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RESEARCH ARTICLE

Association Between Maternal Haematological Profiles, Birth Weight and Apgar Score: A Five-Year Retrospective Study at a Medical Center in Ghana

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Abstract

Background: While pregnancy can be a joyous occasion for women and their families, it can also bring about stress and worry. Globally, the prevalence of adverse birth outcomes has been on the ascendency making it a great public health concern, especially in Africa. Very little is known in the study jurisdiction on the influence of haematological profile on Apgar score and birth weight. The study aimed at determining the association between maternal haematological profiles and birth outcomes.

Methods: This study was a hospital-based cross-sectional retrospective design which retrieved 294 records of pregnant women from November 2018 to December 2022 from the medical records at the Nyaho Medical Center. All data on the Complete Blood Count, Apgar score and birth weight was collected and exported to IBM SPSS Statistics for Windows, Version 28.0 (Armonk, NY: IBM Corporation) after cleaning with MS Excel for statistical analysis. Both descriptive and inferential statistics was undertaken. At a confidence interval of 95% and a 5% margin of error, a p-value less than 0.05 was considered statistically significant.

Results: The study found mild anaemia to be most prevalent across all trimesters and the neonatal period, with the highest prevalence in the second trimester (46.4%). Anaemia prevalence fluctuated over the five-year period, peaking in 2019 (50.0%) and 2022 (48.3%). Significant variations in haematological parameters were observed across trimesters and the neonatal period. Median haemoglobin and platelet count increased from the first trimester to the neonatal period, while neutrophils and monocytes decreased. Spearman rank correlations revealed weak associations between haematological profiles and birth outcomes. Negative binomial regression analysis showed marginal increases in Apgar scores and birth weights with higher haemoglobin levels, and significant increases in birth weight with higher neutrophil counts, though these findings were not statistically significant.

Conclusion: The study revealed the complex relationship between maternal haematological profiles and neonatal outcomes, emphasizing the limited predictive value of parameters like haemoglobin, WBC, and RBC for birth weight and Apgar scores. While some trends were observed, such as higher haemoglobin levels

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and neutrophil counts being associated with marginally better outcomes, these findings lacked statistical significance, underscoring the need for further research.

Keywords: Haematological Profile, Apgar Score, Birth Weight, Anaemia

1. Introduction

While pregnancy can be a joyous occasion for women and their families, it can also bring about stress and worry. During this time, the expectant mother undergoes significant anatomical and physiological changes in order to support the growth and development of the foetus (1). These physiological changes could affect the blood cell lines or impair their numbers or quality (2). Apart from these pregnancy-associated physiological changes, the increase in the body's nutritional requirement during pregnancy could also lead to negative birth outcomes if not properly addressed. Available evidence indicates that deficiencies in micronutrients pose significant health problems in low and middle-income countries, especially for expectant mothers of which Ghana is no exception. These deficiencies have a detrimental effect on the well-being of pregnant women and the outcomes of their birth (3)

According to Kankowski et al (4), both pregnancy and the environment in which the foetus develops can significantly impact the likelihood of various chronic conditions, such as diabetes, obesity, breast cancer, and heart diseases, in both the mother and her children. In addition, globally, the prevalence of adverse birth outcomes have been on the ascendency making it a great public health concern, especially in Africa (5). Specific adverse outcomes reported included preterm, low birth weight, stillbirths and miscarriage (6,7). Over 15 million newborns (15.5% of all births) have a low birth weight globally, with 95.6% of these occurrences happening in developing countries worldwide (8). Furtherance to that, approximately 15% of low birth weight cases happen in Sub-Saharan Africa (9). Sadly, it is reported that babies with low birth weight often face growth stunting and hindered cognitive development, as well as serious health issues from birth and throughout their life (10). In Ghana, a reported 15.2% and 12.5% prevalence of low birth weight (LBW) and preterm births (PTB) was found (11). Expectant mothers who are prone to adverse birth outcomes have certain risk factors. These include a low number of visits to antenatal care, premature rupture of membranes, anaemia, pregnancy-induced hypertension, inadequate dietary supplementation, physical abuse, residing in rural areas, being over the age of 34, being multiple gravidae, lack of adequate prenatal care, and experiencing complications during pregnancy (12,13). A number of studies alluded to the fact that maternal haematological parameters are gravely influenced during pregnancy (2,14) thus, leaving the potential of it impacting on birth outcomes. It is against this background that the present study sought to determine the association between maternal haematological profile and birth outcomes at the Nyaho Medical Center, Accra, Ghana.

