# WHITE BLOOD CELLS EXCHANGE PREVALENCE AMONG PREGNANT WOMEN IN DUHOK AND ZAKHO GOVERNORATE, IRAQ

***Bizav Naji Rasheed***

Department of Nursing, College of Health and Medical Techniques-Shekhan, Duhok Polytechnic University, Duhok, Iraq

**Corresponding author:**
Bizav Naji Rasheed
Mobile: +29647514804321
**E-mail:**
bizav.naji@dpu.edu.krd

Received: 12/02/2024
Accepted: 02/04/2024

**Online ISSN: 2735-3540**

## ABSTRACT*:*

***Aim of the work:*** *To identify the white blood cell counts that take place during pregnancy, and to assess these changes during the first, second, and third trimesters in pregnant women in Duhok, Zakho Governorate, Iraq.*

***Methods:*** *At the Duhok and Zakho Maternity Hospitals, 400 participants; 200 control and, 200 cases pregnant women were subjected to this study. Types of pre-tested questionnaires were used to gather socio-demographic data for trimester changes in white blood cells through an autoanalyzer blood count coulter, after withdrawal of 3 milliliters of venous blood were collected into EDTA tube from each participant, and they had their Complete blood count was checked by Swelab alfa auto analyzer.*

***Results:*** *Of the pregnant women; 140 of pregnant women were in their third trimester, 34 were in their second trimester, and 26 were in their first trimester. The non-pregnant controls' mean age was 32 years (S.D. 8.6), with a range of 17 to 50 years. The difference between the cases' and controls' total white blood cell counts (WBC) was 10.5 ± 3.39 x10$^9$/L vs. 8.2 ± 1.83 x10$^9$/L (P= 0.0001), which is significant. Also no significance between trimesters regarding white blood cells counts and percentage.*

***Conclusion:*** *A white blood cell (WBC) differential helps determine the cause of abnormal results on a WBC count. It is an important factor in diagnosing and/or monitoring an illness affects the immune system, like infection or inflammatory condition, or cancers of white blood cell count, such as leukemia or lymphoma.*

***Keywords****: Hematological profile, pregnancy, leukocytes, Zakho, Duhok*

## 1. INTRODUCTION:

The primary causes of the rise in white blood cell count (WBC) during pregnancy are neutrophilia, and to a lesser extent monocytosis. While pregnancy decreases cell-mediated immunity, it has no effect on the humoral immunity that results in this neutrophilia. It has been linked to physiological stress and has been shown to rise with increasing gestational age [(5)].

The biological elements of blood that regulate the body's immune system are called leucocytes, or white blood cells [(5)].

Several alterations in neutrophils have been observed during pregnancy. These include decreased chemotaxis, a feeble respiratory burst, and compromised apoptosis as a result of the elevated inflammatory response [(3)].

Haematological indicators undergo physiological changes during pregnancy. The primary element impacting the physiological alterations that occur throughout pregnancy and puerperium is the hormonal surroundings. Since all of the hematological changes that take place throughout these periods are natural, the haematologist is not obliged to be aware of them. Pregnancy-related physiological stress is the cause of leucocytosis, which happens throughout the pregnancy. On differential counts, neutrophils predominate the leucocyte population. This is presumably due to a reduction in neutrophilic apoptosis brought on by pregnancy. Pregnant women's serum contains inhibitory chemicals that decrease phagocytic activity and neutrophil chemotaxis [(4)].

Pregnant women's white blood cells (WBC) are frequently examined to check for signs of inflammation or infection. In this high-risk group, however, the inconsistent reporting of the pregnancy-specific reference period exacerbates the ambiguity of the diagnosis. Given the substantial global burden of infection on maternal mortality, physicians need to be able to evaluate WBC counts in the context of normal physiology during pregnancy [(3,5)].

Since infections cause over 50% of maternal fatalities worldwide, clinicians need to be able to interpret test results for infections in pregnant patients. This motivated to examine how WBC could be used to improve the safety of expectant mothers and their unborn children [(5)].

