of anemia in the present study was 11.62%. This prevalence was comparable to studies conducted in Iranian pregnant women (13.6%), Nakhonsawan, Thailand (14.1%), Sudan (10%), Awassa (15.1%), Gondar (16.6%), and DebreBrhan (9.7%) [60, 61, 62, 63, 48, 49].

The result of the present study is much lower than studies conducted in Karantaka India (82.9%), Andhra Pardish India (93.26), highlands of Tibet (ranges 41.3-77.9%), Nepal (41.02%), Malaysia (57.4%), Western Saudi Arabia (94.7%), Uyo Nigeria (54.5%), Jamaica (34.8%), west Algeria (40.08%), Uganda (63.1%), Eastern Ethiopia (56.8%), south west Ethiopia (53.9%), Jima town (41.9%), and Arsi zone (36.6%) [35-40, 64, 65, 66, 67, 42, 43, 44, 46]. Our result is also lower than results reported by studies in Turkey (27.1%), Sokoto, Nigeria (21.3%), Southern Ethiopia (29%), Azezo (21.6%), and TikurAnbessaSpecialized Hospital (21.3%) [68, 69, 45, 47, 50].

The possible reason for the difference may be due to the differences in Socio economic status, geographical variation and differences in dietary habits of the study Participants. The lower

result of our study may also be due to the Governments effort to achieve Millennium Development Goals.

Regarding the levels of anemic status, in this study, 69.70 % of the respondents had mild anemia, 30.30 % had moderate anemia, and none of the respondents had severe anemia. As the result showed mild anemia was common followed by moderate anemia. This finding is similar with studies conducted in Uyo Teaching Hospital Nigeria [65], TikurAnbessa Specialized Hospital [50], DebreBerhan Health Institutions [49],Southwest Ethiopia [43], Western Nepal [37],Andhra Pradesh India [36], and Gondar [48]. However, our result is deviated from the findings obtained in the study conducted in Karnataka India, west Algeria and Jima which showed high moderate Anemia [35, 40, 44].

Our study tried to demonstrate the common morphological characteristic of anemia among pregnant mothers. Out of the total anemic pregnant women, 51.5 % had microcytic hypochromic, 27.3% had normocytic hypochromic, 18.2% had normocytic normochromic, and 3% were dimorphic type of Anemia. This finding is deviated from studies conducted in Turkey [69], Northern Nigeria [70] and Gondar [48] which showed higher rate of normocytic normochromic type of anemia. Microcytic hypochromic and normocytic hypochromic blood picture were the most common morphological types of anemia found in this study, which are characteristic of iron deficiency anemia (71, 65),which is in agreement with studies conducted in Sudan [34], Sokoto Nigeria [70], Uyo Nigeria [65], and New Delhi [71].

Only the association of gestational age (trimester) and iron/folic acid supplementations did reach to a statistically significance level. Pregnant women in second and third trimester were more likely to be anemic when compared to pregnant women in first trimester. This might be due to the higher maternal plasma volume increments (40–50%) relative to red cell mass (20–30%) and accounts for the fall in hemoglobin concentration (16). Our study is similar with studies conducted in Malaysia [65], west Algeria [40], and TikurAnbessa hospital [50].

The risk of developing anemia increased in pregnant women who did not receive iron supplementation during pregnancy when compared to those who received iron supplementation. This may be due to iron deficiencies developing during pregnancy because of the increased iron requirements to supply the expanding blood volume of the mother and the rapidly

growing fetus and placenta. The study is in agreement with study conducted in Karnataka India, Uganda, and Eastern Ethiopia [35, 67, 42].

7.3 Thrombocytopenia (PLT count< 150×10^9/L)

Thrombocytopenia is second to anemia as the most common hematologic abnormality encountered during pregnancy. In this study, the prevalence of thrombocytopenia among the pregnant women was 7.7 %. This figure is similar to studies conducted in India (8.17%)and(8.8%), Iraq (8%), and Ahmedabad (7.67%) [14, 51, 52, 53].It is also similar with literature review conducted by Myers [13], which showed that thrombocytopenia occurs in 8–10% of all pregnancies. However, our result is lower than studies conducted in Ghana (15.3%) and Nigeria (13.5%) [56, 57].Olayemiand Akuffo by studying Ghanaian women reported that high prevalence of thrombocytopenia may be as a result of malaria infection [57].