2. Methodology

2.1 Study Design

The study was a hospital-based cross-sectional retrospective study using archived data from 294 antenatal care (ANC) clinical records available at Nyaho Medical Center between the periods of December 2018 to November 2022.

2.2 Study Site

This study was conducted at the Nyaho Medical Center in the Greater Accra Region of Ghana. It was established in March 1970 by the late Dr. Kwami Nyaho Tamakloe with the goal of delivering the highest quality nursing and medical care in Ghana. It records over 100,000 patient attendances annually with ANC monthly attendance of about 400 with a bed capacity of 105.

2.3 Study Population

The targeted population was pregnant women who sought ANC at the Nyaho Medical Center between the periods of December 2018 to November 2022.

2.4 Eligibility Criteria

The study included medical records of mothers and their birth outcomes between the periods of November 2018 to December 2022 having complete data on haematological profile of the mother during pregnancy and neonatal period and birth outcomes. Data outside the study period were not retrieved for the study.

2.5 Sample Size Determination

Using the Roasoft online sample size calculator with a population of 1200 (400 per month for three months), 95% confidence interval, 5% error margin a recommended sample size of 292 was obtained. However, 294 records was retrieved from the medical records of ANC.

Figure 1. *Location of Nyaho Medical Center in Accra, Greater Accra region, Ghana (Source; Google map)*

2.6 Data Retrieval and Management

Complete Blood Count (CBC) results of pregnant women including Haemoglobin (Hb), red blood cell (RBC), haematocrit (HCT), mean cell volume (MCV), mean corpuscular haemoglobin (MCH), mean cell haemoglobin concentration (MCHC), white blood (WBC), and platelets (PLT) from pregnancy to neonatal period as well as Apgar score and birth weight of infant was extracted from the medical records of the mothers and entered into the Microsoft excel version 2016 worksheet. Data were verified by double-checking the extracted data against the source. This was done by two individuals to ensure that possible errors were corrected. All data captured was stored on a password protected computer and kept appropriately at a convenient place where only investigators can have access.

2.7 Definition of Terms

Apgar score assesses a newborn's condition at birth based on five criteria: color, heart rate, reflexes, muscle tone, and respiration. While scores of 7–10 at 1 and 5 minutes are reassuring, resuscitation must begin immediately and not be delayed for scoring (Simon et al., 2025). Birth weight is the body weight of a baby at their birth. Weight at birth can be classified into three categories, that is normal (birth weight ≥2.5 kg<4.0 kg), too light (low birth weight (birth weight<2.5 kg) or too heavy (macrosomia) (birth weight≥4.0 kg) (Abubakari et al., 2015).

2.8 Determination of Apgar Score and Birth Weight

The Apgar scores, the length and weight of the newborn were evaluated immediately after birth in the delivery room at the labour ward. The Apgar scores were determined at the 5th minute after birth. The birth weight of the baby was calculated after the fifth minute of birth

2.9 Haematological Profile Analysis

CBC was estimated by an automated haematology analyzer (Sysmex XN 350, Germany). Standardization, calibration of the instrument, and processing of the samples were done according to the manufacturer's instructions.

3. Data Analysis

All collected data was exported to IBM SPSS Statistics for Windows, Version 28.0 (Armonk, NY: IBM Corporation) after cleaning with MS Excel for statistical analysis. Both descriptive and inferential statistics were undertaken. Descriptive statistics were presented as frequencies and percentages in tabular and graphical forms for sociodemographic characteristics, severity and prevalence of anaemia. Median and range (minimum-maximum) for age and median with interquartile range for haematological parameters. Kruskal wallis was used to test for the differences between the median haematological parameters across the trimesters and neonatal period. Post Hoc (Games Howell) test was used to test for multiple comparisons

of the haematological parameters across the trimesters and neonatal period. Spearman correlation was used to assess the association between the birth outcomes and the haematological profile. Negative binomial regression was used to assess the strength of the association between the birth outcomes and the haematological parameters at pregnancy for variance co variance estimates with robust standard error. At a confidence interval of 95% and a 5% margin of error, a p-value less than 0.05 was considered statistically significant.

