Haematological Profile of Pregnant Women Attending Antenatal Clinic in Jos, Nigeria

ABSTRACT

Aims: To assess the haematological profile of pregnant women attending ante-natal clinic in a tertiary hospital in Jos, Nigeria.
Study design: A cross sectional study carried out among pregnant women accessing ante natal care.
Place and Duration of Study: Department of Obstetrics and Gynaecology and Department of Haematology and Blood Transfusion, Jos University Teaching Hospital (JUTH) Jos Nigeria. April 2017 and May 2017.
Methodology: 200 pregnant women accessing ante natal care were included. Data on clinical details were obtained with an Interviewer administered questionnaire. Full Blood Count of blood sample was analysed using the Mindray BC 5000 Autoanalyzer.
Results: Values obtained were (mean ± standard deviation): Packed cell volume, 0.38 ± 0.04L/L; haemoglobin concentration, 10.59 ± 0.98 g/dL; red blood cell count, 4.24 ± 0.49 x 10^{12}/L; white blood cells count, 7.05 ± 1.96 × 10^{9}/L; Neutophil 64.5 ± 10.3%; Lymphocyte- 29.5 ± 8.4%; Monocyte- 3.0 ± 1.4%; Eosinophil- 2.2 ± 2.4%; Basophil- 0.53 ± 0.35%; platelets count, 264 ± 94 × 10^{9}/L; mean cell volume 91.06 ± 8.97 fL, mean corpuscular hemoglobin, 25.28 ± 2.67 pg; and mean corpuscular hemoglobin concentration, 28.35 ± 2.97 g/dL; Red cell distribution width, 14.99 ± 8.98; Mean Platelet volume; 9.65 ± 1.06. Complete blood counts studied in the three trimesters of pregnancy showed a consistent increase in WBC count and Neutrophils as pregnancy progressed. There was also a consistent decline in RBC count, Hb conc, PCV, lymphocytes, and Platelet count from the first to the third trimester. MCH, MCV, MCHC values improved from first to second trimester but dropped in the third trimester. The differences were statistically significant for Hb conc, RBC count, PCV (P = 0.00001, 0.002, 0.002) respectively, but not significant for the other values.
Conclusion: Haematological parameters differ as pregnancy progresses, with low levels of haemoglobin and red cell mass differing significantly through different trimesters of pregnancy. Adequate supplementation to reverse negative indicators of poor well-being is recommended.

Keywords: Pregnancy, Haematological profile, trimester, antenatal

1. INTRODUCTION

"Haematological profile is measured all over the world to estimate general health, because it is simple, fast, cost-effective test, and also a reliable indicator"[1]. "Haematological profile is considered to be one of the factors affecting pregnancy and its outcome, and is also affected by pregnancy"[2,3]. "Various studies have shown variation in haematological parameters between normal pregnant women and normal non-pregnant women"[3,4,5]. "The haematologic system adapts to make provision for foetal haematopoiesis, ensuring adequate blood supply to the enlarged uterus and its content thereby protecting both mother and foetus against the effects of impaired venous return in both the supine and erect positions in addition to safeguarding against bleeding at delivery"[6]. "Notable changes associated with pregnancy include a significant fall in haemoglobin concentration, packed cell volume and platelet count, a significant rise in white blood cell count, and hypercoagulability"[6-9,49,50,51].
"Pregnancy is associated with increase in plasma volume attributed to increase in plasma renin and decrease in atrial natriuretic peptide levels. Hence the elevation in plasma volume is in response to an underfilled vascular system resulting from systemic vasodilatation and increase in vascular capacitance, rather than actual blood volume expansion, which would produce the opposite hormonal profile instead - low plasma renin and elevated atrial natriuretic peptide levels"[10]. "There is also increase in red cell mass which is driven by an increase in maternal erythropoietin production. Plasma

volume increases 25%–80% between the sixth and twenty-fourth week of gestation"[11]. "However, the increase in RBC mass has been found to be approximately 30% between the twelfth and thirty-sixth week of gestation when iron and folate are supplemented. The red cell mass is less, compared with the increase in plasma volume, the net result being a dip in haemoglobin concentration"[10]. "Thus, there is dilutional anaemia. Absence of this physiologic anaemia has been associated with an increased tendency for stillbirths while its presence conveys benefits related to decreased blood viscosity and reduced resistances to blood flow culminating in increased perfusion of the placenta"[12]. "The drop in haemoglobin is typically by 1–2 g/dL by the late second trimester and stabilizes thereafter in the third trimester, when there is a reduction in maternal plasma volume owing to an increase in levels of atrial natriuretic peptide"[10]. "Women taking iron supplements have less pronounced changes in haemoglobin, as they increase their red cell mass in a more proportionate manner than those not on haematinic supplements"[10]. "The red blood cell indices change little in pregnancy. Mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) may reduce, while mean corpuscular volume (MCV) increases as pregnancy progresses"[8,9]. "Increased production of RBCs to meet the demands of pregnancy, reasonably explains why there is an increased MCV due to a higher proportion of young RBCs which are larger in size"[10].

