White Blood Cell Counts In Pregnant Women in Port Harcourt, Nigeria

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Abstract: *Pregnancy is characterised by an increase in white blood cell count (WBC) arising mainly from neutrophilia, and to a lesser extent, monocytosis. This neutrophilia is attributed to physiologic stress and it is known to increase with gestational age. While humoral immunity is unaltered in pregnancy, cell mediated immunity is depressed. The neutrophilia of pregnancy is postulated to be a compensatory boost in innate immunity to offset the attenuation in specific immunity. It is important to note that leucocytosis even with a mild left shift and some toxic granulations may not necessarily indicate an infection in pregnant women. The aim of this study was to evaluate WBC count in pregnant women compared with non-pregnant controls and to determine any change in the values in the three trimesters of pregnancy using an automated haematology analyser, PCE 210 (N) ERMA. Our results show a significant increase in leucocytes in pregnant women compared to non-pregnant controls 6.86 ±1.54 Vs 5.80 ± 1.41(p = 0.001). We also demonstrated a progressive increase in WBC count with gestational age: First trimester; 6.38×10^9/L ± 1.76, second trimester; 6.81×10^9 /L ±1.52; and third trimester, 7.36×10^9/L±1.49.*
Keywords:*Pregnancy, Trimester, White Cell Count.*

I.   Introduction

The white blood cells (leucocytes) are the cellular components of blood mediating the body's immune system. They constitute about 1% of blood cells. Leucocytes originate form pluripotent stem cells in the bone marrow. There are five subsets; neutrophils, eosinophils, basophils, Lymphocytes, and monocytes.[1]Pregnancy is associated with alterations in many haematological parameters, one of which is an increase in white blood cell count (leucocytosis). It has been attributed to physiologic stress and increased inflammatory response associated with pregnancy.[2,3] This leucocytosis is mainly due to neutrophiliaand immature forms like metamyelocytes and myelocytes(neutrophil left shift) may be present in the peripheral blood film.Monocytosis is also reported in pregnancy.[4]

Several changes have been reported in neutrophils during pregnancy. They include; impairment of apoptosis due to the increased inflammatory response, reduced chemotaxisand impaired respiratory burst.[3,4,5,6] Crocker etal,[7]   observed that peripheral blood neutrophils in normal pregnancy were neither primed nor activated, but their release of reactive oxygen species (ROS) was impaired.Thus, the neutrophilia of pregnancy is associated with a left shift to enhance phagocytosis by engaging younger band forms and there may be toxic granulations due to poor oxidative metabolism.[6] This boost in non-specific (innate) immunity is said to be a compensation for the attenuation of specific immunity in pregnancy.[8,9]The impairment of specific immunity correlates with a reduction in lymphocyte count in pregnancy. Eosinophils and basophils also decline in number with increasing gestational age.[2,10]

The aim of this study was to assess the changes in total leucocyte count in pregnancy in comparison with non-pregnant controls. We also examined the leucocyte counts across the three trimesters of pregnancy using an automated haematology analyser.

II.   Methodology

The study was approved by the Ethics committee of the University of Port Harcourt Teaching Hospital, Port Harcourt (UPTH/CS&T/118/VOLXII/405). One hundred and fifty (150) apparently healthy pregnant women on their first antenatal visit to three health care facilities in Port Harcourt were recruited into the study. The health care facilities were: the University of Port Harcourt Teaching Hospital (UPTH), Alakahia; the Demonstration clinic of the Rivers State College of Health Science and Technology (RSCHST), Rumueme, and the Family support health centre, Orogbum. It was a cross-sectional study done between July and October, 2009. Written informed consent was obtained from all participants.

One hundred and twenty six (126) apparently healthy non-pregnant women of reproductive age volunteered were used as controls, but only 102 blood samples were eventually analysed. They were drawn from staff of the UPTH, Port Harcourt and patient relatives in the hospital. Additional volunteers were recruited from three churches in Port Harcourt; Living Faith Church, Mgbuoba, Zion Baptist Church, Rumuepirikom, and Goodland Baptist Church, Rumuigbo.

Exclusion criteria included women who were ill, active bleeding from any site; blood pressure $\geq$ 140/90mmHg; major surgery or road traffic accident in the last one year, and women with known haemoglobinopathy.

Data was collected from the case files of the pregnant women and a structured user-administered questionnaire was used for both subjects and controls.Five millilitres (ml) of venous blood was then collected by venepuncture from each participant into potassium ethylene diamine tetra acetic acid (EDTA) bottles. The blood samples were analysed within 2-3 hours of collection in the Haematology laboratory at the University of the Port Harcourt Teaching Hospital (UPTH), for complete blood count (CBC) in an automated cell counter, PCE-210 (N), ERMA. The white cell counts were extracted from the computer print-outs from the machine.

