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

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Abstract

Introduction: Haematological profile of pregnant women provides vital information on physiological changes in pregnancy progress, outcome and possible maternal-foetal complications. The study assessed the haematological profile of pregnant women attending the antenatal clinic. **Methodology:** The cross-sectional study was conducted at the antenatal clinic of Abubakar Tafawa Balewa Teaching Hospital, Bauchi between July and September 2018 among pregnant women attending the antenatal clinic. Study participant was recruited on voluntary basis and study questionnaire and informed consent administered. Blood samples are collected and analysed using System x haematology autoanalyser. **Result:** A total of 191 study participants comprised of 141 pregnant women at different trimester stages and 50 non-pregnant. Mean haematocrit, haemgloblin, white blood count and platelet count of 35.8 ± 9.0, 11.6 ± 1.6, 7.7 ± 5.7, and 234.0 ± 74.6 respectively. Significant difference was observed between pregnant and non-pregnant women in neutrophil (0.016), mixed (eosinophil, basophil and monocyte, 0.05), lymphocyte (0.000), platelets (0.002) and RDWSD (0.025). Comparing haematological profile with trimester stages, significant association was observed with white blood cells count and mixed cell counts. **Conclusion:** The reduction in mean white blood cells count and increased haemocrit concentration with the trimester stages contradict patterns in other similar studies. This further highlights the need for local data for early diagnosis of pregnancy-associated clinical conditions and management approach.

Keywords

Heamatological Profile, Pregnant Women, Antenatal Clinic, Bauchi, Nigeria

1. Introduction

Pregnancy is characterized by physiological changes that affect the heamostatic status, progress and outcomes [1] [2] [3]. It is influenced by several factors which include socio-cultural and religious practices, genetics, environmental and adherence to antenatal advise [1] [2] [4]. Likewise, haematological profile assessed physiological changes and possible associated clinical complications [1] [2] [5]. Of common haematological abnormalities of pregnancy is anaemia, defined as haemglobin concentration below 11.0 g/dl or haemocrit concentration below 33% according to World Health Organization [6]. In developing countries, particularly in subsaharan Africa including Nigeria, anaemia in pregnancy prevalence is greater than 50%, which varies with geographical location and several factors like infectious disease, malaria and intestinal helminthes that affect haemglobin concentration [7] [8] [9]. Associated clinical complications include high maternal mortality rate, preter maturity, low birth weight, miscarriage and abortion [10] [11] [12]. According to the WHO/UNICEF (1999-2015) joint report on maternal mortality in Nigeria, revealed 58,000 maternal death which accounted for 19% globally, with the highest maternal mortality rate in the northeastern Nigeria with 1549 death per 100,000 live birth [13].

In pregnancy, physiological characteristics are noticeable with varied haematological levels. Hormonal secretion of oestrogen and progesterone by placenta stimulated release of renin that activates renin-angiotensin mechanism which causes increase in the plasma volume by 40% - 50%, early in the pregnancy and continued till delivery and sodium retention [1] [14] [15] [16] [17]. While maternal erythropoiesis increases with red cell mass production in response to foetal demand and increased plasma volume results in haemodilutional effect, which is responsible for the decrease in the red blood cell indices [16] [17]. Manifestation of increased haemocrit and haemglobulin concentration decreases with the trimester stages, and typical drop in the second trimester due to maternal plasma volume [2] [5] [18] [19] [20] [21], dependent on factors such as geographical location, malaria, helmthitic infection, dietary and iron supplement intake [22]. While red blood cells indices (MCV, MCH and MCHC) serve as a good indicator of iron-deficiency anaemia in pregnancy and concentration varies with studies [1] [14].

The absolute white blood cell counts increased early in pregnancy and continued throughout the trimesters stages, primarily due to physiological stress, neutrophil count and neutrophilic apoptosis [1] [14] [23] [24]. Neutrophil is a major leucocyte of differential count and contributes significantly to leucocytosis in pregnancy [25] [26] [27]. Gestational thrombocytopenia is second to anaemia of heamatological abnormalities, which occurs in 7% - 8% pregnancy, a mild condition that requires no clinical attention [1] [14] [28]. But the decrease in platelets count can be attributable to platelets activation, and clearance [29] [30] [31].