"Increased white blood cell count in pregnancy follows the physiologic stress induced by the pregnant state"[4,7,9,10]. "Neutrophilia is most common and attributed to impaired neutrophilic apoptosis in pregnancy"[9]. "Myelocytes and metamyelocytes may be found in the peripheral blood film of healthy women during pregnancy and do not have any pathological significance"[10]. "They simply indicate adequate bone marrow response to an increased drive for erythropoiesis occurring during pregnancy. Lymphocyte count decreases during pregnancy through the first and second trimesters and increases during the third trimester"[10]. "There is an absolute monocytosis during pregnancy, especially in the first trimester, but decreases as gestation advances. Monocytes help in preventing foetal allograft rejection by infiltrating the decidua tissue possibly, through PGE2 mediated immunosuppression[10]. Eosinophil and basophil counts, however, do not change significantly during pregnancy"[10].

"Pregnancy is a relatively hypercoagulable state with an increased platelet activity and consumption. This combined with the haemodilution state leads to a mean platelet count that is slightly lower than that in the non-pregnant state"[4,10]. "An increased platelet production can be inferred from the increase in circulating platelets width and volume. There is also an increase in thromboxane A2 with an increased tendency for platelets aggregation in pregnancy"[13,14,15].

2. MATERIAL AND METHODS

A hospital- based, analytic, cross- sectional study was performed among pregnant women attending Antenatal Clinic of JUTH between April 2017 and May 2017. The two hundred (200) participants were recruited into the study using nonrandom, convenience sampling.

A blood sample (2 mL) was withdrawn from each participant with minimal stasis from the antecubital vein using a dry, sterile disposable syringe and needle. The blood was dispensed into tubes containing the anticoagulant ethylenediaminetetraacetic acid (EDTA). The specimens were labeled with the subject's age, and identification number. The EDTA samples were kept at room temperature until processing, which occurred within 4 hours of collection.

Full blood count was performed using a Mindray BC 5000 Hematology Analyzer, a five-part auto analyzer able to test parameters per sample including Hb concentration, PCV, RBC concentration, MCH, MCV, MCHC, WBC count, and Platelet count. Standardization, calibration of the instrument, and processing of the samples were done according to the manufacturer's instructions.

Each blood sample was mixed well and then approximately 20 µL was aspirated by allowing the analyzer's sampling probe into the blood sample and depressing the start button. Results of the analysis were displayed, after which the analyzer generated a paper copy of the results on thermal printing paper.

The data collected was analysed using Epi Info version 7.2.5.0. Continuous data presented as mean and standard deviation (SD). Student's t-test was used to assess the significance between means of two groups and ANOVA used to compare the means of multiple groups. Chi-square (X2) was used to compare categorical data. A p-value of < 0.05 was considered statistically significant. The results were reported in tables.

3. RESULTS AND DISCUSSION

Within a period of one month, blood samples were collected from two hundred pregnant women receiving ante-natal care in Jos University Teaching Hospital.

The ages of the studied population ranged between 18 and 44 years (mean ± SD = 29.57 ± 5.99 years). Most (73.5%) of the participants were aged between 20 and 35 years.

One hundred and eighteen (59%) had obtained tertiary education, sixty six (33%) had secondary education, twelve (6%) had primary education, while four (2%) had no formal education (Table 1).

Most of the participants were multigravida, 144 (72.0%), while the remaining fifty eight (28.0%) were primigravida. Ninety five (47.5%) were in the third trimester of pregnancy, eighty four (42.0%) in the second trimester, while twenty one (10.5%) were in the first trimester.

The mean ± standard deviation of the complete blood counts studied in the participants are as follows: Hb- 10.59 ± 0.98g/dl; PCV- 38. ± 4%; RBC- 4.24 ± 0.49 x 10^{12}/L; MCV- 91.06 ± 89.97fl; MCH- 25.28 ± 2.67 pg; MCHC- 28.35 ± 2.97 g/dl; RDW- 14.99 ± 1.13; WBC- 7.05 ± 1.96 x 10^{9}/L; NeuP- 64.5 ± 10.3%; LymP- 29.5 ± 8.4%; MonP- 3.0 ± 1.4%; EosP- 2.2 ± 2.4%; BasP- 0.53 ± 0.35%; Platelet- 264 ± 94 x 10^{9}/L; MPV- 9.65 ± 1.06fL.