Among the thrombocytopenic pregnant mothers in the present study, 90.91% had mild thrombocytopenia, 9.09% had moderate thrombocytopenia and none of them had severe thrombocytopenia. These results are the same with the study conducted in Iraq [53] and it also agrees with studies conducted in Ghana, India, Nigeria, and Ahmedabad` , which showed the presence of high frequency of mild thrombocytopenia [14, 51,56,,57].

Most of the cases of thrombocytopenia (90.91%) in our study were mild with platelet counts between 100 × 10^9/L and 150 × 10^9 /L. This may be attributed to gestational thrombocytopenia (GT). Gestational thrombocytopenia accounts for the majority of thrombocytopenias during pregnancy and is characterized by mild thrombocytopenia [16]. It is not associated with any adverse events for either the mother or baby and requires no specific treatment; but, the other etiologies must be excluded (i.e. megaloblastic anemia, immune thrombocytopenia, eclampsia, and liver disorders) before labeling the patient as gestational thrombocytopenia [15]. Especially, many features of GT are similar to mild immune thrombocytopenia and it can be difficult to distinguish between the two disorders [13].

In our study, high prevalence of thrombocytopenia was observed among pregnant women in the third trimester. This agrees with various studies [51, 53, 56, 57]. The observed high prevalence of thrombocytopenia in the third trimester could be due to an increase in platelet aggregation

especially during last 8 weeks of gestation. It has been reported that significant fall in platelet count can occur from 32 weeks ofgestation onwards [15]. Platelet count decreases due to hemodilution, increased platelet activation, and accelerated clearance during pregnancy, particularly in the third trimester [8].

8. Limitation of the study

- Our study lacks control group (nonpregnant women) to compare with our study participants (pregnant women)
- Our participants were not examined for parasites, chronic disease, Number of fetus, auto immune disease, acquired and inherent anemia, malignancy and etc.

9. Conclusion and recommendation

9.1 Conclusion

In our study, WBC, Hb, HCT, RDW, lymphocyte and neutrophil counts showed statistically significant difference between trimesters ($P<0.05$). Whereas, The difference in mean RBC count, MCV, MCH, MCHC, Platelet count, MPV and mixed WBC count between all trimesters were not statically significant ($P>0.05$).

The prevalence of anemia (Hb<11g/dl) among the pregnant women was 11.62%. Most of the anemic pregnant women had mild type of anemia. Morphologically, the predominant type of anemia was microcytic hypochromic followed by normocytic hypochromic, which are mostly characteristic features of iron deficiency anemia. Gestational age (trimester) and iron/folic acid supplementation were associated with anemia with statistical significance.

The prevalence of thrombocytopenia among the pregnant women was 7.7 %. Among the thrombocytopenic pregnant mothers, 90.91% had mild thrombocytopenia, 9.09% had moderate and none of them had severe thrombocytopenia. The prevalence of thrombocytopenia was high in the third trimester.

9.2 Recommendation

- All hematological parameters (complete blood count) should be routinely performed during pregnancy instead of screening for hemoglobin only.
- The result of complete blood count should be properly interpreted to recognize pregnancy complications early.
- Hematological reference value should be developed for pregnant women in general or at different trimesters specifically.
- Anemic pregnant women‟s red blood cell blood picture (peripheral blood morphology) should be reviewed to characterize the type of anemia and administer the correct therapy.
- A large community based study should be done to determine the prevalence and associated factors of anemia and thrombocytopenia in the general population of pregnant women.
- In our study thrombocytopenia is found in all gestational groups and higher in pregnant women who were at the third trimester. Therefore, platelet count should be routinely performed during antenatal visit to differentiate the cause of thrombocytopenia and to avoid excessive bleeding during or after childbirth early by diagnosing timely.

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Annexes

Annex I: English and Amharic Versions Questionnaire

Questionnaireabout Socio demographic data and other relevant possible risk factors of Anemia

Serial number_____ ID. No._____ Date_____

1. How old are you? _____
2. Where do you live?(Residence)
   A. Urban
   B. Rural
3. What is your occupation?
   A. Farmer
   B. house wife
   C. Merchant
   D. private
   E. Governmental employee
   F. others
4. What is your monthly income? _____.
5. What is your educational Status?
   A. Illiterate
   B. Primary School
   C. Secondary school
   D. Preparatory school
   E. University/college graduate
6. What is your Gestational age in weeks/months? _____
7. Have you been pregnant before?
   A. Yes B. No
8. If you say yes for question number 7 how many times? _____.
9. If you say yes for question number 7, how many children do you have? _____.