Variability in haematological profile in pregnancy due to several factors as documented in most studies the need for local data derivable from pregnant women attending antenatal clinic to provide important information for clinical

assessment of pregnancy, wellbeing, and early detection of pregnancy associated complication. Based on this information, we assessed the haematological profile of pregnant women attending antenatal clinic of tertiary hospital in Bauchi State.

2. Methodology

The cross-sectional study was conducted at the antenatal clinic of Abubakar Tafawa Balewa University Teaching Hospital, Bauchi between July and August 2018. The 750-bed hospital in Bauchi, North-eastern provides multi medical specialties services to Nigerian and nationals of neighboring countries. The study protocol was approved by ATBUTH instutional review board. Recruitment of study participants was voluntary based on verbal briefing in English and Hausa languages. A well-structure study questionnaire and informed consent were administered by the authors [MAB, LMD, AS] on the study participants after routine antenatal clinical review. Age-matched non-pregnant study participant as control were recruited among member of staff of the hospital with no evidence of pregnancy. Information of the questionnaire includes, age, occupation, residential location, marital status, type of relationship, educational background, gestational age, parity and haematenic intake.

Five millimeter of venous blood specimen was collected aseptically into labeled EDTA bottles for haematological analysis, using Sysmex haematology analyser. The eosinophil, basophil and monocyte were presented as mixed counts.

Haematological profile and demographic variables were analysed using SPSS version20.0, values expressed in mean, frequency and percentages. Categorical variables were compared using chi-square test with statistical significance at $p < 0.05$.

3. Result

A total of 191 study participants, comprised of 141 pregnant women at different gestational stages and 50 non pregnant as controls, mean age of 29.26 ± 5.94 years. Demographic characteristic of study participant presented in Table 1, majority of study participants were within age-group 27 - 32 years (n = 76, 39.79%), 52 (26.18) involved in one business or other, 79 (41.36) had tertiary educational background, 72 (37.70) at second trimester stage 143 (74.87) takes the routine haematenics and 88 (46.08) had multiple parity.

Comparing the haematological profile of pregnant and non-pregnant women as presented in Table 2, significance difference was observed between pregnant and non-pregnant women with mean neutrophil count (0.016), mixed count (0.005), lymphocyte (0.000), platelet (0.002) and RDWSD (0.025). Slightly higher concentration of WBC (7.7 ± 5.7), neutrophil (63.7 ± 8.9), MCV (86.4 ± 8.0), and low concentration of mixed (9.4 ± 5.3), lymphocyte (26.5 ± 9 ± 7.4), PCV (35.8 ± 9.0), Hb (11.6 ± 1.6), MCH (29.2 ± 3.5), MCHC (33.8 ± 2.6) were recorded among the pregnant compared to non-pregnant women.

Table 1. Demographic characteristics of pregnant women and control subject.

Mean Age	29.26 ± 5.94
Variable	**Frequency (%)**
Age Group	
15 - 20	15 (7.85)
21 - 26	43 (22.51)
27 - 32	76 (39.79)
33 - 38	41 (21.47)
>39	16 (8.38)
Occupation	
Student	43 (22.51)
Civil Servant	37 (19.37)
Applicant	15 (7.85)
Business	50 (26.18)
Trader	9 (4.71)
Others	37 (19.37)
Residence	
Urban	155 (81.20)
Semi Urban	34 (17.80)
Rural	2 (1.00)
Marital Status	
Married	188 (98.43)
Non-Married	3 (1.57)
Type of Relationship	
Monogamous	135 (70.68)
Polygamous	56 (29.32)
Educational Status	
Islamic	37 (19.37)
Primary	19 (9.95)
Secondary	56 (29.32)
Tertiary	79 (41.36)
Gestational Stage	
First Trimester	12 (6.28)
Second Trimester	72 (37.70)
Third Trimester	56 (29.32)
Control	51 (26.70)
Haematenics	
Yes	143 (74.87)
No	48 (25.13)
Parity	
Single	38 (19.90)
Double	65 (34.03)
Multiple	88 (46.08)

