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Hematological Profile of Pregnant Women Followed in Prenatal Consultation in Health Structures in Kinshasa, Democratic Republic of Congo

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Abstract*—*Introduction: *Pregnancy is a state characterized by physiological, changes, some of which can be demonstrated by changes in the appropriate parameters. It produces physiological changes that become more prominent as the pregnancy progresses. This study aimed to compare different hematological parameters between pregnant women from the first to the third trimester of pregnancy in Kinshasa.* ***Method***: *This analytical cross-sectional study recruited 451 pregnant women Kinshasa, from December 2022 to April 2023. Complete blood counts were performed using Mindray hematology analyzer BC- 5150. The hematological profile and demographic variables were analyzed using SPSS version 24 software. The variables are expressed as mean, frequency and percentage. Categorical variables were compared using the chi-square test with statistical significance at $p<0.05$.* ***Results***: *This study recruited 451 pregnant women. The average age is 27.42±5.83 years. We observed a significant decrease in mean values of GR, Hb, HCT, RDWSD and RDWCV and a significant increase in WBC values from the first to the third trimester of pregnancy.* ***Conclusion***: *Pregnancy is accompanied by changes in hemoglobin, hematocrit and red blood cells whose rate decreases significantly and the white blood cell whose rate increases significantly from the first to the third trimester of pregnancy.*

***Keywords*—** *Complete blood count, pregnant women, Kinshasa.*

I. INTRODUCTION

Hematological parameters are frequently used to determine the general state of health of individuals. These parameters are known to vary with age, gender, race, geographic location, and even special circumstances such as pregnancy, among others. The latter is itself influenced by many factors, some of which include culture, environment, socioeconomic status and access to medical care (1). The state of pregnancy in women is not a disease in itself, but rather a physiological state that is accompanied by physiological changes that become more prominent as the pregnancy progresses (2). These physiological changes in the maternal organism, which aim to accommodate and nourish the fetus, can modify the blood content of certain hematological or even biochemical parameters. During normal pregnancy, physiological changes in hemoglobin concentration, hematocrit value, white blood cell count and platelet count are well known (3-5). Thus, certain haematological phenomena reported during pregnancy such as anemia and leukocytosis may reflect the physiological response or its exacerbation due to a pathological event such as iron deficiency (6). Since an individual's hematological profile largely reflects their general state of health, variations cannot be ignored (1). The objective of this study was to compare different hematological parameters in pregnant women during the different trimesters of pregnancy in the prenatal consultation centers of Kinshasa, Democratic Republic of Congo.

II. METHODS

This study was an analytical cross-sectional which extended from December 2022 to April 2023 in five health structures in the city of Kinshasa which organize prenatal consultations in particular University Clinics of Kinshasa (CUK), le Centre Mere et Enfant de Barumbu (CME Barumbu) , Centre mere et enfant de Bumbu (CME Bumbu), le Centre hospitalier de Kingasani (CHK) et Centre Hospitalier de Binza Ozone (CHBO).

A total of 451 pregnant women from all socioeconomic levels were recruited. Method of recruitment: During CPN, each pregnant woman was subjected to a clinical and biological examination. Only women meeting the criteria and having consented were selected for the sample. From each of them, four ml of blood was taken into a tube with EDTA and then mixed by inversion 8 to 10 times. At the sampling site, the samples were kept in isothermal containers and transferred to the Clinical Biology laboratory of the University Clinics of Kinshasa within 4 hours, where the analyzes were carried out on the Myndray-BC-5150 Hematology analyzer immediately at the arrival. Parameters of interest: The parameters of interest were, on the one hand, sociodemographic data (age of pregnant women, district of origin, linguistic region and marital status), obstetrical data (gestational age, gestational age, parity) and on the other hand the data of the hemogram (GR, WBC, Hct, Hb, VGM, CCMH, TCMH, Platelets, the VPM and the leukocyte formula). Statistical analyses: After encoding and validation of the data, these were entered on the computer, using Excel software version 13. After validation, the data were exported to SPSS for Windows software version 24. Qualitative data were represented in absolute and relative frequency (%) and quantitative data as means ± standard deviations (SD). Pearson's Chi-square test or Fischer's exact were used to compare proportions for categorical data. Student's t-test was used to compare the means of two groups with normal distributions. Ethical considerations: The protocol

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of this study was submitted to the ethics committee of the School of Public Health of the University of Kinshasa for approval and obtained approval under number ESP/CE/11/2023 of the 27/January/2023.

III. RESULTS

A total of 451 pregnant women were selected. Sociodemographic characteristics of the study population.The average age of pregnant women was 27.42 ± 5.83 years with extremes of 15 to 49 years. Age, marital status, district of origin and linguistic region are reported in Table 1.