10. How much is the interval between the current pregnancy and last child?
    A. 1 year
    B. 2 year
    C. 3 year
    D. 4 year and above
11. Was there any blood loss in your current pregnancy?
    A. Yes
    B. No
12. Was there any abortion in your pregnancy?
    A. Yes
    B. No
13. If you say yes for question number 12 how many times? _____.
14. Have you taken iron folic acid supplementation in the current pregnancy?
    A. Yes
    B. No
15. Do you eat meat and animal products?
    A. Yes
    B. No
16. If you eat meat and animal products how many times?
    A. Daily
    B. Every 2 day
    C. Every week
    D. Once a month
17. Do you eat fruit and vegetables?
    A. Yes
    B. No
18. If you eat fruit and vegetables how many times?
    A. Daily
    B. Every 2 day
    C. Every week
    D. Once a month
19. What is your Weight? _____ Kg. (should be measured)

Amharic version of questionnaire

ማህበራዊናህዝባዊ፣ለደምማነስየሚያጋልጡእናሌሎችተዛማጅየሆኑመጠይቆች

ተራቁጥር፡_____ መለያቁጥር፡_____ ቀን፡_____

ተ.ቁ	ጥያቄ	መልስመስጫ	
ነ	ዕድሜዎትስንትነው?		
2	የትነውየሚኖሩት?	ሀ. ከተማ ለ. ገጠር	
3	ሥራዎትምንድነው?	ሀ. ገበሬ ለ. የቤትእመቤት ሐ. ነጋዴ መ. የግል መ. የመንግስትሰራተኛ ረ. ሌላ (ይጠቀስ)	
4	የወርገቢዎትስንትነው?		
5	የትምህርትደረጃዎትስንትነው?	ሀ. ምንምያልተማረ ለ. አንደኛደረጃ (1-8ኛክፍል) ሐ. ሁለተኛደረጃ (9-10 ክፍል) መ. መሰናዳአ (11-12) ረ. ዩኒቨርሰቲይ/ኮለጅ	
6	ካረገዙስንተኛሳምንትዎ/ወርዎነው?		
7	ከዚህበፊትአርግዘውያውቃሉ?	ሀ. አዎ ለ. አላረገዝኩም	
8	ለ ጥያቄ 7መልስአዎከሆነለስንተኛግዜአርግዘዋል?		
9	ለ ጥያቄ 7መልስአዎከሆነስንትልጆችአልዎት?		
ነ0	የመጨረሻልጆዎከኣሁንእርግዝናዎበምንያህልግዜይራራቃል?	ሀ. አንድአመት ለ. ሁለትኣመት ሐ. ሦስትኣመት መ. አራትአመትእናከዛበላይ	

11	በአሁኑየእርግዝናግዜውስጥየደምመፍሰስአጋጥምዎትያውቃል?	ሀ. አዎ ለ. አላጋጠመኝም	
12	ውርጃአጋጥምዎትያውቃልን?	ሀ. አዎ ለ. አላጋጠመኝም	
13	ለ ጥያቄ 12መልስአዎከሆነስንትግዜ?		
14	በአሁኑየእርግዝናጊዜለደምማነስየሚሰጥመድሀኒት (አይረንእናፎሊክአሲድ) ወስደዋልን?	ሀ. አዎ ለ. አልወሰድኩም	
15	ስጋናየእንስሳትዉጤቶችይመገባሉን?	ሀ. ኣዎ ለ. አልመገብም	
16	ስጋናየእንስሳትዉጤቶችየሚመገቡከሆነበምንያህልግዜ?	ሀ. በየቀኑ ለ. በየሁለትቀኑ ሐ. በየሳምንቱ መ. በወርአንዴ	
17	አትክልትእናፍራፍሬይመገባሉ?	ሀ. ኣዎ ለ. አልመገብም	
18	አትክልትእናፍራፍሬየሚመገቡከሆነበምንያህልግዜ?	ሀ. በየቀኑ ለ. በየሁለትቀኑ ሐ. በየሳምንቱ መ. በወርአንዴ	
19	ክብደት		

