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Original Article

Haematological parameters of normal pregnant women during antenatal clinic booking in Ilorin, North Central Nigeria

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Abstract

Alterations in the values of some haematological parameters like packed cell volume and haemoglobin concentration during pregnancy have been reported to significantly influence pregnancy outcome. The aim of this study was to determine the values of haematological parameters in apparently healthy pregnant women during the antenatal clinic booking visit at the University of Ilorin Teaching Hospital, Ilorin, North central Nigeria.

A total of 298 apparently healthy pregnant women who presented for antenatal care booking and satisfied the inclusion criteria were included in the study. There were 64 (21.5%) women in first trimester, 146 (49.0%) women in second trimester and 88 (29.5%) in third trimester; and were aged between 22 and 42 years. Packed cell volume, haemoglobin concentration, Red cell count, mean haemoglobin concentration, mean corpuscular volume, mean corpuscular haemoglobin concentration, Total white blood cell count and differentials, Platelet count and erythrocyte sedimentation rate were carried out in the subjects.

The overall mean values and SD of the pregnant women for the haematological parameters were as follows: PCV (32.76±2.18%), Hb (10.82±0.77g/dl), RBC (3.87±2.32 x10^{12}/L), MCH (28.08±2.06 pg), MCV (85.16±5.82 fl), MCHC (33.01±1.05 g/dl), TWBC (7.35±2.62 x10^{9}/L), Platelet count (192.15±62.80 x10^{9}/L) and ESR (34.07±16.85 mm/hr). There were statistically significant differences in the mean values of PCV, MCH and MCV with increasing gestational age ($p<0.05$).

Conclusion: The present study provides a baseline data on the haematological values in pregnancy in the North central zone of the country on which further large scale studies in future may be based. This study will also be of immense benefit in the monitoring of pregnant women to determine those at risk for timely intervention thereby improving pregnancy outcome.

Keywords: Haematological, Parameters, Pregnant, Antenatal

Introduction

Pregnancy is a physiological state which is characterized by a variety of haematological changes that may appear pathological in the non-pregnant state[1,2]. Profound changes occur in almost every organ or body system during normal pregnancy to accommodate the increasing demand by the growing foetus[2,3].

Pregnancy outcome is often influenced by several factors such as the socioeconomic status, environment, cultural beliefs and access to healthcare among others [4,5].

Laboratory parameters during normal pregnancy have been reported to differ significantly from those of the non-pregnant state[6] and alterations in the levels of haematological indices have been reported to have a major impact on pregnancy and its outcome[1,6].

The plasma volume is said to increase by 30-45%, which results in a general haemodilution which had been termed "physiological anaemia" of pregnancy due to the apparently observed reduction in haematocrit of normal pregnant women. These progressive physiological changes that occur are necessary to support and protect the growing foetus and prepare the mother for parturition[2,7,8].

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Assessment of the haematological indices has been used in pregnant women worldwide to estimate their general health status and monitor or predict pregnancy outcome [1,4,5,6]. This is because it is believed to be a reliable indicator of health which is simple, fast and cost effective[9].

During normal pregnancy, haemoglobin concentration is the most common haematological parameter that is assessed[10]. Anaemia or reduced haemoglobin concentration has been widely reported as a major haematological abnormality which could adversely affect pregnancy outcome. Anaemia in pregnancy has been defined as either haemoglobin concentration lower than 11.0g/dl, or haemoglobin concentration which is less than the 5th percentile of the haemoglobin distribution in a healthy reference population, and it has been reported by several authors to be a major contributor to low birth weight, miscarriages and high maternal mortality[3,4,10,11].

The haematological parameters that had been used to monitor the general health of pregnant women include – Packed cell volume (PCV) or haematocrit, haemoglobin concentration (Hb), Red blood cell count (RBC), mean corpuscular haemoglobin (MCH), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin concentration(MCHC), Total white blood cell count(TWBC) and differentials, platelet count and Erythrocyte sedimentation rate(ESR)[1,4,6,10,11,12,13,14]. The haematological parameters may be affected by factors including age, diet, medications, environmental influences as well as ethnic and tribal peculiarities[1,15].They are also useful in risk assessment of pregnant women, and the booking visit provides an opportunity for their evaluation so as to predict and monitor pregnancy outcome or in establishing a reference range for the parameters [11,12,13,14].

