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Burden and Characteristics of Anemia in Pregnancy: A Cross-Sectional Study from a Public Sector Hospital in Karachi

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Abstract

Background: *Anemia in pregnancy remains a major health concern, especially in developing countries. Iron deficiency anemia is the most common type, significantly contributing to maternal and neonatal complications.*
This study aimed to evaluate the hematological profile and determine the prevalence of anemia among pregnant women attending a public hospital in Karachi, Pakistan.
Methodology*: A cross-sectional study was conducted, involving 45 third-trimester pregnant women. Blood samples were analyzed for hematological parameters. Participants were grouped as anemic or non-anemic based on WHO criteria (Hb <11.0 g/dL). Statistical analysis included Mann–Whitney U test and Cohen's d to compare hematological differences between groups.*
Results: *Two-thirds (66.7%) of participants were found to be anemic. The mean hemoglobin level was 10.28 ± 1.78 g/dL, with significantly lower levels ($p = 1 \times 10^{-5}$) in the anemic group. Significant differences ($p < 0.05$), were also observed in RBC count, PCV, MCH, and MCHC suggesting hypochromia, commonly associated with iron deficiency. MCV differences were not statistically significant, indicating the mixed-type or early-stage anemia.*
Conclusion*: The study highlights a high prevalence of anemia in pregnancy. Routine red cell indices and timely iron supplementation during antenatal care, are critical in reducing the associated health risks in both mothers and their infants.*

Keywords: *Anemia, Pregnancy, Hematological Profile, Iron Deficiency, Red Cell Indices*

Introduction

Anemia is the most common complication witnessed during pregnancy, especially in the developing countries like Pakistan. 38% of pregnant women are being affected with anemia worldwide (WHO, 2011). It is associated with increased risks of maternal morbidity, mortality, and adverse neonatal outcomes such as low birth weight and preterm delivery. According to the World Health Organization (WHO), anemia is a condition in which the red blood cell (RBC) count or oxygen-carrying capacity is inadequate to meet physiological demands (WHO, 2023). In pregnancy, it is defined as a hemoglobin (Hb) level below 11.0 g/dL (WHO, 2013). There can be multiple underlying causes resulting in anemia during pregnancy but the top among the list is microcytic (iron deficiency) anemia, where the mean cell volume (MCV) is < 80 fL (Chao *et al*., 2025).

In Pakistan, the occurrence of anemia among pregnant women varies across different regions and populations. A meta-analysis reported the overall estimated prevalence ranged from 55% to 63%, indicating considerable variability across the included data (Sehar *et al*., 2024). Another study conducted in Hyderabad found that 90.5% of pregnant women were anemic, with 75% having mild anemia and 14.8% moderate anemia (Baig-Ansari *et al*., 2008). Similarly, a cross-sectional survey in Lahore reported that 57.7% of pregnant women were anemic, with significant associations observed between anemia and factors such as low income and limited education (Ullah *et al*., 2018).

In Karachi, a study found 64.7% prevalence of anemia among pregnant women, with 25% experiencing severe anemia (Jahan *et al*., 2021). Another study by Ashraf *et al*., (2024) reported that 71.9% of pregnant women were anemic, highlighting the influence of dietary habits and socioeconomic status on anemia prevalence.

In view of the high burden of anemia among pregnant women in Pakistan, the present study was conducted to

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assess the hematological profile of pregnant women attending a public sector hospital in Karachi. Specifically, to evaluate the prevalence of iron deficiency anemia (IDA) in this population.

Methodology

A Cross-sectional study was conducted in the Abbasi Shaheed Hospital, Karachi, Pakistan, from (04-08-24 till 06-09-24) during which 45 pregnant women, who came to visit the hospital in their 3rd trimester, were observed. Participants were selected based on their availability and willingness to take part in this study through non-random sampling.

Written consent was taken from all pregnant women prior to the data collection and, their confidentiality were maintained throughout the study.