Annex II: Procedure of tests

1. VENOUS BLOOD COLLECTION

Supplies and Equipment

1. Test requisition
2. Tourniquet and disposable gloves
3. Alcohol (70%) and gauze square or alcohol wipes
4. Sterile disposable needles (double-pointed or syringe type)
5. Evacuated blood tubes (appropriate to the test ordered) and a needle holder or a syringe (in special cases)

Method (procedure)

1. Identify the patient
2. Assemble all necessary equipment
3. Visually inspect both arms. Choose the arm that has not been repeatedly used for venipunctures and one that is free of bruises, abrasions, and sites of infection. In the arm, three veins are commonly used for venipuncture: the cephalic, basilic, and median cubital.
4. Applying the tourniquet
5. Using a cotton ball saturated with 70% alcohol or an alcohol pad saturated with 70% alcohol, cleanse the skin in the area of the venipuncture site. Using a circular motion, clean the area from the center and move outward. Do not go back over an area once it has been cleansed.
6. Allow the site to dry
7. Use one hand to hold the evacuated tube assembly or syringe. Use one or more fingers of the other hand to secure the skin area of the forearm below the intended venipuncture site. This will tighten the skin and secure the vein. Position the patient‟s arm in a slightly downward position.
8. Hold the needle with attached syringe or evacuated tube about 1 to 2 inches below and in a straight line with the intended venipuncture site. Position the blood drawing unit at an angle of about 20°. The bevel of the needle should be upward.
9. Gently insert the needle through the skin and into the vein. This insertion motion should be smooth.

10. The tourniquet may be released as soon as the blood begins to flow into the evacuated tube or syringe or immediately before the final amount of blood is drawn.
11. Ask the patient to open the hand.
12. After the desired amount of blood has been drawn, place a gauze pad over the venipuncture site.
13. Withdraw the blood collecting unit with one hand and immediately press down on the gauze pad with the other hand.
14. If possible, have the patient elevate the entire arm and press on the gauze pad with the opposite hand. If the patient is unable to do this, apply pressure until bleeding ceases.
15. Place a non-allergenic adhesive spot or strip over the venipuncture site.
    Note: Failure to apply sufficient pressure to the venipuncture site could result in a hematoma (a collection of blood under the skin that produces a bruise).
16. Mix tubes with anticoagulant by inverting the tubes several times. If a syringe was used, carefully remove the needle before dispensing the blood into a test tube. Blood should never be forced back through the needle, and the syringe plunger should be slowly depressed. Discard the used needle into an appropriate safety container.
17. Label all test tubes as required by the laboratory.
18. Clean up supplies from the work area, remove gloves, and wash hands. Note: If the patient is an outpatient, wait a few minutes after the venipuncture is complete, and check to be sure that the patient does not feel dizzy or nauseated before discharge. Discard all contaminated supplies in a biohazard disposal bag.

2. Blood film preparation and staining

Technique of making a thin blood film

1. Place a drop of blood on the end of a clean dry slide. Avoid making the drop too large (if too large, use a drop from the excess blood to make the film).

2. Using a clean smooth edged spreader, draw the spreader back to touch the drop of blood and allow the blood to extend along the edge of the spreader. Holding the spreader at an angle of about 30^0, spread the drop of blood to make a film about 40-50 mm in length (two thirds of the slide).

   Note: When the blood is from an anemicpatient, increase the angle of spreading and spread the blood more quickly. When the blood is thick and viscous, reduce the angle of spreading and spread the blood more slowly.

3. Wipe clean the end of the spreader.

4. Immediately air dry the film. Protect the dried film from dust and insects.

   Note: When not using a frosted ended slide, write the patient‟s name and number on the dried blood at the top or along the side of the film using a lead pencil.

5. Feature of a well-made film

   - ✓ Not too thick, nor too long
   - ✓ Free from lines and holes
   - ✓ Has a smooth „tail‟

Wright's staining technique

Reagents

- ✓ **Wright's stain Reagent:** Wright‟s stain deteriorate rapidly when the stainabsorbs moisture or is stored at high temperatures or inbright sunlight. Wright‟s stain should also be renewedevery 3 months and left 3–5 days before being used.
- ✓ **pH 6.8 buffered water Reagent:** Some users of Wright‟s stain prefer to usePH 6.4 buffered water