Statistical Analysis: The data generated was analysed using the Microsoft Excel, 2007 and EPI-INFO version 6.1softwares. Differences between the means in the groups were assessed using the student's t-test and p-values below 0.05 (5%) were considered significant.

III. Results

The mean age of the pregnant women was 29.82years (S.D. 4.72) and rangedbetween 19 and 46 years. Twenty-three (23) of the women were in their first trimester, 76 in their second trimester while 51 were in their third trimester at booking. The mean age ofthe non-pregnant controls was 27.64 years (S.D. 5.78) and a range of19-47 years. The total white blood cell count (WBC) for the subjects and controls was $6.86 \pm 1.54 \times 10^9$ /L vs. $5.80 \pm 1.41 \times 10^9$ /L (p = 0.001). WBC increased progressively with gestational age (Figure 1): First trimester; $6.38 \pm 1.76 \times 10^9$ /L, second trimester; $6.81 \pm 1.52 \times 10^9$ /L and third trimester, $7.36 \pm 1.49 \times 10^9$ /L.The differences between the means were not statistically significant from the first to the second trimester (student's t-test, 1.12; p = 0.265); from the second to the third trimester (student's t-test; p = 0.066). But the difference in mean WBC between the first and the third trimester was highly significant (student's t-test, 2.31; p = 0.024)
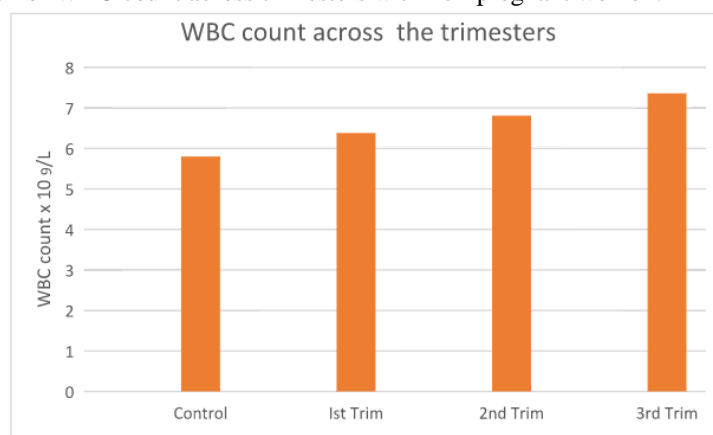Figure 1: A comparison of WBC count across trimesters with non-pregnant women.

Figure 1: A comparison of WBC across trimesters, compared with controls.

Key: Control = non-pregnant women; Trim = Trimester

IV. Discussion

In pregnancy, humoral immunity is said to be intact, but cell mediated immunity is markedly depressed, upregulation of innate immunity has been theorised to be a compensatory mechanism.[8,9]A major change in innate immunity noted is an increase in WBC count mainly due to neutrophilia.[4,5,6,7,8,11] Our overall WBC counts in pregnant and non-pregnant confirm this finding. The trimester distribution of leucocyte counts in this study shows a progressive increase with gestational agealthough only statistically significant between the first and the third trimester, (p = 0.024),it is a pointer to the concept of a boost in leucocyte function in pregnancy (Figure1). This is consistent with the results of many other studies in Nigeria and in other parts of the world (Table 1).

Table1: Comparison of WBC in pregnancy in our study with other studies.

Population	WBC count (x10^9/L)			
	Control	1st Trimester	2nd Trimester	3rd Trimester
This study	5.80 ± 1.41	6.38 ± 1.76	6.81 ± 1.52	7.36 ± 1.49
Northern Nigeria[12]	5.26 ± 2.9	6.19 ± 2.48	6.41 ± 2.88	7.12 ± 2.36
Southern Nigeria[13]	5.28 (2.9-8.7)	5.49 (4.03-6.95)	6.57 (6.19-6.95)	6.92 (6.53-7.30)
Southern Nigeria[14]		7.31 ± 2.38	7.88 ± 2.33	8.37 ± 2.15
Jamaica[15]		8.25 ± 2.60	9.66 ± 2.84	8.79 ± 2.50
UK[5]	5.96 ± 0.62	7.32 ± 0.68	7.81 ± 0.71	10.24 ± 1.30

However, the increase in leucocyte count with increasing gestational age was less marked in our study. This is probably because ours was a cross-sectional study with varying numbers of subjects at different gestational ages. In a longitudinal study by Crocker et al,[5] the leucocytosis was particularly high in the third trimester.To the clinician, especially the Obstetrician, it is noteworthy that a mild to moderate leucocytosis and even a slowly rising leucocytosis is not a good indicator of an infection in pregnancy.The peripheral blood film may show a mild to moderate left shift and even some toxic granulations in a normal pregnant woman without any pathological significance.[2,4]

In spite of the fact that the WBC is increased in normal pregnancy, higher counts may be an indicator of haematologic malignancies. These may occur rarely (1:75,000 - 100,000) in pregnancy and may pose a problem for managing obstetricians.[16]This underscores the need for the review of the complete blood count during antenatal care. However, leucocytosis should be interpreted with caution and further tests should be requested to confirm the diagnosis of an infection or other conditions in pregnant women.