A comparison of the complete blood counts studied in the three trimesters of pregnancy showed a consistent increase in WBC, Neutrophils, and monocytes as pregnancy progressed. There was a consistent decline in RBC count, Hb concentration, PCV, and Platelet count from the first to the third trimester. MCV, MCH, and MCHC values improved from first to the second trimester but dropped in the third trimester. The differences were statistically significant for Hb concentration, RBC count, and PCV (P = 0.00001, 0.002, 0.002) respectively, but not significant for the other values.

Table 1; Socio- demographic characteristics of participants

Characteristic	Frequency n (%)
Age	
≤20	17 (8.5)
21-25	34 (17.0)
26-30	64 (32.0)
31-35	49 (24.5)
36-40	30 (15.0)
41-45	6 (3.0)
Total	200 (100.0)
Occupation	
Artisan	16 (8.0)
Civil servants	58 (29.0)
House wife	57 (28.5)
Student	27 (13.5)
Trader	42 (21.0)
Total	200 (100.0)
Educational qualification	
No formal education	4 (2.0)
Primary education	12 (6.0)
Secondary education	66 (6.0)
Tertiary education	118 (59.0)
Total	200 (100.0)

Table 2: Obstetric history of study participants

Characteristics	Frequency n (%)
Gravidity	
Primigravida	56 (28.0)
Multigravida	144 (72.0)
Total	200 (100.0)
Trimester	
First	21 (10.5)
Second	84 (42.0)
Third	95 (47.5)
Total	200 (100.0)

Table 3: Haematological parameters of participants

Parameters	Mean ± Std n = 200
WBC: White blood cells count x 10^9/L	7.05 ± 1.96
RBC: Red blood cells count x 10^{12}/L	4.24 ± 0.49
Haemoglobin concentration g/dl	10.59 ± 0.98
Packed cell volume PCV L/L	0.38 ± 0.04
Mean corpuscular volume fL	91.06 ± 8.97
Mean corpuscular haemoglobin pg	25.28 ± 2.67
Mean corpuscular haemoglobin concentration g/dl	28.35 ± 2.97
Platelet count x 10^9/L	264 ± 94
Neutrophil percentage %	64.5 ± 10.3
Lymphocyte percentage %	29.5 ± 8.4
Monocyte Percentage %	3.0 ± 1.4
Eosinophil percentage%	2.2 ± 2.4
Basophil percentage %	0.6 ± 0.4
Red cell distribution weight	14.99 ± 8.98
Mean platelet volume	9.65 ± 1.06

Key:
Hb: Haemoglobin concentration
PCV: Packed cell volume
MCV: Mean corpuscular volume
MCH: Mean corpuscular haemoglobin
MCHC: Mean corpuscular haemoglobin concentration
Platelet: Platelet count
NeuP: Neutrophil percentage
LymP: Lymphocyte percentage
EosP: Eosinophil percentage
BasP: Basophil percentage
RDW: Red cell distribution weight
MPV: Mean platelet volume

Table 4: Complete Blood Counts of participants in different trimesters of pregnancy

	Trimesters				
	All	First	Second	Third	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Parameters	**n = 200**	**n = 21**	**n = 84**	**n = 95**	**P value**
WBC x 10^9/L	7.05 ± 1.96	6.75 ± 1.39	7.07 ± 2.01	7.10 ± 2.02	0.820
RBC x 10^{12}/L	4.24 ± 0.49	4.68 ± 0.46	4.24 ± 0.53	4.18 ± 0.44	0.002
Hb g/dl	10.59 ± 0.98	11.84 ± 1.63	10.56 ± 0.87	10.45 ± 0.98	0.00001
PCV %	37.55 ± 4.27	40.3 ± 3.4	37.3 ± 4.5	37.2 ± 3.8	0.002
MCV fl	91.06 ± 8.97	86.7 ± 7.0	91.5 ± 9.4	90.6 ± 8.1	0.15731
MCH pg	25.28 ± 2.67	25.1 ± 1.1	25.4 ± 2.8	25.1 ± 2.7	0.83030
MCHC g/dl	28.35 ± 2.97	29.31 ± 2.91	28.34 ± 2.72	28.35 ± 3.11	0.49
Platelet x 10^9/L	264 ± 94	319 ± 100	263 ± 96	254 ± 88	0.05362
NeuP %	64.5 ± 10.3	64.0 ± 10.3	64.2 ± 10.1	64.7 ± 10.6	0.3779
LymP %	29.5 ± 8.4	30.3 ± 9.6	30.3 ± 9.2	28.6 ± 7.3	0.2455
MonP %	3.0 ± 1.4	2.8 ± 1.1	2.8 ± 1.1	3.3 ± 1.6	0.3138
EosP %	2.2 ± 2.4	2.3 ± 2.6	2.0 ± 2.1	2.2 ± 2.6	0.4845
BasP %	0.53 ± 0.35	0.58 ± 0.39	0.54 ± 0.42	0.52 ± 0.26	0.2394
RDW	14.41 ± 1.13	14.18 ± 0.98	14.53 ± 1.27	14.35 ± 1.16	0.8880
MPVfl	9.65 ± 1.06	9.66 ± 1.49	9.64 ± 0.97	9.66 ± 1.03	0.2280