Most haematological reference values which had been reported for normal pregnant women were based on Caucasian populations with a few studies from African countries, Nigeria inclusive. In Nigeria, the studies that reported on haematological parameters in pregnancy were mainly from the south western and south eastern part of the country and none from the north central part of Nigeria [4,9,10,13,14,16].

This study therefore aims to determine the haematological parameters in apparently healthy pregnant women during the booking visit for antenatal care at the University of Ilorin Teaching Hospital (U.I.T.H) Ilorin, north central Nigeria, and compare with previous reports from within and outside Nigeria, and it also intends to provide a baseline data for a larger study that will establish a reference range for the haematological parameters in the Northern part of the country which may help to identify at risk pregnant patients that would require prompt intervention thereby improving pregnancy outcome.

Materials and Method

This was a cross-sectional study that was carried out at both the Antenatal Clinic and the Department of Haematology and Blood transfusion of the University of Ilorin Teaching Hospital, Ilorin, Nigeria between September and November 2012. The University of Ilorin Teaching Hospital (U.I.T.H.) serves the population of Ilorin metropolis and the surrounding towns and villages. It also serves as a referral centre for primary and secondary healthcare facilities in the neighbouring states (Oyo, Osun, Ekiti, Ondo and Niger) of Nigeria. Ilorin, the capital city of Kwara state, Nigeria is located in the North Central geo-political zone, an area of stable malaria transmission all year round.

Using the serial recruitment method, all consecutive apparently healthy pregnant women who presented for booking at the Antenatal clinic of the U.I.T.H., Ilorin and consented to the study were enlisted during the study period. A pretested structured questionnaire was administered on each subject prior to venous blood sampling for the haematological tests. The socio-demographic data (name, age, educational status, parity etc.), history of fever and or treatment for any febrile illness within the last two weeks of presentation were recorded. The pregnant women with fever (body temperature $\geq 37^0$C) at presentation, those that were receiving treatment or had received treatment for a febrile illness within two weeks of presentation, and those with underlying medical conditions such as hypertension (BP≥140/90 mmHg), diabetes, sickle cell disorders (Hb SS, SC and CC), bleeding disorders Hepatitis B virus (HBV) and Human immunodeficiency virus (HIV) infections etc. were excluded from the study. Ethical approval for the research was sought and obtained from the Ethical Review Committee (ERC) of the U.I.T.H., Ilorin.

The height, weight and vital signs of the participants were also measured in addition to complete medical and obstetric examinations.

Five milliliters (5ml) of venous blood sample was collected from each participant by a trained phlebotomist during booking and dispensed into vacutainer specimen bottles containing K^+- ethylene diamine tetra-acetic acid (EDTA) as anticoagulant by venepuncture using aseptic techniques. The blood samples were transported to the laboratory and analyzed within two hours of collection. The following parameters – PCV, Hb, RBC, MCH, MCV, MCHC, TWBC with differentials and Platelet counts were determined using the Sysmex KX-21 N Automated cell counter (Sysmex Corporation, Kobe, Japan). Standardization, instrument calibration and sample processing were carried out according to the manufacturer's instructions[17]. Erythrocyte sedimentation rate was determined using the Westergreen method as described by Dacie and Lewis [18].

The data obtained were entered into a Microsoft Excel data sheet. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software version 11. Association between variables was tested using the Chi-square test for discrete variables and the Student t-test for continuous variables. Analysis of variance (ANOVA) test was used to compare the means of haematological parameters, and the level of statistical significance of data was taken as P value equal to or less than 0.05 ($p \leq 0.05$).

Results

A total number of 298 apparently healthy pregnant women at various stages of pregnancy who satisfied the inclusion criteria and gave their consent for the study were recruited over the 3-month period. There were 64 (21.5%) women in the first trimester, 146 (49.0%) women in the second trimester and 88 (29.5%) women were in the third trimester. The age distribution of the 298 pregnant women in the study, and their other socio-demographic characteristics are shown in Table 1.

The overall mean values for the various haematological parameters assessed in the study population were: PCV (32.76±2.18%), Hb Conc. (10.82±0.77g/dl), RBC (3.87 ±2.32x10^{12}/L), MCH (28.08±2.06pg), MCV (85.16±5.82fl), MCHC (33.01±1.05g/dl), WBC (7.35±2.62x10^9/L), Platelet (192.15±62.80x10^9/L), and ESR (34.07±16.85mm/hr) – Table 2.