Method

1. Place the air-dried smear film side up on a staining rack (two parallel glass rods kept 5cm apart).
2. Cover the blood film with undiluted stain but do not flood the slide and leave for 2 minute. If using a dropper bottle count the number of drops required to cover the film.
   Note: The undiluted stain not only acts as a fixative but also partially stains the smear. This stage is required to obtain the best possible staining results
3. Add the same volume of pH 6.8 buffered water as the stain is used.
4. Mix by blowing until a metallic sheen appears and allow the diluted stain to act for 3-5 minutes.
5. Wash off the stain with running tap water/wash bottle. Don‟t tip off the stain, because this will leave a fine deposit covering the film.
6. Wipe the back of the slide clean and stand it in a draining rack for the smear to dry (head part down).
7. The blood film should appear neither too pink nor too blue (check the results microscopically)
8. The blood films are initially viewed with 10x objective, to find the best area where RBCs are evenly distributed, just touching but not overlapping. Then use the 100x (oil immersion) objective for studying the details of the Red blood cell morphology.

9. Size of Red blood cell is determined by comparing the red cell to the nucleus of a small lymphocyte. Both are normally about 6-8µm wide.

    - **Normocytic:** Red cells that are similar to the size of small lymphocyte nucleus.
    - **Microcytic:** Red cells that are smaller than the small lymphocyte nucleus.
    - **Macrocytic:** Red cells that are larger than the small lymphocyte nucleus.

10. After red cell size assessed ,Hb content of the red blood cell also examined and classified as;
    - **Normochromic:**Red cell with a small central pallor (about 1/3 of the cell diameter)
    - **Hypochromic:**Red cell with a more pronounced central pallor (i.e. greater than 1/3 the diameter of the cell)

Quality control of the staining

- ✓ When a new batch of stain is prepared, decide the best staining time to use, e.g. stain films made from the same blood at different times e.g. 5, 7, 10, minutes. Compare the results with a stained control blood film.
- ✓ Check the pH of newly prepared buffered water and re-check it at weekly intervals. The pH of the buffered water used to dilute the stain must be correct. It is mainly responsible for the staining reactions.

3. Cell-Dyn 1800 Hematology Analyzer

Principle

The Cell-Dyn 1800 Hematology Analyzer performs a Complete Blood Count (CBC), Platelet Count, and a Three-Part Differential. Whole blood is aspirated, diluted, and then divided into two samples. One sample is used to analyze the red blood cells and platelets while the second sample is used to analyze the white blood cells and hemoglobin. Electrical impedance is used to count the white blood cells, red blood cells, and platelets as they pass through an aperture. As each cell is drawn through the aperture, a change in electrical resistance occurs generating a voltage pulse. The number of pulses during a cycle corresponds to the number of cells counted. The amplitude of each pulse is directly proportional to the cell volume.

Lyse reagent is added to the diluted sample and used to count the white blood cells. After the white blood cells have been counted and sized, the remainder of the lysed dilution is transferred to the Hb Flow Cell to measure Hemoglobin concentration.

The Cell-Dyn uses electronic sizing to determine a three part automated differential. The percentage and absolute counts are determined for lymphocytes, neutrophil, and mid-size population of monocytes, basophils, eosinophils, blasts, and other immature cells.

Results will be used to monitor patient‟s cell counts and absolute neutrophil count and to determine if further chemotherapy should be administered.

Specimen Requirements

1. Whole blood collected in an EDTA tube.

2. Minimum sample volume is 0.5 mL using the Open Sample Mode. The instrument aspirates 30 µL of patient sample.

3. Samples are stable at roomtemperature for eight hours.

Procedure to perform patient testing

1. Press MAIN to return to the MAIN MENU screen. Enter in the Operator ID and press RUN. Press SPECIMEN TYPE then press PATIENT SPECIMEN. Verify that RUN Ready is displayed in the Status Box.
2. Enter specimen number and patient name in the MRN and Patient Name using the keyboard.
3. Mix the patient sample well and remove the cap.
4. Place the sample probe in the tube so that the end is immersed in the sample but not resting on the bottom of the tube.
5. Press the Touch Plate to start the run. The Status Box on the RUN menu indicates the stage of the run.
6. When Remove Specimen is displayed in the Status Box and the probe has moved up through the wash block remove the sample tube and replace the tube cap. A beep will indicate that the probe cleaning cycle has begun.
7. After the probe cleaning cycle is complete, the probe will move down into position for the next sample and the results will be displayed on the screen.
8. If needed, press PRINT REPORT for a hardcopy of the report.
9. After sampling is complete, press MAIN to return to the MAIN MENU. Change the Operator ID to “000”for the next user.