The sample size was estimated using the Raosoft sample size calculator (Raosof, 2004), with a 5% margin of error, 95 % confidence interval and an expected monthly obstetric patient influx of 50, resulting in a sample size of 45 participants. Data was collected by observing the complete blood count (CBC) reports and obstetrics history of the pregnant women that covered all aspects of questions related to IDA. Moreover, the subjects were also physically examined to confirm the diagnosis under the supervision of female doctors on duty.

The inclusion criteria were pregnant women attending Abbasi Shaheed Hospital in the 3rd trimester of pregnancy, while the exclusion criteria were pregnant women with hemoglobinopatheies or those already on iron supplements.

Collected data was statistically analysed by using SPSS 22.

Results

The hematological parameters of 45 pregnant females were obtained from their blood reports. The mean values, standard deviations (SD), and the range for each parameter are summarized in Table-1.

The consideration of red cell indices exhibited a marked variation, suggesting a clinically heterogeneous group in terms of anemia status. The mean Hb level of 10.28 ± 1.78 g/dL showed that many participants of the study had Hb levels below the normal threshold for pregnancy, indicating a high prevalence of anemia.

Both the mean RBC count (3.81 ± 0.65 × 10^6/µL) and PCV (30.89 ± 5.42%) were near the lower boundary of the normal range, further supported the chances of anemia in these pregnant females.

The MCV (80.73 ± 9.14 fL), MCH (26.52 ± 3.12 pg), and MCHC (33.05 ± 2.01 g/dL) values represented a normocytic to mildly microcytic, and normochromic to mildly hypochromic profile on average.

However, the wide ranges, particularly for MCV (53–98 fL) and Hb (4.3–12.9 g/dL) suggested a considerable variation in both the type and severity of anemia. The minimum Hb level of 4.3 g/dL reflected the presence of severe anemia in at least some females of the study, while the upper range (12.9 g/dL) suggested that some were within the normal range.

Table-1. Summary of hematological indices of pregnant females in the 3rd trimester

Parameter	Mean ± SD	Minimum	Maximum
Hemoglobin (g/dL)	10.28 ± 1.78	4.3	12.9
RBC count (×10^6/µL)	3.81 ± 0.65	1.43	5.02
PCV (%)	30.89 ± 5.42	13	41.8
MCV (fL)	80.73 ± 9.14	53	98
MCH (pg)	26.52 ± 3.12	19	34
MCHC (g/dL)	33.05 ± 2.01	30	37.3

The participants of the study were further classified into non-anemic (n = 15) and anemic (n = 30) groups according to the WHO criterion for pregnancy where Hb below 11.0 g/dL is considered as anemic.

Since the data did not follow a normal distribution ($p < 0.05$), determined by the Shapiro–Wilk test, therefore, the Mann–Whitney U test was applied for group comparisons. Table -2 presented a comparison of hematological parameters between non-anemic and anemic groups.

The statistical analysis revealed the Hb levels were significantly lower in the anemic group ($p = 1 \times 10^{-5}$), confirming the classification.

RBC count and PCV were also significantly reduced (p= 0 .0036 and $p= 1 \times 10^{-5}$ respectively) in anemic females, indicating a reduction in red cell mass and oxygen-carrying capacity.

Similarly, MCH and MCHC were significantly decreased (p= 0.0128 and p = 0.0488 respectively) in the anemic group, reflecting hypochromia typically associated with IDA.

Whereas, MCV was lower in the anemic group, but the difference was not statistically significant (p = 0.3271), suggesting that the anemia was not be predominantly microcytic.

In addition to the statistical significance, to evaluate the magnitude of differences between the non-anemic and anemic groups, Cohen's d effect size was calculated (Table-2). For Hb levels the analysis revealed a very large difference between groups (Cohen's d = 2.36). Moderately large to large differences were observed for RBC count (d = 0.88) and PCV (d = 1.61), while MCH and MCHC showed moderate differences (d = 0.80 and d = 0.72, respectively). MCV showed a very small difference (d = 0.31), consistent with the non-significant p-value.