Comparsion of haematological profile and trimester stage of pregnant women (Table 3), mean haematocrit concentration increased with trimester (36.4 ± 3.2) at first trimester, a dip at the second trimester (34.7 ± 7.1), rise at the third trimester (37.1 ± 11.5), while slight decrease with heamglobulin concentration, 12.3 ± 1.2, 11.6 ± 1.4 and 11.3 ± 2.0 respectively. MCV, MCH and MCHC concentration showed a slightly stable increase from first to third trimester, MCV 83.4 ± 7.7, 86.4 ± 7.7, 87.0 ± 8.3, MCH-28.1 ± 3.3, 29.2 ± 3.0 and 29.4 ± 3.1 and MCHC-33.7 ± 2.1, 33.8 ± 3.0 and 33.8 ± 2.1. The mean RDWSD concentration showed increase from 47.6 ± 3.2 at the first trimester, drop to 46.5 ± 6.5 at second trimester, and rise to 49.0 ± 9.4 at the third trimester.

Table 2. Comparison of haematological profile of pregnant and non-pregnant women.

Variables	Pregnant women	Non-Pregnant women	P-value
PCV	35.8 ± 9.0	36.3 ± 8.9	0.753
HB	11.6 ± 1.6	11.7 ± 2.2	0.683
WBC	7.7 ± 5.7	7.4 ± 5.6	0.134
NEU	63.7 ± 8.9	52.2 ± 53.9	0016
LYM	26.9 ± 7.4	44.7 ± 14.7	0.0001
MIX	9.4 ± 5.3	13.7 ± 15.7	0.005
PLT	234.0 ± 74.6	279 ± 1.2	0.002
MCV	86.4 ± 8.0	85.4 ± 6.9	0.449
MCH	29.2 ± 3.5	30.0 ± 9.6	0.424
MCHC	33.8 ± 2.6	40.0 ± 45.0	0.104
RDWSD	47.6 ± 7.7	62.9 ± 79.3	0025

Table 3. Comparison of haematological profile with trimester stages.

Variables	Overall mean	1st Trimester	2nd Trimester	3rd Trimester	p-value
PCV	35.8 ± 9.0	36.4 ± 3.2	34.7 ± 7.1	37.1 ± 11.5	0.313
HB	11.6 ± 1.6	12.3 ± 1.2	11.6 ± 1.4	11.3 ± 2.0	0.227
MCV	86.4 ± 8.0	83.4 ± 7.7	86.4 ± 7.7	87.0 ± 8.3	0.387
MCH	29.2 ± 3.5	28.7 ± 3.3	29.2 ± 3.9	29.4 ± 3.1	0.575
MCHC	33.8 ± 2.6	33.7 ± 2.1	33.8 ± 3.0	33.8 ± 2.1	0.973
RDWSD	47.6 ± 7.7	47.6 ± 3.2	46.5 ± 6.5	49.0 ± 9.4	0.190
WBC	7.7 ± 5.7	13.29 ± 19.29	7.7 ± 2.1	6.8 ± 1.8	0.002
NEU	63.7 ± 8.9	60.49 ± 7.5	65.0 ± 7.6	62.6 ± 10.5	0.145
LYM	26.9 ± 7.4	31.46 ± 6.4	26.4 ± 6.6	26.9 ± 7.3	0.099
MIX	9.4 ± 5.3	8.1 ± 3.1	8.5 ± 3.2	10.7 ± 7.3	0.046
PLT	234.0 ± 74.6	270.2 ± 1.1	231.4 ± 68.5	230.2 ± 75.1	0.247