Annex III: English and Amharic Versions of Participant Information sheet and consent form

Addis Ababa University, College of Health Sciences,

Department of Medical Laboratory Sciences

You are invited to participate in a study to be conducted by MSc student AngesomGebreweld at Addis Ababa University, College of Health Sciences, Department of Medical Laboratory Science. Please read the following statements and ask any unclear points before you agree to participate.

Introduction

The topic of this study is Hematological profiles of pregnant women at St. Paul‟s Hospital Millennium Medical College Addis Ababa, Ethiopia. Participation in this study is exclusively voluntarily. If you are not interested to participate, there will be no consequences and you will get all the services provided in the hospital with no problems. If you decide to participate, you have to sign on the consent permission template form.

What is expected from me as participant of the study?

As a participant of this study, you will be requested to give small amount of blood. Blood will be collected from your arm using sterile syringe. If you are agree to give sample you will be also requested to answer for questionnaire.

Potential Risks and Discomforts

There will be some pain during collection of blood from your arm but this does not produce serious pain and not harmful to your health.

Potential benefits to participant and/or to the society

Based on the diagnosis result you will be treated accordingly. On the other hand, the result of the study will be beneficial to put a new strategy for control of pregnancy complications. Hence, you are indirectly benefiting other patients and the society in this respect.

Compensation for participation

You will not receive any payment for your participation in this research study.

Confidentiality

On the request paper your name or your identities will not be mentioned. Samples and information given by the participants will serve only for this research not for any other purpose.

Person to contact

Please direct any questions or problems you may encounter during this study to the principal investigator:

AngesomGebreweld

Department of Medical Laboratory Sciences, College of Health Sciences

Addis Ababa University

Cell phone: +251- 09 20 470567

Email: afsaha@gmail.com or angesom.gebreweld@yahoo.com

Consent form

ID.No:_____

This page contains an agreement signature to participate in the study entitled "hematological profiles of pregnant women St. Paul‟s Hospital Millennium Medical College Addis Ababa, Ethiopia." So please read the following points and sign your signature at the end in the space provided.

1. I understand the objective of the study in "hematological profiles of pregnant women at St. Paul‟s Hospital Millennium Medical College Addis Ababa, Ethiopia."
2. I know that the information and sample (blood) that I gave are going to be used for this study only.
3. I understand that, all the information given for the study and the results are confidential.
4. I understand that I will not get any money for my participation.
5. All the information is explained by Midwives /Nurse.

Therefore, with full understanding of the situations I agree to give the entire necessary information
And blood sample for laboratory analysis.

Signature of the participant: _____

Date: _____

በአዲስአበባዩኒቨርሲቲ፤ የጤናሳይንስኮሌጅ

የህክምናላቦራቶሪ ት/ክፍል

በአዲስአበባዩኒቨርሲቲ፤የጤናሳይንስኮሌጅየህክምናላቦራቶሪ
ት/ክፍልበሁለተኛዲግሪተማሪበሆነውአንገሶምገብረወልድየመመረቂያጥናትላይእንዲሳተፉተጋብዘዋል፡፡
እባክዎበዚህጥናትላይከመሳተፍዎበፊትከዚህቀጥሎየሚገኘዉንምንባብበጥሞናያንብቡ/ይመልሱ ፤
ግልፅያልሆነነገርካጋጠመዎትይጠይቁ፡፡

መግቢያ

የጥናቱርእስየነፍሰጡሮች“ሄማቶሎጂካልፕሮፋይል”።እርስዎበዚህጥናትላይየሚኖሮትተሳትፎሙሉለሙሉበበጎፈቃደኝነትላይየ
ተመሠረተነዉ፡፡በዚህጥናትዉስጥላለመሳተፍከወሰኑበዚህየህክምናቦታዉስጥየሚሰጥዎትአገልግሎትአይቃረጥም፡፡በጥናቱለመ
ሳተፍየሚስማሙከሆነየስምምነትቅጹላይበጹሑፍወይምበጣትፊርማዎትንማስቀመጥይጠበቅቦታል፡፡

የጥናቱተሳታፊበመሆኔየሚጠበቅብኝምንድንነዉ?