Table-2. Comparative analysis of hematological parameters among Anemic and Non- anemic pregnant women in the 3rd trimester

Parameter	Anemic group (n=30)	Non-anemic group (n=15)	p-value	Cohen's d
Hemoglobin (g/dL)	9.39 ± 1.47	12.05 ± 0.62	1×10^{-5}	2.36
RBC count ($\times 10^6/\mu L$)	3.64 ± 0.68	4.14 ± 0.42	0.0036	0.88
PCV (%)	28.69 ± 5.01	35.31 ± 2.99	1×10^{-5}	1.61
MCV (fL)	79.83 ± 9.77	82.55 ± 7.73	0.3271	0.31
MCH (pg)	25.75 ± 3.11	28.04 ± 2.62	0.0128	0.80
MCHC (g/dL)	32.58 ± 1.84	33.98 ± 2.07	0.0488	0.72

Discussion

The present study highlighted the prevalence of anemia among pregnant females visiting a public sector hospital in Karachi, Pakistan. The analysis of data revealed that two-thirds (66.7%) of the participants had Hb levels below 11.0 g/dL, which aligns with global trends, where anemia in pregnancy remains a significant public health concern (Lee and Okam, 2023).

The mean Hb (10.28 ± 1.78 g/dL), RBC count (3.81 ± 0.65 $\times 10^6/\mu L$), and PCV (30.89 ± 5.42%) values were near or below the lower limit of normal, indicating reduced oxygen-carrying capacity. These findings are in accordance with the regional studies, that report a high prevalence of anemia among pregnant women in low-income settings, particularly in South Asia, where dietary iron deficiency, inadequate antenatal care, and parasitic infections are common contributing factors (Rahman *et al*., 2022; Baig-Ansari *et al*., 2008).

Furthermore, the red cell indices including MCV, MCH, and MCHC, suggested a normocytic to mildly microcytic, and normochromic to mildly hypochromic anemia profile. Even though, the microcytic hypochromic anemia is the distinctive feature of IDA, the non-significant difference in MCV between anemic and non-anemic groups in the present study suggests various categories of anemia, probably because of early or mixed anemia conditions, such as combined iron and folate deficiencies, which mask the characteristic features of microcytic anemia (Rabindrakumar *et al*., 2018).

The significant reductions in MCH and MCHC among pregnant anemic group ($p = 0.0128$ and $p = 0.0488$, respectively), along with their small-to-moderate effect sizes ($d = 0.80$ and $d = 0.71$), are the indicators of hypochromia, a characteristic feature of IDA (Trivedi *et al*., 2022). Also, these parameters have been shown to provide valuable diagnostic insights in low-resource settings where serum ferritin or transferrin saturation tests are not readily available (Vora *et al*., 2021).

In addition, the very large effect size observed for Hb ($d = 2.36$) and moderately large effects for PCV and RBC count ($d = 1.61$ and $d = 0.88$ respectively) indicate the significant changes in hematological parameters among anemic pregnant women. These marked alterations are likely to have impact on the maternal-fetal outcomes. Anemia in pregnancy is associated with increased risks of preterm birth, intrauterine growth restriction, and maternal morbidity (Wang *et al*., 2025). Therefore, early detection through routine blood profiling is essential, particularly in public healthcare settings that serve to underprivileged populations.

Conclusion

Finally, to conclude, the findings highlight the clinical importance of red cell indices in the detection and characterization of anemia during pregnancy. The observed significant changes in these parameters among anemic pregnant females, suggesting a significant impact on maternal and fetal health. Early diagnosis and timely intervention, particularly through iron supplementation, can help reduce the risk of adverse effects. These results support current clinical guidelines that recommend universal iron supplementation for pregnant women, especially in low-resource settings.

Limitations & recommendations

As a cross-sectional analysis, this study cannot establish cause-and-effect relationships or evaluate variations in Hb and other indices over time. Additionally, the relatively small sample size may limit the applicability of the findings. Future longitudinal studies with larger populations are recommended for better understanding the progression of anemia across pregnancy trimesters.
The high prevalence of anemia in pregnancy highlights the need for targeted interventions, including nutritional education, supplementation programs, and improved access to prenatal care, to reduce the associated health risks for both mothers and their infants.

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