## 2. MATERIALS AND METHODS

### 2.1 *Study design*

A cross-sectional study was conducted at Duhok Maternity Hospitals in Duhok and Zakho city, Northern of Iraq.

### 2.2 *Study period*

The study was performed between November 2022 and June 2022 in Duhok and Zakho Maternity Hospitals.

### *2.3 Sample of the study*

In this study, 210 (70 of 1$^{st}$, 70 of 2$^{nd}$, and 70 of 3$^{rd}$ trimesters) pregnant women at Duhok Maternity Hospital were participated.

### *2.4 Inclusion and exclusion criteria*

Pregnant women who attended the Duhok Maternity Hospital were included in this study apart of pregnant voluntaries who were with hematological diseases were excluded.

### *2.5 Laboratory procedure*

The study carried out a descriptive study for the pregnant women in Duhok and Zakho Maternity Hospitals, from October to April 2023. From each participant pregnant of different gestational age (first, second, and third trimesters) as a case, healthy non pregnant as a control; a questionnaire of pretest socioeconomic data (name, address, age, gestational age) was taken, and then 3 ml of venous blood was collected from the anticubital vein of each of them, putted in an EDTA tube, for a complete blood count test by automated blood analyser (Swelab coulter), and then result of the white blood cell count reported including total white blood cell counts, differential blood cell count and percentage (neutrophil, lymphocytes, monocytes, eosinophil and basophil) were recorded after testing on automated machine.

### *2.6 Data analysis*

The data was entered and analysed using the Statistical Package for the Social Sciences (SPSS) Version16 statistical software. Descriptive statistics were summarized using frequencies and means ± SD. The hematologic results were compared across trimesters using one-way analysis of variance

(ANOVA). P values < 0.05 were deemed as statistically significant.

**Ethical consideration:**

Approval of Research Ethics Committee. College of Health and Medical Technology, Duhok Polytechnic University. Reference number 22102022-1 [22/10/2022].

## 3. RESULTS:

Data was entered, managed, and analysed by Microsoft Excel (Microsoft Office LTSC Professional Plus 2021), and SPSS (version 26).

### *3.1. The study results and statistics among pregnant women:*

The pregnant women's ages ranged from 17 to 45 years old, with a mean age of 28 years (S.D. 5.71); 26 were in their first trimester, 34 were in their second trimester, and 140 were in their third trimester at the time of registration.

The WBC total count ranged from 4.6 to 32.1 x$10^9$/L, with a mean of 10.54, S.D 3.39, and a mean percentage and SD of differential count of WBC of (neutrophil 72.14 ± 6.87, lymphocyte 21.50 ± 6.39, monocyte 5.14 ± 2.49, eosinophil 1.16 ± 1.00, and basophil 0.05 ± 0.22), as shown in Table (1).

**Table 1:** Total white blood cell count and differential percentage and counts of pregnant women.

| Variable | Mean | Median |
|---|---|---|
| Age (year) | 28.06 | 27.00 |
| Total WBC (x$10^9$/L) | 10.54 | 10.10 |
| Neutrophil (%) | 72.14 | 73.00 |
| Lymphocyte (%) | 21.50 | 21.00 |
| Monocyte (%) | 5.14 | 4.50 |
| Eosinophil (%) | 1.16 | 1.00 |
| Basophil (%) | 0.05 | 0.00 |

### *3.2. The study results and statistics among control women:*

The non-pregnant controls' ages ranged from 17 to 50 years old, with a mean age of 32 years (S.D. 8.60) at the time of registration.

The WBC total count ranged from 3.7 to 11.0 x$10^9$/L, with a mean of 6.56, S.D 1.36, and a mean percentage and SD of differential count of WBC (neutrophil 59.15 ± 10.05, lymphocyte 31.03 ± 9.18, monocyte 8.65 ± 4.09, eosinophil 1.11 ± 0.33, and basophil 0.24 ± 0.43, as shown in Table (2).