TABLE 1: Distribution of the study population according to socio-demographic characteristics

Variables	N	Percentage %
Age		
≤20 years old	38	8,4
21-29 years old	255	56,5
30-39 years old	151	33,5
≥40 years old	7	1,6
Marital status		
Married	386	85,6
Bachelor	65	14,4
District of residence		
Lukunga	106	23,5
Mont Amba	100	22,2
Funa	141	31,3
Tshangu	104	23
Linguistic region		
Kongo	208	46,1
Ngala	65	14,4
Luba	154	34,1
Swahili	24	5,3

The majority of women were married, 85% (n=386). They came from all the districts of the city-province of Kinshasa. Funa district was the most represented with 31.3% (n=141), followed by Lukunga district (23.5%; n=106), Tshangu district (23%; n=104) and Mont Amba (22.2%; n=100) and were from the Kongo linguistic region with 46.1% (n=208), followed by Luba (34.1%; n=154), Ngala (14, 4%; n = 65) and Swahili (5.3%; n = 24).

Obstetric characteristics of the study population

The Table 2 shows the obstetrical characteristics of participants.

TABLE 2: Obstetric characteristics of pregnant women

Variables	(n=451)	%
Gestational age		
1st trimester	125	27,7
2nd trimester	148	32,8
3rd trimester	178	39,5
Parity		
Nulliparous	138	30,6
Primiparous	127	28,2
Pauciparous	152	33,7
Multiparous	34	7,5
Gestiture		
Primigest	138	30,6
2-3ème gesture	216	47,9
Multigesture	97	21,5
Abortion		
No	448	99,3
yes	3	0,7

Of all the women selected, 39.5% were in the third trimester of pregnancy, 33.7% were pauciparous, 47.9% were in their second or third pregnancy and 99.3% had no ATCD of abortion.

Hemogram

CBC parameters regardless of gestational age

The parameters of the complete blood count of pregnant women regardless of the age of pregnancy are presented in Table 3.

TABLE 3: CBC parameters regardless of gestational age

Parameters	Mean±SD
RBC(x10^6/µl)	3,8±0,5
Hb(g/dl)	10,4±1,27
HCT(%)	31,6±3,7
MCV(fl)	83,7±8,3
MCHC(g/dl)	33,0±1,6
MCH(pg)	27,6±3,0
RDWCV	15,1±2,4
RDWSD	45,8±7,8
WBC(x10^3/µl)	6,6±2,2
Neutrophils(x10^3/µl)	4,2±1,8
Lymphocytes(x10^3/µl)	1,7±0,6
Monocytes(x10^3/µl)	0,5±0,3
Eosinophils(x10^3/µl)	0,081±0,012
Basophils(x10^3/µl)	0,0134±0,0115
Platelet(x10^3/µl)	195,84±64,4
MVP (fl)	10,3±1,2

The mean values of the hemogram parameters were: RBC: 3.8±0.5106/µl, Hb: 10.4±1.27 g/dl, HCT: 31.6±3.7%, MCV: 83 .7±8.3 fl, MCH: 27.6±3.0 pg, MCHC: 33.0±1.6 g/dl, WBC: 6.6±2.2 x103/µl, Neutrophils: 4.2 ±1.8 x103/µl, Lymphocytes: 1.7±0.6 x103/µl, Monocytes: 0.5±0.3 x103/µl, Eosinophils: 0.081±0.012x103/µl, Basophils: 0.0134±0 .0115 x103/µl, Platelets: 195.84±64.4x103/µl, MVP: 10.3±1.2fl.

Complete blood count parameters by trimester

The parameters of the blood count of pregnant women according to the trimesters are presented in table 4.

TABLE 4: Mean values of complete blood count parameters by trimester

Parameters	First trimester Men±SD	Second trimester Mean±SD	Third trimester Mean±sd	P-value
WBC(x10^3/µl)	6,8±1,53	6,96±1,77	6,97±1,8	0,026
Neutrophils (x10^3/µl)	3,9±1,96	4,2±1,6	4,3±1,6	0,086
Lymphocytes x10^3/µl)	1,7±0,5	1,8±0,6	1,7±0,6	0,726
Monocytes (x10^3/µl)	0,59±0,2	0,58±0,24	0,57±0,27	0,644
Eosinophils (x10^3/µl)	0,15±0,07	0,16±0,08	0,15±0,07	0,960
Basophils (x10^3/µl)	0,0015±0,0007	0,0015±0,0007	0,0015±0,0007	0,922
RBC(x10^3/µl)	4,0±0,6	3,7±0,5	3,7±0,5	<0,001
Hb (g%)	10,9±1,2	10,3±1,2	10,4±1,3	<0,001
Ht (%)	32,9±3,4	31,1±3,4	31,0, ±3,8	<0,001
MCV (fl)	82,6±8,6	84,6±7,5	83,7±8,7	0,130
MCH (pg)	28,0±2,7	30,2±1,58	30,4±1,7	0,114
MCHC (g/dl)	32,9±1,66	32,9±1,49	32,9±1,7	0,056
RDWCV	15,0±2,1	14,6±2,0	15,5±2,0	0,004
RDWSD	44,8±6,3	45,1±7,5	47, ±8,8	0,011
Platelets (x10^3/µ	233±44,4	234±44,3	233±44,4	0,890
MVP (fl)	10,3±1,1	10,3±1,2	10,2±1,3	0,520

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For the red line, the difference in the mean values of RBC, Hb and HCT between the 3 trimesters was statistically significant ($p<0.001$). For the white line, only the mean WBC values between the 3 trimesters were statistically significant ($p<0.026$). For platelet lineage, there was no statistically significant difference in parameters between the 3 trimesters of pregnancy.