3.1 Ethical Considerations

Ethical approval for this study protocol was obtained from the Research Ethics Committee of the University of Health and Allied Sciences with reference number UHAS-REC [19] 23-24. Permission was also obtained from the management of Nyaho Medical Center. All archived data for the study were kept undisclosed and used for the study only. Patients' consent was not sought for this study because it was retrospective.

4. Results

4.1 Sociodemographic Characteristics of Study Participants

Table 1 below shows the sociodemographic characteristics of the pregnant women seeking healthcare at the Nyaho Medical Center. The study revealed that the median age of the participants was 35.0 with majority of them aged from 30-39 years (72.8%). Majority of the babies were males (52.4%). The median weight for the babies was 3.4 with the majority of them having 2.5kg-3.9kg weight (84.6%). Majority of the babies had an Apgar score from 7-10 (96.2%).

Table 1. *Sociodemographic characteristics of participants*

Variables	Frequency	Percentage (%)
Maternal age (n=294)		100.0
Median (Minimum-Maximum)	35.0 (21.0-49.0)	
21-29	20	6.8
30-39	214	72.8
40-49	60	20.4
Baby's Sex (n=286)		100.0
Male	150	52.4
Female	136	47.6
Baby's weight (n= 294)		100.0
Median (Minimum-Maximum)	3.4 (2.3-5.6)	
<2.5	4	1.3
2.5-3.9	249	84.7
≥4	41	14.0
Apgar's Score (n=294)		100.0
0-3	2	0.7
4-6	9	3.0
7-10	283	96.3
Years (n= 294)		100.0
2018	56	19.0
2019	60	20.4
2020	60	20.4
2021	60	20.4
2022	58	19.7

4.2 Prevalence and Severity of Anaemia among Study Participants

Figure 1 below shows the prevalence and severity of anaemia among the pregnant women from first trimester to the last trimester of their pregnancy and the neonatal period. It was revealed that anaemia was most prevalent in the second trimester (46.4%) and less prevalent in the first semester (27.0%). Furthermore, mild anaemia was found to be highest within all the trimesters and neonatal period (76.0%,68.7%,69.7% and 60.7% respectively). Severe anaemia was 1.3% in the first trimester and 1.6% in the neonatal period.