V. Conclusion

The White cell count increases steadily in pregnancy from the first to the third trimester. There was a significant difference between the white cell counts of women booking in the first trimester and those booking in the third trimester. It was not an indication for the diagnosis of infection in these women. However, it is necessary to request for a complete cell count in pregnant women and leucocytosis may require further testing to rule out other diseases.

References

[1]. Ravandi F and Hoffman R (2005). Phagocytes. In Hoffbrand AV, Catovsky D, Tuddenham EGD, Eds. Postgraduate Haematology. 5th Edition, Blackwell Publishing Oxford, UK; 277-302.
[2]. Chandra S, Tripathi AK, Mishra S, Amzarul M, Vaish AK (2012). Physiological Changes in Hematological Parameters During Pregnancy. Indian J Hematol Blood Transfus; 28 (3): 144-146.
[3]. Canzoneri BJ, Lewis DF, Groome L, Wang Y (2009). Increased Neutrophil Numbers Account for Leukocytosis in Women with Preeclampsia. Am J Perinatol; 26 (10): 729-732.
[4]. Crouch SP, Crocker IP, Fletcher J (1995). The effect of pregnancy on polymorphonuclear leukocyte function. J Immunol; 155 (11): 5436-5443.
[5]. Crocker IP, Baker PN, Fletcher J (2000). Neutrophil function in pregnancy and rheumatoid arthritis. Ann Rheum Dis; 59 (7): 555-564.
[6]. Bjorksten IM, Soderstrom T, Damber M-G, Schoultz B, Stigbrand T(1978). Polymorphonuclear leucocyte function during normalpregnancy. Scand J Immunol; 8 (3): 257-262.
[7]. Crocker IP, Wellings RP, Fletcher J, Baker PN (1999). Neutrophil function in women with pre-eclampsia. Br J ObstetGynaecol; 106 (8): 822-828.
[8]. Pramanik SS, Pramanik T, Mondal SC, Chanda R (2007). Number, maturity and phagocytic activity of neutrophils in the three trimesters of pregnancy. East Mediterr Health J; 13 (4): 862-867.
[9]. Luppi P (2003). How immune mechanisms are affected by pregnancy. Vaccine; 21(24): 3352-3357.
[10]. Pitkin RM, Witte DL (1979). Platelet and leukocyte counts in pregnancy. JAMA; 242: 2696-2698.
[11]. Valdimarsson H, Mulholland C, Fridriksdottir V, Coleman DV (1983). A longitudinal study of leucocyte blood counts and lymphocyte responses inpregnancy: a marked early increase of monocyte-lymphocyte ratio. ClinexpImmunol; 53: 437-443.
[12]. Onwukeme KE, Uguru VE (1990). Haematological values in pregnancy in Jos. West Afr J Med; 9(2): 70-75.
[13]. Akingbola TS, Adewole IF, Adesina OA, Afolabi KA, Fehintola FA, Bamigboye FA, Aken'ova YA, Shokunbi WA, Anwo JA, Nwegbu MM (2006). Haematological profile of healthy pregnant women in Ibadan, South-Western Nigeria. J ObstetGynaecol; 26 (8): 763-769.
[14]. Akinbami AA, Ajibola SO, Rabiu KA, Adewunmi AA, Dosunmu AO, Adediran A, Osunkalu VO, Osikomaiya BI, Ismail KA (2013). Haematological profile of normal pregnant women in Lagos, Nigeria. Int J Women's Health; 5:227-232.
[15]. James TR, Reid HL, Mullings AM (2008). Are published standards for haematological indices in pregnancy applicable across populations: an evaluation in healthy pregnant Jamaican women. BMC Pregnancy and Childbirth. 2008, 8:8 http://www.biomedcentral.com/1471-2393/8/8.
[16]. Pentheroudakis G, Orecchia R, Hoekstra HJ, Pavlidis N (2010). Cancer, fertility and pregnancy: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. Ann. Oncol. 21(Suppl. 5), v266–v273