Significant decrease was observed in the mean absolute white cells count with the trimester stages, 13.29 ± 19.3 at the first, 7.7 ± 2.1 at second and 6.8 ± 1.8 at third trimester ($p < 0.002$). The mean neutrophil count increased with the trimesters, peaked at the second (65.0 ± 7.6) and drops at third (62.6 ± 10.5). Significant increase was observed with the mixed counts, from 8.1 ± 3.1 at first trimester, 8.5 ± 3.2 and 10.7 ± 7.3 at third trimester (0.045). Slight decrease in the mean lymphocyte counts was observed, 31.46 ± 6.4 to 26.9 ± 7.3. Mean Platelet counts demonstrated progressive decrease with trimester, 270.2 ± 1.1 at first trimester, 231.4 ± 68.5 and 230.2 ± 75.1 at third trimester

4. Discussion

Haematological profile of pregnant women provides vital information on physiologoical changes associated with pregnancy progress, outcome and maternal-fetal complication [1] [2] [7] [8] [10]. Anaemia is the most common haematological abnormalities that have adverse impact on pregnancy outcome, particularly in developing countries with high maternal mortality [13]. In Nigeria, antenatal care seeking behavior by pregnant women tends to vary with geographical location, ethinic/tribal background, religious belief, educational background, distance from hospital, educational background and economic status [32] [33]. While the haematological profile is associated with genetic background, ethinic/tribal, dietary pattern and parasitic/infectious diseases [22] [34]. As presented on **Table 1**, the sociodemographic variables of pregnant women like age, parity gestational age, residential location educational background and economic status, were similar with other studies [5] [18] [21] [35] The main findings of our study is the reduction in WBC count and increase in heamocrit concentration, which contradict findings of most similar studies [2] [5] [18] [19] [21] [24]. In addition, overview of our study data, revealed higher haemtological levels than those reported in studies conducted in and outside Nigeria [2] [5] [18] [35] [36], which buttressed the effect of geographical and environmental factors on physiological changes in pregnant women.

In this study, the mean concentration of haemocrit and heamoglobin concentration was slightly lower among pregnant women compared to non-pregnant, with no significant difference, which highlights pregnancy induced physiological changes. However, the mean haemocrit concentration increased with the trimesters, 36.4 ± 3.2 recorded at first trimester, with slight dip at the second trimester 34.7 ± 7.1 and increase at the third trimester, 37.1 ± 11.5 which is at variance with other studies that reported decrease in haemocrit concentration [2] [5] [18] [19] [21] [35] [36]. The observed increase in heamocrit concentration of our study may be due to increase maternal erythropesis as a result of iron demand as pregnancy progresses, fetal growth and increase iron supplement intake [12] [17] [22] [37]. As presented in **Table 1**, 74.8% of study participants take haematenics regularly, with no case of anaemia in pregnancy recorded among study participants and low malaria prevalence (2%) was documented among the

pregnant women [22]. Typically, reduced mean haemocrit and heamglobin concentrations recorded in the second trimester observed in our study is consistent with other studies [2] [5] [18] [19] [21], which is due to increase plasma volume as reported in most studies. The mean haemoglobin concentration showed a slight decrease with the trimester stages, which is consistent with other studies [2] [5] [18] [19] [21]. As reported in most studies [1] [14] [17], the hormonal secretion of oestrogen and progesterone by placenta cause release of renin which in turn stimulate renin-angiotensin mechanism which triggers increase in plasma volume which range between 40% - 50% dependent on the trimester stage, resulting in maternal haemglobin dilution causing physiological anaemia. MCV, MCH and MCHC are red blood cells indices used in the assessment of iron-deficiency anaemia in pregnancy [1] [14]. In this study, the mean MCV and MCH concentration of 83 ± 7.7, 86.4 ± 7.7, 87.0 ± 8.3 and 28.7 ± 3.3, 29.2 ± 3.9 and 29.4 ± 3.1 revealed a slight increase with the trimesters, while MCHC concentration was stable throughout the trimester stages, similar to other studies but varied with reported concentration [2] [5] [18]. The relatively stable concentration of red blood cells indices as observed in our study could be due to the low prevalence malaria and iron-supplement intake among the pregnant women [22]. In addition, the mean RDWSD level assessed red blood cell width variation, the level increases during pregnancy, and asses iron-deficiency anaemia during pregnancy [2]. In this study, the RDWSD concentration exhibited similar pattern with haemocrit and heamglobin concentration, with increased level at first trimester, slight reduction at second trimester and later increase in the third trimester.