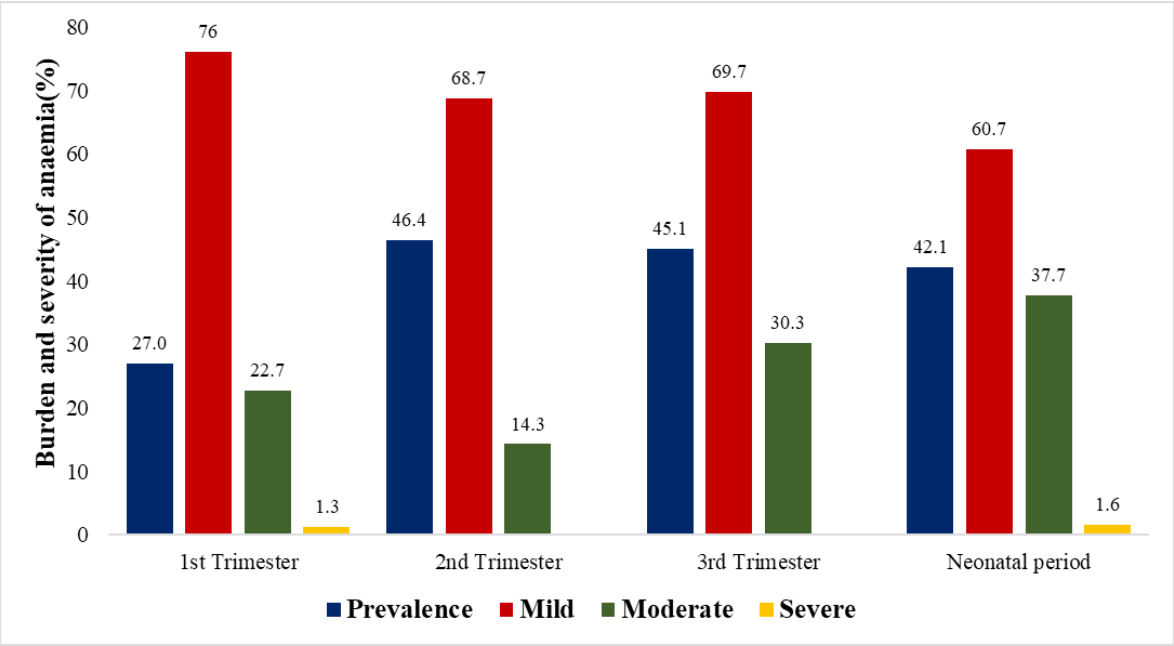

Figure 1. *Prevalence and severity of anaemia among study participant*

4.3 Trend of Anaemia During Pregnancy and Neonatal Period Over the Period of Five Years.

Figure 2 below illustrates the trend of anaemia during pregnancy and neonatal over the period of five years. In 2018, 2020 and 2022 anaemia were more prevalent in the second trimester (48.2%,38.3 and 62.3% respectively), whiles in 2019 and 2021 anaemia was more prevalent in the third trimester (55.9% and 48.3%). Overall, the prevalence of anaemia increased from 48.2% to 50.0% from 2018 to 2019 whiles it declined sharply from 2019 to 2020 (33.0%) with a sudden increase from 2021(35.0%) to 2022(48.3%).

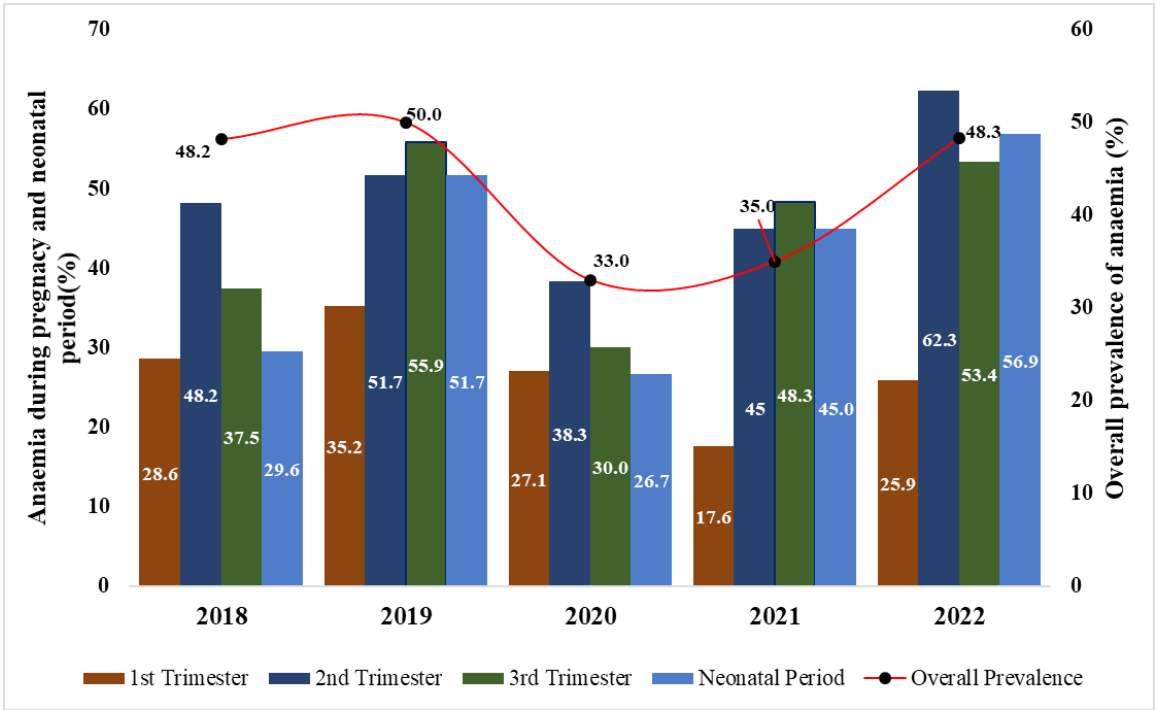

Figure 2. *Trend of anaemia during pregnancy and neonatal period over the period of five years*