**Table 2**: Total white blood cell count and differential percentage and counts of non-pregnant control women.

| Variable | Mean | Median | S. D | Minimum | Maximum |
|---|---|---|---|---|---|
| Age (year) | 32.24 | 32.50 | 8.60 | 17 | 50 |
| Total WBC (x$10^9$/L) | 6.56 | 6.40 | 1.36 | 3.70 | 11.00 |
| Neutrophil (%) | 59.15 | 58.00 | 10.05 | 36.00 | 84.00 |
| Lymphocyte (%) | 31.03 | 31.00 | 9.18 | 11.00 | 72.00 |
| Monocyte (%) | 8.65 | 8.00 | 4.09 | 3.00 | 21.00 |
| Eosinophil (%) | 1.11 | 1.00 | 0.33 | 0.00 | 2.00 |
| Basophil (%) | 0.24 | 0.00 | 0.43 | 0.00 | 2.00 |

### *3.3. The study relationship between pregnant and control participant women white blood cells and differential counts:*

The difference between the pregnant and controls' total white blood cell counts was (P=0.0001) by using T. test pair sample, regarding differential count of white blood cells, there were significant differences between the two groups regarding neutrophil, lymphocyte, monocyte, and basophil with

p-value (P = 0.0001), while there was no difference in the eosinophil percentage of the two groups, with (P = 0.171), as shown in Table (3).

**Table 3**: Differences of Total white blood cell count, differential percentage and counts between pregnant and control women.

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | PTWBC – CTWBC | 3.976 | 3.673 | 0.259 | 3.464 | 4.488 | 15.309 | 199 | .000 |
| Pair 2 | PNEUT – CNEUT | 12.985 | 11.302 | 0.799 | 11.409 | 14.560 | 16.248 | 199 | .000 |
| Pair 3 | PLCC – CLC | -9.535 | 10.216 | 0.722 | -10.959 | -8.110 | -13.199 | 199 | .000 |
| Pair 4 | PMON – CMON | -3.510 | 4.994 | 0.353 | -4.206 | -2.813 | -9.939 | 199 | .000 |
| Pair 5 | PEOS – CEOS | 0.045 | 0.462 | 0.032 | -0.019 | 0.109 | 1.376 | 199 | .171 |
| Pair 6 | PBAS – CBAS | -0.185 | 0.481 | 0.034 | -0.252 | -0.117 | -5.433 | 199 | .000 |

### *3.4 Statistical differences between white blood cells (total, differential) count in different trimesters of pregnant women's*

The WBC total count and their differential count, including neutrophil, lymphocytes, monocyte, basophil and eosinophil counts, shows no statistical difference between the three trimesters with a p value of all more than 0.05, by using ANOVA test (Post Hoc Tests) that shows the WBC count in pregnant women across the trimesters, as shown in Table (4).

**Table 4**: Differences of total white blood cell, differential counts between three trimesters of pregnant women

| Dependent Variable | (I) trimester | (J) trimester | Mean Difference (I-J) | Sig. |
|---|---|---|---|---|
| TWBC | first trimester | second trimester | -.42941 | .835 |
| | | third trimester | -1.24143 | .123 |
| | second trimester | first trimester | .42941 | .835 |
| | | third trimester | -.81202 | .370 |
| | third trimester | first trimester | 1.24143 | .123 |
| | | second trimester | .81202 | .370 |
| NEUT | first trimester | second trimester | -1.90950 | .453 |
| | | third trimester | -1.32967 | .606 |
| | second trimester | first trimester | 1.90950 | .453 |
| | | third trimester | .57983 | .870 |
| | third trimester | first trimester | 1.32967 | .606 |
| | | second trimester | -.57983 | .870 |
| LC | first trimester | second trimester | 1.41629 | .590 |
| | | third trimester | 1.46923 | .482 |
| | second trimester | first trimester | -1.41629 | .590 |
| | | third trimester | .05294 | .999 |
| | third trimester | first trimester | -1.46923 | .482 |
| | | second trimester | -.05294 | .999 |
| MON | first trimester | second trimester | .51810 | .687 |
| | | third trimester | -.22308 | .913 |
| | second trimester | first trimester | -.51810 | .687 |
| | | third trimester | -.74118 | .200 |
| | third trimester | first trimester | .22308 | .913 |