Table 1: Showing the Socio-demographic variables of the pregnant women studied

Variables	N= 298 Frequency (%)
1. Age (years)	
18-22	23 (7.7)
23-27	44 (14.8)
28-32	144 (48.3)
33-37	70 (23.5)
38-42	17(5.7)
2. Parity	
Nulliparous	60(20.1)
Para 1	196(65.8)
Para 2	32(10.7)
≥Para 3	10(3.4)
3. Level of Education	
None	19(6.4)
Primary	42(14.1)
Secondary	115(38.6)
Tertiary	122(40.9)
4. Occupation	
Civil Servant	148(49.7)
Housewife	56(18.8)
Self Employed	40(13.4)
Petty Trading	54(18.1)
5. Tribe	
Yoruba	210(70.5)
Hausa	20(6.7
Igbo	42(14.1)
Others	26(8.7)
6. Religion	
Islam	162(54.4)
Christianity	136(45.6)
Others	0(0.0)
7. Marital Status	
Single	48(16.1)
Married	250(83.9)
8. Gestational Age	
First Trimester	64(21.5)
Second Trimester	146(49.0)
Third Trimester	88(29.5)

When the pregnant women were grouped according to their gestational age, the mean values of the various haematological parameters in the first, second and third trimesters in them are shown in Table 3. The mean values for PCV, MCH and MCV were found to show statistically significant relationship with increasing gestational age (p= 0.032, p=0.022 and p= 0.005 respectively). There were no statistically significant relationships observed between the mean values of Hb

concentration, RBC, MCHC, TWBC, ESR and platelet counts and increasing gestational age Table 3).

Table 2: Mean values of Haematological parameters in the pregnant women studied (n=298)

Parameter	Mean±SD	Reference Values*
PCV %	32.76±2.18	38.0 – 48.0
Hb. Conc g/dl	10.82±0.77	11.5 – 16.5
RBC x10^{12}/L	3.87±2.32	3.8 – 5.8
MCH pg	28.08±2.06	27.0 – 32.0
MCV fl	85.16±5.82	76.0 – 96.0
MCHC g/dl	33.01±1.05	32.0 – 36.0
TWBC x109/L	7.35±2.62	4.0 – 10.0
Neutrophils %	55.25±7.35	40.0 – 80.0
Eosinophils %	11.40±3.80	1.0 – 6.0
Basophils %	1.15±0.25	<1.0 – 2.0
Monocytes %	1.38±0.17	2.0 – 10.0
Lymphocytes %	35.67±5.35	20.0 – 40.0
Platelet x109/L	192.15±62.80	100.0 – 400.0
ESR mm/hr	34.07±16.85	0.0 – 15.0

*Dacie and Lewis Practical Haematology[18]

Table 3: Haematological parameters of the pregnant women studied over the three trimesters

Parameter	1st Trimester Mean±SD	2nd Trimester Mean±SD	3rd Trimester Mean±SD	P Value
PCV %	31.54±3.35	29.88±3.24	30.84±3.08	).032*
Hb. Conc. g/dl	10.79±1.56	10.44±1.80	10.63±1.68	).093
RBC X10^9/L	3.99±1.15	4.18±2.06	4.22±1.92	).187
MCH pg	27.68±2.95	28.86±2.99	28.58±3.02	).022*
MCV fl	77.58±6.72	83.63±7.15	84.32±7.88	).005*
MCHC g/dl	33.87±1.85	34.13±1.93	34.05±1.32	).553
TWBC 10^9/L	6.96±3.35	7.85±3.33	7.99±3.64	0.152
Neutrophils%	56.05±8.34	50.69±13.83	55.36±12.45	0.265
Eosinophils %	10.76±5.31	9.82±4.10	11.01±5.11	0.160
Basophils %	1.10±0.05	1.0±0.00	1.05±0.15	0.886
Monocytes %	1.36±0.58	1.28±0.67	1.40±0.25	0.346
Lymphocytes %	35.12±8.44	36.66±10.22	34.95±11.35	0.822
Platelet x10^9/L	188.19 ±68.05	192.65 ±73.55	188.43 ±72.26	).078
ESR mm/hr	33.68 ±18.63	35.08 ±17.24	34.89 ±16.78	0.088

*Statistically significant (p value <0.05)

Discussion

Many changes are known to occur during pregnancy which are meant to compensate for the increased demand of the foeto-placental unit[1],[3] and laboratory monitoring of the haematological indices in pregnant women have been reported by several authors t influence or predict outcome of pregnancy [2,4,6,10,12,15].