የጥናቱተሳታፊእንደመሆንዎየደምናሙናእንዲሰጡይጠየቃሉ። ደሙከክንድዎበአዲስመርፌእናስሪንጅየሚቀዳይሆናል።
ናሙናውለመስጠትፍቃደኛከሆኑለሚቀርብልዎጥያቄዎችመልስእንዲሰጡእንደገናይጠየቃሉ።

በዚህጥናትመሳተፍየሚያስከትላቸዉችግሮች

ደምከክንድዎሲቀዳልዎትትንሽየህመምስመትሊሰማዎትይችላል።
ህመሙግንከባድወይምየጤናመቃወስየሚያስከትልአይደለም።

በዚህጥናትመሳተፍየሚያስገኛቸውጥቅሞች

በናሙናውዉጤትመሰረትይታከማሉ።
በተጨማሪምየጥናቱዉጤትከእርግዝናጋርተያይዞየሚመጡችግሮችንለመቆጣጠርየራሱየሆነጥቅምይነረዋል።ስለሆነምየጥናቱተ
ሳታፊዎችበተዘዋዋሪመንገድለሌሎችነፍሰጡሮች።ብሎምለህብረተሰቡይጠቅማሉማለትነው።

በዚህጥናትበመሳተፍየሚከፈልክፊያ

በዚህጥናትስለተሳተፉምንምዓይነትክፍያአይከፈልዎትም።

የተሳታፊዎችሚስጢርስለመጠበቅ

በመጠየቂያውወረቀትየተሳታፊዎችስምወይምማንነትኣይገለጽም።
በተሳታፊዎችየሚሰጥናሙናእናመረጃለዚህጥናትጥቅምብቻየሚያገለግልይሆናል።

ጥያቄካሎዎት

ይህንጥናትበተመለከተወይምከዚህጋራበተዛመደመልኩስለሚያጋጥሙድንገተኛችግሮችወይምጥያቄካሎትበሚከተለዉኣድራሻ ይጠቀሙ::

ኣንሶምገብረወልድ

የሕክምናላብራቶሪሳይንስ ት/ክፍል፤ የጤናሳይንስኮሌጅ፤ አዲስአበባዩኒቨርሲቲ

ሞባይል: +251- 09 20 470567

ኢ-ሜይል-: afsaha@gmail.com or angesomgebreweld@yahoo.com

የስምምነትመጠየቅያቅጽ

የጥናቱተሳታፊመለያቁጥር፡_____

የዚህጥናትርእስየነፍሰጡሮች“ሄማቶሎጂካልፕሮፋይል” በቅዱስጳውሎስሆስፒታልሚልንየምሜዲካልኮለጅያተኩራል። እባክዎትንከዚህበታችየተዘረዘሩነጥቦችበጥሞናያንቡቡእናበመጨረሻበተሰጠውክፍትቦታፌርማዎንያኑሩ።

1. የነፍሰጡሮች“ሄማቶሎጂካልፕሮፋይል”በቅዱስጳውሎስሆስፒታልሚልንየምሜዲካልኮለጅየሚካየደውጥናትዓላማው ተረድቻለሁ።
2. የምሰጠውመረጃእናናሙናለዚህጥናትብቻእንደሚዉልአውቂያለሁ።
3. ለጥናቱየምሰጠውመረጃእናናሙናእንዲሁምውጤቱበሚስጥርእንደሚያዝተረድቻለሁ።
4. በጥናቱበመሳተፌየሚከፈለኝክፍያእንደሌለኣውቂያለሁ።
5. ሁሉምየሚያስፈልገውነገርበአዋላጅነርስይብራራልኛል።

ስለዚህከላይየተጠቀሱትነጥቦችበመረዳትየደምናሙናእናመረጃለመስጠትተስማምቻለሁ።

የተሳታፊፌርማ፡_____

ቀን፡_____

Annex IV: Declaration

I, the undersigned, declare that this MSc thesis is my original work, has not been presented for a degree in Addis Ababa University or any other universities. I also declare that all sources of materials used for the thesis have been duly acknowledged.

Name of the candidate: AngesomGebreweld(BSc)

Signature_____

Place: Addis Ababa University School of Medical Laboratory Sciences, Ethiopia

Date of submission_____/_____/_____

This thesis has been submitted with my approval as university advisor.

Name of advisor: Dr. Aster Tsegaye(MSc, PhD)

Signature _____

Place: Addis Ababa University,Departmentof Medical Laboratory Sciences, Ethiopia

Date of submission_____/_____/_____