| | | | | |
|---|---|---|---|---|
| | | second trimester | .74118 | .200 |
| EOS | first trimester | second trimester | -.00452 | .999 |
| | | third trimester | .10220 | .492 |
| | second trimester | first trimester | .00452 | .999 |
| | | third trimester | .10672 | .376 |
| | third trimester | first trimester | -.10220 | .492 |
| | | second trimester | -.10672 | .376 |
| BAS | first trimester | second trimester | -.02036 | .930 |
| | | third trimester | -.01868 | .902 |
| | second trimester | first trimester | .02036 | .930 |
| | | third trimester | .00168 | .999 |
| | third trimester | first trimester | .01868 | .902 |
| | | second trimester | -.00168 | .999 |

## DISCUSSION:

Innate immunity upregulation has been postulated as a compensating mechanism, as humoral immunity is expected to remain strong during pregnancy but cell-mediated immunity is severely weakened. A surge in white blood cell count, primarily induced by neutrophilia, implies a significant alteration in innate immunity [8,10].

This observation is supported by total WBC counts in both pregnant and non-pregnant individuals. This is consistent with the findings of previous research conducted in other nations worldwide. Our findings are consistent with a study conducted in Nigeria, which found a substantial difference in white blood cell counts between pregnant and non-pregnant women (p-value < 0.001)[11], and our study results agree too with the results done in Northwest Morocco, in which there was significant difference between white blood cells count in pregnant and non-pregnant women (p value < 0.001)[2].

In this study, the correlation between the increase in leucocyte count and gestational age (trimesters) was less pronounced. This is presumably due to the fact that our study was cross-sectional and included a range of subject populations at various gestational ages. In a long-term investigation, the third trimester saw a notably high leucocytosis rate, as shown in research done in Nigeria[1,9], United Kingdom[6], and Jamaica[7] in which they show differences between trimesters of pregnancy as shown in Table (5).

**Table 5**: Comparison between our study and others regarding WBC count in pregnancy

| Population | WBC count ($x10^9$/L) | | |
|---|---|---|---|
| | 1st Trimester | 2nd Trimester | 3rd Trimester |
| Our study | 9.60 ± 2.75 | 10.02 ± 3.01 | 10.84 ± 3.56 |
| UK[6] | 7.32 ± 0.68 | 7.81 ± 0.71 | 10.24 ± 1.30 |
| Southern Nigeria[1] | 7.31 ± 2.38 | 7.88 ± 2.33 | 8.37 ± 2.15 |
| Jamaica[7] | 8.25 ± 2.60 | 9.66 ± 2.84 | 8.79 ± 2.50 |
| Northern Nigeria[9] | 6.19 ± 2.48 | 6.41 ± 2.88 | 7.12 ± 2.36 |

According to the doctor, a mild to moderate leukocytosis, even one that is gradually rising, is not a reliable marker of an infection during pregnancy. A healthy pregnant woman may have a small to moderate left shift on her peripheral blood film, as well as some toxic granulations, with no clear clinical consequences.

Given that WBC levels are raised during a regular pregnancy, higher numbers may indicate hematologic malignancies.

**Conclusion:**

The white cell count steadily rises throughout the first and third trimesters of pregnancy. The white cell counts of women in the first trimester and those in the third trimester differed significantly. According to the diagnosis, there was no indication of an infection in these women. Pregnant women must, however, acquire a full cell count, and extra leucocytosis testing may be required to rule out other illnesses.

**Recommendations:**

1. Additional research is needed to address inadequacies in the current study on white blood cells.
2. WBC requires additional study to be published in diverse areas, cultures, and locations worldwide.
3. To ensure pregnancy safety, women should protect themselves from infection and inflammation.
4. Pregnant women should regularly check their pregnancy through antenatal care, for early changes in investigation detection, and for early detection of infection and any malignant predisposition.

**Disclaimer**:

The information in this article can be used for research purposes, and author disclaimed no liability in connection with the use of this information.

**Competing interests:**

Authors declare no conflict of interest.

**Funding disclosure:**

No fund has been received for this research work.