4.4 Variations in Haematological Profile of Pregnant Women During Pregnancy and Neonatal Period.

Table 2 below shows Kruskal wallis test on variations in haematological profile of pregnant women during pregnancy and neonatal period. The study revealed that there were significant variations in the medians of haemoglobin, white blood cell, platelets, red blood cells, haematocrit, mean platelet value, red blood cell indices and the white blood cell indices across the three trimesters in pregnancy and neonatal period.

Table 2. *Variations in haematological profile of pregnant women during pregnancy and neonatal period.*

Haematological parameters	1st Trimester	2nd Trimester	3rd Trimester	Neonatal Period	
	Median ± IQR	Median ± IQR	Median ± IQR	Median ± IQR	P-value
Haemoglobin (g/dl)	11.52±1.17	10.90±1.40	11.15±1.4	11.20±1.70	< 0.0001
White Blood Cell (10^9/L)	6.53 ±2.05	7.57±2.22	7.62±2.88	7.77±3.95	< 0.0001
Platelets (10^9/L)	251.67±82.70	236.00±72.17	225.33±82.00	230.00±98.00	< 0.0001
Red blood cells(10^{12}/L)	4.17±0.62	3.88±0.61	3.98±0.64	4.00±0.71	< 0.0001
Haematocrit (%)	35.20±4.30	33.20±3.75	34.33±4.08	34.75±5.90	< 0.0001
MPV (fL)	9.00±1.43	9.05±1.57	9.27±1.57	9.30±1.50	< 0.0001
MCV (fL)	84.80±8.95	86.60±8.37	86.75±9.15	87.45±10.10	< 0.0001
MCH (pg)	28.20±3.53	28.50±3.67	28.6±3.47	28.50±3.60	0.0966
MCHC (g/dL)	33.00±1.80	32.90±1.90	32.50±1.75	32.20±2.10	< 0.0001
RDW (fL)	13.20±1.53	13.40±1.73	13.50±1.68	13.50±1.90	0.0008
Monocytes# (10^9/L)	0.43±0.20	0.45±0.22	0.47±0.20	0.47±0.31	0.0032
Eosonophils#(10^9/L)	0.10±0.10	0.13±0.11	0.11±0.08	0.11±0.10	0.0218
Basophils#(10^9/L)	0.03±0.03	0.04±0.03	0.03±0.02	0.03±0.03	0.4101
Neutrophils#(10^9/L)	24.22±26.96	5.12±1.84	5.20±2.28	5.37±4.02	< 0.0001
Lymphocytes#(10^9/L)	1.96±0.67	1.81±0.70	1.75±0.57	1.81±0.80	< 0.0001

P-value is significant at p<0.0001 and p<0.05. IQR; Interquartile range, MPV; Mean Platelet value, MCV; Mean Corpuscular Volume, MCH; Mean Corpuscular Haemoglobin, MCHC; Mean Corpuscular Haemoglobin Concentration, RDW; Red cell Distribution Width.

4.5 Multiple Comparisons of Haematological Profile Across the Trimesters of Pregnancy and Neonatal Period Using Post Hoc Analysis (Games Howell)

Table 3 revealed that there was increase in median haemoglobin from first trimester to neonatal period (Δmedian=0.56, 0.46, 2.66). Similarly, there was a significant increase in the median platelets from first trimester to second trimester (Δmedian= 16.52, 24.40, 21.89). There was a decrease in neutrophil from first trimester to the last trimester (Δ median =-0.82, -0.96). Likewise, monocytes also decreased from first semester to neonatal period (Δmedian= -0.22, -0.05 ,-0.04)

Table 3. *Multiple comparison of haematological profile across the trimesters of pregnancy and neonatal period.*