IV. Discussion

The average age of pregnant women was 27.42±5.835 years. 56% of pregnant women were between the ages of 21 and 29, 33.5% between the ages of 30 and 39, 5.4% under the age of 20, and 1.6% over the age of 40. 27.7% of pregnant women were in the first trimester, 32.8% in the second trimester and 39.5% in the third trimester. Azab et al (7) reported that the average age of pregnant women in northwestern Libya was 30±5.8 years, while Melku and Agnas in northwestern Ethiopia reported an age average of 26.3±4.55 years (8). In the study by Azab et al, 48.4% of pregnant women were between the ages of 21 and 30, 40.8% between the ages of 31 and 40, 5.8% over the age of 40 and 5% between the ages of under 20 (7); however in that of Melku and Agnas in northwestern Ethiopia, 38.2% of pregnant women were between 26 and 30 years old, 37.4% were between 20 and 25 years old, 12.3% had a less than 20 years old, 8.6% were between 31 and 35 years old and 3% were over 35 years old(8). The majority of pregnant women in the various studies are between 20-30 years old. In this study, we noted a gradual decrease in Hb levels from the first to the third trimester of pregnancy. Similar results were observed by Azab et al (7), Akinbami et al in Lagos (9), Akingbola, al in North West Nigeria (10), Bakrim et al in North West Morocco (11). This drop in Hb levels from the first to the third trimester of pregnancy may be due to an increased demand for iron as the pregnancy progresses (9). Indeed, a significant amount of iron is necessary to meet the expansion of maternal blood mass and the needs of fetal growth. And also, the extra progesterone and estrogen secreted by the placenta cause renin to be released from the kidneys (9)...renin stimulates the renin angiotensin aldosterone system which leads to retention of sodium and water, and therefore causes an increase in plasma volume. (7). The increase in plasma volume is relatively greater than the increase in globular mass, which leads to a relative drop in maternal Hb, hence physiological anemia. The present study also showed a significant decrease in HCT values from the first to the third trimester of pregnancy. This result is similar to those of Azab et al, Wulsa et al in India (12), Bakrim et al in North West Morocco (11) and Geetanjali et al in West India (1). This decrease in HCT values could be due to a marked increase in plasma volume associated with a normal pregnancy leading to a dilution of many circulating factors and cells, causing physiological anemia (7). In this study, there were no significant differences in the values of MCV, MCH and MCHC during pregnancy. This result is consistent with those of Thanoon AH et al in Iraq (13), Taj N et al in Pakistan (14) Kadas AS et al in Nigeria (15). These results could be explained by the use of iron supplementation in pregnant women, which is systematic in pregnant women followed in CPN in the DRC. In this study, we noted a significant difference between the RDW values. This result is consistent with that of Kadas AS et al, (15). Indeed the RDW is the parameter that can reveal an iron deficiency even in subclinical (), a deficiency often encountered during pregnancy (16, 17). Hence the importance of recommended supplementation for pregnant women. In the present study, the number of WBC increased significantly from the first to the third trimester. This observation was consistent with the results of Azab et al, Akinbami et al, onwukeme and Ugunu in Nigeria (18) and Akingbola et al, Taj N et al (14) Bakrim et al in North West Morocco. Increased neutrophils, presence of pain, nausea, vomiting and anxiety have been reported to cause leukocytosis in the absence of infection (19). However, no significant increase in neutrophil count was observed. Indeed, the numbers of neutrophils, lymphocytes and monocytes did not change significantly from the first to the third trimester of pregnancy. This observation corroborates the results of Kadas AS (15), Thanoon AH et al (13) Mba CO at Port Harcourt in Nigeria, (20).

In this study, it was not noted a significant variation in the level of platelets from the first to the third trimester of pregnancy, unlike Azab et al, Akinbami and Akingbola who observed a decrease in the level of platelets significantly, explained by the effect of dilutions and the accelerated destruction of platelets passing through the often scarred and damaged trophoblastic surface of the placenta (21).

V. Conclusion

This study showed that in pregnant women followed in prenatal consultation in Kinshasa, changes in certain hematological parameters were noted, in particular hemoglobin, hematocrit and red blood cells, the rates of which decrease significantly from the first to the third trimester of pregnancy; and white blood cells, the rate of which increases significantly from the first to the third trimester of pregnancy.

Limitation of study: This study has some limitations. In addition to the fact that it did not take into account all the hematological parameters, in particular the serum iron concentration in the referent subjects, which is generally not the case in the usual follow-up of pregnant women, the study considered the distribution of the age of pregnancy into trimesters. However, it would have been interesting to look for variations in parameters that would occur within weeks.

Conflict of interest: No conflict of interest has been reported

Contribution of the authors

Design, data collection, interpretation and writing: Donat Kalombo Muamba

Supervision and writing: Jérémie Masidi Muwonga,

Protocol development: Gustave Ntita Ilunga, Dphie Tshibuela Beya

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