Generally, it had be·n reported that the levels of th different haematological indices decrease durin pregnancy due to haemodilution and increased deman of pregnancy[1,4,8,15]. In the present study, it wa observed that parameters of pregnant women such a PCV (haematocrit) and Hb concentration were lowe than normal. This observation agrees with the previou studies that were carried out within Nigeria and other parts of the world [1,4, 5,6,8,9,12,13]. Osonuga IO et al in their study of pregnant women in south weste Nigeria reported no significant change in PCV valu across the three trimesters. This result contrasts wi the finding in our study where a statistically significa reduction in PCV values was recorded across t different trimesters. The little differences which we observed between our study and the other studies m be related to genetic variations, ethnic and rac differences, climate and other environmental factc Also, the reduction in the PCV may be explained the general increase in plasma volume a haemodilution which occurs in pregnancy [1,2,19].

The mean MCV value in this study was found to lowest in the first trimester, but increased during t second and third trimesters. The pattern observed w the MCV values agrees with the work of James TR al [15] which reported similar finding in Jamaic primigravid women during the first antenatal visit West Indies. The increase in MCV during pregnan has been attributed to increased red blood cell volu which becomes noticeable in the second trimester a this may suggest a compensatory mechanism for t haemodilutional anaemia which occurs in pregnan This "physiological anaemia" of pregnancy demonstrable by the low Hb and haematocrit levels the pregnant women when compared with their n pregnant counterparts [1,2,4,9,10].

The mean corpuscular haemoglobin (MCH) is measure of the haemoglobin concentration within red blood cells. In this study, mean MCH value w found to have increased from the first trimester throu the second and third trimesters. Similar observati was reported by other studies[3,4,12,16,20]. The patt observed with MCH values in this study and the ot studies possibly corroborates the explanation for MCV increase in pregnancy. The low levels

haematocrit and Hb concentration which was found in the subjects may have been compensated for by the increased MCV and MCH resulting from increased individual red blood cell volume and haemoglobin concentration such that the haemodilutional anaemia does not adversely affect the pregnant mother in the absence of any other pathology.

The white blood cells (neutrophils, eosinophils, basophils and lymphocytes) are mainly involved in the defense of the body against invading microorganisms. This study revealed that WBC value was lowest in the first trimester but increased in the second and third trimesters, although, the change was not statistically significant ($p = 0.152$). This observation was similar to the findings of Ichipi-Ifukor PC et al [4] which also did not observe any statistically significant change in the WBC values of the pregnant women studied across the three trimesters. Pughikumo OC et al [21] in Port Harcourt, however, reported statistically significant increase in the leucocyte counts of pregnant women with increasing gestational age.

Similar to the findings of Akingbola TS et al[13] in Ibadan, South west Nigeria and Akinbami AA et al[9] in Lagos, Nigeria, we observed a gradual decrease in the platelet counts of the pregnant women from the first trimester through the second to the third trimester in our study. Following the haemodilution and plasma volume expansion which occur during pregnancy, the platelet counts may decrease by approximately 10% especially during the second and third trimesters [2,7,22], but the absolute platelet counts remain within the normal reference values.

Erythrocyte sedimentation rate (ESR), although a non-specific test, is a reliable measurement of acute phase response to inflammation or treatment. In this study, ESR was found to be lowest in the first trimester and then increased in the second and third trimesters. Increased ESR values during pregnancy were also reported by Osonuga IO et al [10] and Dapper DV et al [14] in their studies. Pregnancy is a hypercoagulable state which is associated with an increased circulating fibriqAnogen and immunoglobulin levels[23]. Therefore, the observed increase in ESR values during the second and third trimesters in this study may be due to increased level of fibrinogen or other proteins which had been reported to be increased during pregnancy [24]. The mean values of the various haematological parameters studied among the apparently healthy pregnant women that presented for antenatal care at the U.I.T.H, Ilorin during the study period have been shown to be comparable with the findings of other researchers within and outside Nigeria.

Conclusion

It can be reasonably concluded that pregnancy brings about considerable alterations in some of the haematological parameters especially PCV, Hb concentration, MCH and MCV. Therefore, routine measurement of these parameters in pregnant women during antenatal care booking visit, even when they show apparent physical wellness, may help in the early detection of those at risk and prompt intervention will be of immense benefit and certainly contribute to better pregnancy outcome. This study in addition, will serve to provide additional baseline data for haematological parameters in healthy Nigerian pregnant women, especially in the North central zone of the country where there is paucity of data in this regard.

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