Haematological parameters	T1-T2	T1-T3	T1-NP	T2-T3	T2-NP	T3-NP
	(Δmedian)	(Δmedian)	(Δmedian)	(Δmedian)	(Δmedian)	(Δmedian)
Haemoglobin (g/dl)	0.56***	0.46***	2.66***	-0.10	2.09***	2.19***
White Blood Cell (10^9/L)	-0.93***	-1.14***	1.01***	-0.21	1.94***	2.15***
Platelets (10^9/L)	16.52**	24.40***	21.89***	7.87	5.37	-2.50
Red blood cells(10^{12}/L)	0.28***	0.22***	-6.68***	-0.05	-7.26***	-7.20***
Haematocrit (%)	1.63***	0.83**	0.66	-0.80*	-0.97*	-0.17
MPV (fL)	-0.02	-0.32*	-0.43***	-0.30*	-0.41***	-0.11
MCV (fL)	-1.86*	-2.69***	-3.16***	-0.81	-1.27	-0.46
MCHC (g/dL)	0.13	0.47***	0.62***	0.33*	0.49***	0.15
MCH (pg)	-1.04	-0.42	-0.37	0.63	0.67	0.05
RDW (fL)	-0.09	-0.29*	-0.29*	-0.19	-0.20	-0.01
Basophils# (10^9/L)	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
Monocytes# (10^9/L)	-0.22	-0.05**	-0.04**	-0.03	-0.02	-0.02
Eosonophils#(10^9/L)	-0.02*	0.01	0.01	-0.01	0.01	0.00
Neutrophils#(10^9/L)	-0.82**	-0.96***	2.56***	-0.14	3.37***	3.52***
Lymphocytes#(10^9/L)	0.21***	0.22***	-1.93***	0.00	-2.14***	-2.15***

**** P value is significant at p<0.001,**. P value is significant at P<0.01 *. P value is significant at p<0.05. T1; Trimester 1, T2; Trimester 2, T3; Trimester 3, NP; Neonatal period, Δmedian; median change.*

4.6 Spearman Rank Correlation Between Haematological Parameters at Pregnancy and Birth Outcomes

Table 4 below shows spearman rank correlation between haematological profile at pregnancy and birth outcomes. It was revealed that haemoglobin, White Blood Cells, Red blood cells, Mean Platelet Value, Red cell Distribution Width, Monocyte, Eosinophils, Basophils and Neutrophils showed a weak positive correlation with Apgar score (r=0.034,0.010,0.034,0.061,0.077,0.042,0.024 and 0.008), whiles Platelet, haematocrit, MCH, MCH, MCV, Monocytes and lymphocyte showed a weak negative correlation with Apgar score (r=-0.018, -0.11, -0.045, -0.054 and -0.062). Furthermore, White Blood Cells, Platelet, MPV, MCV, Red cell Distribution Width, Monocyte, Basophils and Neutrophils showed a weak positive correlation with birth weight. (r=0.020, 0.059, 0.029, 0.040, 0.019, 0.081, 0.018 and 0.024) whiles haemoglobin, Red blood cells, Haematocrit, MCH, MCHC and Eosonophils showed a weak negative correlation with birth weight (r=-0.073,-0.031,-0.057,-0.120,0.003,-0.066).

Table 4. *Spearman rank correlation between haematological parameters at pregnancy and birth outcomes*

Haematological parameters	Apgar score	Birth weight
	Spearman's *r*	Spearman's *r*
Haemoglobin (g/dl)	0.034	-0.073
White Blood Cell (10^9/L)	0.010	0.020
Platelets (10^9/L)	-0.018	0.059
Red blood cells (10^{12}/L)	0.034	-0.031
Haematocrit (%)	-0.11	-0.057
MPV (fL)	0.061	0.029
MCV (fL)	-0.045	0.040
MCH (pg)	-0.028	-0.023
MCHC (g/dL)	-0.078	**-0.120***
RDW (fL)	0.077	0.019
Monocytes# (10^9/L)	-0.054	0.081
Eosonophils#(10^9/L)	0.042	-0.003
Basophils#(10^9/L)	0.024	0.018
Neutrophils#(10^9/L)	0.008	0.024
Lymphocytes#(10^9/L)	-0.062	-0.066