**Acknowledgements:**

I am grateful to everyone with whom I have had the pleasure of working on this and other similar initiatives. Each member of my Dissertation Committee has given me considerable personal and professional advice and taught me a lot about scientific research and life in general. Special gratitude to Duhok, Zakho maternity hospitals, and laboratory staff (biochemistry and phlebotomy sections) for their assistance and concern for us.

**List of abbreviations:**

BAS : Basophil
CBAS : Control basophil.
CBC : Complete Blood Count
Cc : cubic centimeters
CEOS : Control eosinophil
CLC : Control lymphocyte
CMON : Control monocyte
CNEUT : Control neutrophil
CWBC : Control white blood cell
EDTA : Ethylenediamine Tetra acetic Acid
EOS : Eosinophil
Hb : Hemoglobin
Hct : Hematocrit Test
ID : Identification
LC : Lymphocyte
Mg : Milligrams
mg/dl : Milligrams per deciliter
Ml : Milliliter
MON : Monocyte
NEUT : Neutrophil
P Value : Probability Value
PBAS : Pregnant basophil
PEOS : Pregnant eosinophil
PGE2 : Prostaglandin E2
PLC : Pregnant lymphocyte
PMON : Pregnant monocyte
PNEUT : Pregnant neutrophil
RBC : Red Blood Cells
S.D : Standard deviation
SPSS : Statistical Package for the Social Sciences
TWBC : Total white blood cell
WBC : White Blood Cells
WBCP : Pregnant white blood cell

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# انتشار تبادل خلايا الدم البيضاء بين النساء الحوامل في محافظة دهوك و زاخو ، العراق

**بزاف ناجي رشيد**

قسم التمريض - كلية الصحة والتقنيات الطبية – شيخان - جامعة دهوك التقنية - دهوك - العراق

**الهدف**: تحديد عدد خلايا الدم البيضاء التي تحدث أثناء الحمل ، وتقييم هذه التغييرات خلال الثلث الأول والثاني والثالث من الحمل لدى النساء الحوامل في محافظة دهوك ، زاخو ، العراق.

**الأساليب**: في مستشفيي دهوك وزاخو للولادة، ٤٠٠ مشارك. تم إخضاع ٢٠٠ حالة ضابطة و ٢٠٠ حالة من النساء الحوامل لهذه الدراسة. تم استخدام أنواع الاستبيانات التي تم اختبارها مسبقا لجمع البيانات الاجتماعية والديموغرافية للتغيرات في الثلث في خلايا الدم البيضاء من خلال محلل تلقائي لتعداد الدم ، بعد سحب ٣ ملليلتر من الدم الوريدي تم جمعها في أنبوب EDTA من كل مشارك ، وتم فحص تعداد الدم الكامل بواسطة محلل (Swelab alfa ) التلقائي.

**النتائج**: من النساء الحوامل; كانت ١٤٠ من النساء الحوامل في الثلث الثالث من الحمل ، و ٣٤ في الثلث الثاني من الحمل ، و ٢٦ في الثلث الأول من الحمل. كان متوسط عمر الضوابط غير الحامل ٣٢ عاما (الانحراف المعياري ٨,٦) ، مع نطاق يتراوح من ١٧ إلى ٥٠ عاما. كان الفرق بين إجمالي عدد خلايا الدم البيضاء للحالات والضوابط ( ١٠,٥ ± ٣,٣٩ × $١٠^{٩}$ / لتر) مقابل ( ٨,٢ ± ١,٨٣× $١٠^{٩}$ / لتر) (P = 0.0001) ، وهو أمر مهم. كذلك لا توجد أهمية بين الثلث فيما يتعلق بعدد خلايا الدم البيضاء والنسب.

**الخلاصة**: يساعد تفاضل خلايا الدم البيضاء في تحديد سبب النتائج غير الطبيعية في عدد كرات الدم البيضاء. إنه عامل مهم في تشخيص أو مراقبة مرض يؤثر على جهاز المناعة ، مثل العدوى أو الحالة الالتهابية ، أو سرطانات عدد خلايا الدم البيضاء ، مثل سرطان الدم أو سرطان الغدد الليمفاوية.