DISCUSSION

"There was a progressive decline in Hb concentration, red blood cell count, and haematocrit from the first to the third trimester, and a drop in haematocrit from first to the second trimester which rose slightly in the third trimester. This pattern corroborates findings of a similar study undertaken in India"[16]. "The findings contradicts patterns reported in other similar studies"[8,9,17,18,19,20,21,22]. "The progressive decline in Hb concentration from the first to third trimester may be due to an increased demand for iron to meet the expansion of maternal Hb mass and the needs of foetal growth as pregnancy progresses. Also, there is greater increase in plasma volume compared to the increase in red cell mass, although the difference in this increase reduces in the third trimester"[8].

"The increase observed in WBC count from the first to third trimester in this study is consistent with the findings of Akingbola et al, Akinbami et al, Onwukeme et al, and other similar studies"[6,8,9,16,17,18,21,22]. The finding contradicts decrease in WBC count reported in other similar studies[19,20]. The increase is associated with an increase in neutrophils, and may result from the redistribution of the WBCs between the marginating and circulating pools in response to the physiologic stress associated with pregnancy. Nausea, vomiting, anxiety and pain which are common in pregnancy, have been reported to cause leukocytosis in the absence of infection. The body in response to stress releases cortisol, adrenaline, and catecholamine which act as natural alarm, temporarily increasing WBC production especially neutrophils. Impaired neutrophilic apoptosis has been reported in pregnancy to be a contributing factor increased WBC count[9].

The progressive reduction in platelet count as pregnancy advanced in this study is comparable to the findings of most other studiesl[8,9]. Haemodilution secondary to expansion of plasma volume can account for 10% decrease in platelet count in normal pregnancy, with most of this decrease occurring during the third trimester[13,14]. However, the absolute platelet count tends to remain within the normal reference range in most patients[13,14] as reported in this study. After anaemia, thrombocytopenia is the second most common haematologic abnormality that occurs during pregnancy[15]. The overall incidence of thrombocytopenia in pregnancy is 8%, but when patients with obstetric or medical conditions are excluded, the incidence drops to 5.1%[15]. Approximately 75% of these cases are due to a benign process of gestational thrombocytopaenia which is mild and have no significance for mother or fetus. Thrombocytopaenia in pregnancy

associated with a complex clinical disorders such as preeclampsia and hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome (20%), or idiopathic thrombocytopenic purpura (ITP) (5%) can be profound and have life-threatening results for both mother and baby [21].

MCV increased from the first to the second trimester, and decreased slightly in the third trimesters in this study. Increased production of RBCs to meet the demands of pregnancy, may explain why there is an increased MCV due to a higher proportion of young RBCs which are larger in size[7].

MCH and MCHC decreased as pregnancy progressed in this study. Although these differences were not statistically significant, they may be a reflection of iron depletion. This is possibly due to late registration for ante natal care, irregular ante natal visits especially when the women are feeling very well, non-compliance to routine ante natal haematinics[23,24]. This is at variance with Akinbami et al's study that showed decline in MCV, and a relatively stable MCH and MCHC through the three trimesters[9]. Other similar studies showed varying patterns combing these red cell indices with progress of pregnancy.

4. CONCLUSION

White blood cells and neutrophils were progressively increased whereas lymphocyte count, RBC count, hemoglobin, haematocrit, MCHC, MCH and platelet were decreased as pregnancy progressed. Haematological parameters differ as pregnancy progresses, with low levels of haemoglobin and red cell mass differing significantly through different trimesters of pregnancy. Haemoglobin estimation is an important parameter to measure well-being. Adequate supplementation to reverse negative indicators of poor well-being is recommended.

CONSENT

All authors declare that 'written informed consent was obtained from the participants for publication of this case report and accompanying images.

ETHICAL APPROVAL

Ethical approval (ref; JUTH/DCS/ADM/127/XIX/6587) was obtained from the institution's Research and Ethics Committee prior to commencement of the study.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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