** Correlation is significant at $p < 0.05$, Spearman's r is coefficient of correlation. MPV; Mean Platelet value, MCV; Mean Corpuscular Volume, MCH; Mean Corpuscular Haemoglobin, MCHC; Mean Corpuscular Haemoglobin Concentration, RDW; Red cell Distribution Width*

Table 5. *Negative binomial regression analysis between haematological parameters at pregnancy and birth outcomes*

Haematological parameters	Apgar score		Birth weight	
	aOR[95% CI]	P value	aOR[95% CI]	P value
Haemoglobin (g/dl)	1.01[0.80-1.29]	0.910	1.03[0.00-1.41]	0.995
White Blood Cell (10^9/L)	0.99[0.98-1.02]	0.958	0.98[0.62-1.56]	0.941
Platelets (10^9/L)	1.00[0.99-1.00]	0.988	1.00[0.98-1.03]	0.994
Red blood cells(10^{12}/L)	0.98[0.52-1.85]	0.955	0.89[0.57-1.05]	0.992
Haematocrit (%)	0.99[0.97-1.03]	0.886	1.00[0.76-1.32]	0.999
MPV (fL)	0.99[0.93-1.07]	0.982	1.04[0.53-2.04]	0.921
MCV (fL)	0.99[0.97-1.02]	0.908	0.98[0.69-13.96]	0.990
MCH (pg)	1.00[0.95-1.06]	0.889	1.04[0.00-7.81]	0.992
MCHC (g/dL)	0.99[0.89-1.11]	0.905	0.93[0.00-9.06]	0.983
RDW (fL)	1.00[0.92-1.09]	0.899	0.95[0.40-2.22]	0.898
Monocytes# (10^9/L)	0.99[0.91-1.09]	0.936	0.99[0.68-1.45]	0.955
Eosonophils#(10^9/L)	1.02[0.21-5.06]	0.979	0.83[0.25-1.18]	0.969
Basophils#(10^9/L)	1.27[0.00-4.61]	0.936	0.43[0.24-0.99]	0.984
Neutrophils#(10^9/L)	0.99[0.98-1.01]	0.948	1.00[0.86-1.16]	0.995
Lymphocytes#(10^9/L)	0.99[0.96-1.04]	0.978	1.17[0.10-13.14]	0.899

aOR; Adjusted odds ratio, MPV; Mean Platelet value, MCV; Mean Corpuscular Volume, MCH; Mean Corpuscular Haemoglobin, MCHC; Mean Corpuscular Haemoglobin Concentration, RDW; Red cell Distribution Width.

4.7 Negative Binomial Regression Analysis Between Haematological Parameters at Pregnancy and Birth Outcomes

Table 5 below shows a negative binomial regression analysis between haematological parameters at pregnancy and birth outcomes.The study revealed that for every 1-unit increase in haemglobin there was 1% increase in Apgar score and 3% increase in birth weight (aOR=1.01, 95% CI; 0.80-1.29, p=0.910, aOR=1.03, 95% CI; 0.00-1467.41, p=0.995). Furhermore, for every 1-unit increase in platelets there was no change in Apgar score and birth weight(aOR=1.00, 95% CI;0.99-1.00, p=0.988, aOR=1.00, 95% CI; 0.98-1.03, p=0.994). For every 1-unit increase in neutrophils there was 1% decrease in Apgar score and 17% increase in birth weight (aOR=0.99, 95% CI;0.96-1.04, p=0.978, aOR=1.17, 95% CI; 0.10-13.14, p=0.899)

5. Discussion

The study presents the prevalence and severity of anaemia among pregnant women across different trimesters and neonatal period with their association on birth outcomes, with significant findings and implications for maternal and neonatal health. Anaemia was prevalent in all trimesters, particularly in the second trimester (46.4%). Across all stages, mild anaemia accounted for 76.0% in the first trimester, 68.7% in the second trimester, 69.7% in the third trimester, and 60.7% in the neonatal period. Severe anaemia was rare, occurring in 1.3% during the first trimester and 1.6% during the neonatal period. Comparative analysis with other studies revealed variability in anaemia prevalence. For instance, a study in Eswatini reported the prevalence of anaemia 43.1%, with mild, moderate, and severe cases accounting for 21.3%, 21.1%, and 0.7%, respectively (17). In Ghana, studies reported diverse prevalence rates, such as 11.4%, 50.8% in Northern Ghana and 78.5% in a district study respectively (13,18,19). These variations underscore the influence of regional and contextual factors, including nutritional status, healthcare access, and compliance with iron supplementation.