In pregnancy, leucocytosis increases from early stage and continued to the delivery stage, due to series of immunological activities of inflammatory response, selective immune tolerance, immunosuppression and immunomodulation of foetus [19] [23]. This contributes to the slight increase in the mean white blood cells and neutrophil counts among pregnant women compared to non-pregnant women, in contrast to high mean mixed, lymphocyte and platelet counts among non-pregnant women. But significant difference was observed with mean neutrophil (0.015), mixed (0.005) and lymphocyte (0.000) and platelet (0.000). Comparing the mean white blood cell counts with the trimesters, there was significant decrease to the mean absolute white cell count with the trimesters, 13.29 ± 19.29, 7.7 ± 2.1 and 6.8 ± 1.8 ($p < 0.002$). This pattern contradicts the increased WBC count with the trimester stages, as documented in most studies [2] [5] [38], which is attributable to pregnancy induced physiological stress, number of circulating neutrophil and neutrophilic apoptosis [23] [39]. The reduction in WBC count pattern observed in our study was slightly similar to the study conducted in Port Harcourt, Nigeria [35], that reported a relative reduction in WBC count of 9.21 ± 2.86, 9.36 ± 3.02 and 9.01 ± 4.2. This reduction pattern may be attributable to haemodilutional effect of increased plasma volume.

In normal pregnancy, mean WBC count ranged between 5.7 - 13.6 at the first,

5.6 - 14.8 and 5.6 - 16.8 at the third trimester [40]. The increased WBC counts in pregnancy may not be a good indicator of infection assessment, nevertheless, high WBC count in pregnancy can be a predicator of pregnancy outcome such as preterm delivery, miscarriage, and abortion [41] [42] [43]. Neutrophil is the major leucocyte in differential analysis of WBC count which influenced the absolute WBC count attributable to impaired neutrophil apoptosis [25] [26]. In this study, the mean neutrophil count increased from first trimester 60.49 ± 8.9, to 65.0 ± 7.6 at the third trimester, with a slight drop to 62.6 ± 10.5 at the second trimester, consistent with other studies [2] [5] [18]. In pregnancy, physiological process of oxidative metabolism increased neutrophil count due to activation of neutrophil chemotaxis and phagocytic activity that are depressed by inhibitory factors present in serum of pregnant women [25] [26] [30]. Significant difference was observed in the mean lymphocyte count of pregnant women and non-pregnant women ($p < 0.0001$). In most studies, mean lymphocytes count decreases with the trimester, which is consistent with our findings that showed a relatively stable decrease with the trimesters, a slight drop at second and increase at third trimester [2] [5] [18] [21].

Eosinophil, monocyte and basophil count response to allergy to intestinal parasitic infection [1]. In this study, eosinophil, basophil and monocyte were presented as mixed counts; significant difference was observed between pregnant women and non-pregnant women, while significant association was observed with the trimesters as reported in similar study conducted in Libya, which revealed relatively decreased mixed counts with the trimester [18]. Primarily, monocyte functions in preventing foetal allograft rejection. While eosinophil and basophil count seem relatively unchanged during pregnancy [1] [14].

The mean platelets count showed a significant difference between pregnant women (234 ± 74.6) and non-pregnant women (279 ± 1.2), ($p < 0.002$). The mean PLT count showed a progressive decreases with the trimester, 270 ± 1.1, 231.4 ± 68.5, 230.2 ± 75.1 which is consistent with findings of other studies [2] [5] [18] [21]. This decrease in mean platelets count is due to haemodilutional effect of increase in plasma volume, platelet activation and accelerated clearance [25] [26] [27].

5. Conclusion

The reduction in the WBC count with trimester and increase haemocrit concentration affirmed the need for more local studies on haematological profiles of pregnancy which is essential to effective monitoring and management during antenatal visits.

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Conflict of Interest

The authors have collectively reviewed the paper and have no conflict of interest to declare.

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