These findings suggest that while preventive measures are somewhat effective, routine screening and targeted nutritional interventions are critical to prevent progression to severe anaemia and its associated complications, including fatigue, infections, and adverse pregnancy outcomes (17,20,21)

The study's haematological findings revealed significant trimester-specific variations in parameters such as haemoglobin, platelets, and immune cells, reflecting physiological changes to support foetal development and prepare for childbirth. Median haemoglobin levels increased progressively from the first trimester to the neonatal period, while platelet counts rose in the second trimester. Neutrophil and monocyte count declined, indicating immune modulation throughout pregnancy. These findings align with a study by Gebreweld et al (22), which highlighted trimester-specific trends in haematological parameters.

Implications for clinical practice include the necessity for regular monitoring of haematological profiles to detect deviations and prevent complications such as anaemia, infections, or clotting disorders. Tailored care, including targeted nutritional supplementation during specific trimesters, can optimize maternal and foetal outcomes. The weak correlations observed between haematological profiles and neonatal outcomes, such as Apgar scores and birth weight, indicate the need for a comprehensive approach to prenatal care, integrating factors such as maternal health, genetics, and environmental influences.

Negative binomial regression analysis suggested complex relationships between maternal haematological parameters and neonatal outcomes. Higher haemoglobin levels and neutrophil counts were associated with marginal increases in birth weight, though not statistically significant. Conversely, elevated white blood cell and platelet counts, have been associated with adverse birth outcomes. These markers can indicate inflammation or underlying conditions that might impair foetal growth (23). Optimal haemoglobin levels in pregnant women correlate with better Apgar scores, whereas both low and high haemoglobin levels can be detrimental (24).

Furthermore, blood transfusions in pregnant women with severe anaemia can improve Apgar scores in newborns by enhancing the mother's oxygen-carrying capacity and overall health (25). Maintaining a healthy haematological profile during pregnancy is vital for optimal neonatal outcomes, including improved birth weight and Apgar scores. Strengthening primary healthcare systems to prevent, diagnose, and manage anaemia can significantly reduce risks such as low birth weight, preterm delivery, and childbirth complications (21)

6. Conclusion

The study highlights the complex relationship between maternal haematological profiles and neonatal outcomes, emphasizing the limited predictive value of parameters like haemoglobin, WBC, and RBC for birth weight and Apgar scores. While some trends were observed, such as higher haemoglobin levels and neutrophil counts being associated with marginally better outcomes, these findings lacked statistical significance, underscoring the need for further research. These results emphasize the importance of a comprehensive approach to prenatal care that goes beyond haematological parameters. Factors such as maternal health, genetics, nutrition, and environmental influences must be integrated into care strategies. Strengthening such multidisciplinary approaches can improve maternal and neonatal health outcomes, guiding more effective interventions and predictive models.

Limitation

The study was conducted at a single medical center (Nyaho Medical Center), which might not reflect the diversity of sociodemographic and clinical characteristics present in other healthcare settings or regions. Potential confounding factors such as maternal diet, socioeconomic status, and access to healthcare services were not accounted for, which could influence the study's findings.

Recommendation

To improve maternal and neonatal health outcomes, it is essential to implement routine anaemia screening for all pregnant women, particularly during the second trimester when prevalence is highest. Additionally, comprehensive nutritional education and support should be provided, emphasizing the importance of iron, folic acid, and multivitamin supplementation. Further research is also needed in other facilities to better understand the complex interactions between maternal health factors and birth outcomes as well as to enhance generalizability of findings, which can guide the development of more effective prenatal care strategies. Future research should include potential confounders such as maternal diet, socioeconomic status, and access to healthcare services to improve upon the study findings.

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Data Availability

Data for this work will be available upon request from corresponding author.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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