SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Deo and Kumari, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.1.14

Research Article

open access

Study of Severity of Anemia during Pregnancy and Adverse Maternal and Fetal Outcomes at Tertiary Care Centre

Sujata Deo[1*], Pratibha Kumari[2]

[1]Professor, Department of Obstetrics and Gynecology, King George's Medical University, Lucknow, India
[2]Research Scientist C, Department of Obstetrics and Gynecology, King George's Medical University, Lucknow, India

***Address for Correspondence:** Dr. Sujata Deo, Professor, Department of Obstetrics and Gynecology, King George's Medical University, Lucknow, India
E-mail: drsujata.2008@rediffmail.com

Received: 26 Aug 2023/ Revised: 23 Oct 2023/ Accepted: 03 Dec 2023

ABSTRACT

Background: Anemia is a recognized risk element for numerous adverse outcomes during pregnancy and childbirth. However, limited comprehensive data is available regarding its influence on specific maternal health issues. Additionally, there is inadequate research on the connections between anemia during pregnancy and the resulting impacts on both the mother and the fetus outcome.

Methods: In this observational study, a total of 414 pregnant female participants were recruited according to their hemoglobin levels (Hb). The subjects were divided into mild, moderate, and severe anemia according to their hemoglobin level,

Results: The study consisted of 414 women with varying degrees of anemia: mild (228,55.1%), moderate (128,30.9%), and severe (58,14%). The morphological analysis indicated that the majority of cases exhibited normocytic normochromic anemia, as opposed to microcytic hypochromic anemia, in both mild (60.5% vs 39.5%) and moderate anemic pregnant women (55.5% vs 44.5%). However, this proportion was reversed in severe cases, with a prevalence of 84.5% for microcytic hypochromic anemia. The results indicated that pregnant women with anemia were more likely to experience adverse outcomes, except for placental complications (p-value=0.05), delivery method (p-value=0.02), and fatal consequences such as low birth weight and miscarriage ($p<0.05$, respectively).

Conclusion: The prevalence of mild-moderate and severe anemia was found to be associated with maternal complications and adverse outcomes such as low birth weight and miscarriage. Adopting a comprehensive approach to prevent anemia in women of reproductive age is crucial to improving their hematological status and enhancing maternal and child health outcomes.

Key-words: Anemia, Hemoglobin, Preterm birth, IUD, Fetal growth restriction

INTRODUCTION

Anemia is the most commonly occurring nutritional deficiency among pregnant women across the globe [1]. The World Health Organization's (WHO) latest data shows that between 2012 and 2016, most of anemic women aged 15 to 49, whether pregnant or not, has increased in most countries [2]. To combat this issue, the 65th World Health Assembly established a nutrition goal, it is an aim for a 50% decrease in the prevalence of anemia among reproductive-aged women by 2025. However, global progress falls short of meeting this target [3]. In 2016, the worldwide prevalence of anemia in pregnant women reached 40.05%. Southeast Asia exhibited the highest rates, with 75% in general and a staggering 88% prevalence in India [4]. Given the alarmingly high prevalence of anemia, any detrimental impacts on the health of both the mother and the fetus during pregnancy would significantly affect public health [5].

Maternal mortality is influenced significantly by anemia, which is the primary cause in 20% of cases and an associated factor in another 20% [6]. The World Health Organization (WHO) states that the prevalence of anemia varies across different regions of India, ranging

How to cite this article
Deo S, Kumari P. Study of Severity of Anemia during Pregnancy and Adverse Maternal and Fetal Outcomes at Tertiary Care Centre. SSR Inst Int J Life Sci., 2024; 10(1): 3542-3549.

Access this article online
https://iijls.com/

from 33% to 89% [3]. In addition, anemia is responsible for 19% of maternal fatalities in the country [6]. Previous studies have indicated that the occurrence of anemia during pregnancy varies among women with distinct socioeconomic backgrounds, lifestyles, and healthcare-seeking behaviors, which differ across diverse cultures [6]. Maternal anemia not only increases the risk of low birth weight, premature delivery, intrauterine growth restriction, perinatal and neonatal mortality but also impairs iron storage for the baby. Consequently, it elevates the risk of maternal morbidity. The prevalence of maternal anemia is rising, posing a significant threat not only to the affected individual but also to their family and the overall economic growth of the nation. WHO categorized anemia into three levels: mild anemia (10-10.9 gm/dl), moderate anemia (7-9.9 gm/dl), and severe anemia (<7 gm/dl) [4]. Among the most common problems that occur during pregnancy is anemia. This condition is often considered a risk factor for an unfavorable pregnancy outcome, posing dangers to both the mother and the fetus. It can lead to complications such as preterm birth, low birth weight, fetal disability, and even maternal and fetal fatalities [7-9]. This research study aimed to examine the impact of anemia severity on the health of both the mother and the fetus throughout pregnancy.

MATERIALS AND METHODS

Place of the study- The present observational record-based study was conducted at the Department of Obstetrics and Gynecology in King George's Medical University (KGMU), Lucknow, India, from 1st May to 31st July 2022.

Selection criteria of Subject- A total of 414 pregnant women in the reproductive age group were included in our research. Anemia, as defined by the WHO, was categorized into three groups: mild anemia (Hb 10-10.9 g/dl), moderate anemia (Hb 7-9.9 g/dl), and severe anemia (Hb<7 g/dl) [4].

Inclusion Criteria- Anemic Pregnant women attending the antenatal clinic who have less than 11 g/dl Hemoglobin value.

Exclusion Criteria- Those pregnant women, who have not less than 11 g/dl Hemoglobin value excluded from the study.

Data collection- The primary data were obtained from the departmental antenatal records of patients. This data included various socio-demographic characteristics such as age, trimester, parity gravida, mode of delivery, and other investigations conducted during routine antenatal checkups, per the hospital's standard protocol. We recorded maternal outcomes such as placental complications, preterm birth, mode of delivery, hypertension disorders, fetal growth restriction (FGR), premature rupture of membranes (PROM), postdate pregnancy, GDM (gestational diabetes mellitus), cholestasis, heart disease, urinary diseases, antepartum hemorrhage, and abnormal placenta. Fetal outcomes consisted of malformation (including deformations, congenital malformation, and chromosomal abnormalities during hospitalization), growth restriction, growth restriction, malformation (including congenital malformations, deformations, and chromosomal abnormalities diagnosed during hospitalization), baby weight, and IUD.

Statistical Analysis- The data obtained from the research was analyzed using various statistical techniques. To check the normality of continuous data, the Kolmogorov-Smirnov test was employed. On the other hand, categorical data was presented in terms of frequency and percentage. The representation of continuous data was done using the mean and standard deviation. SPSS-21 package software by IBM, located in Chicago, USA was used for the statistical data analysis. Additionally, the graphs illustrating the data were created using Prizm software. A two-tailed p-value of less than 0.05 was considered significant to determine the significance of the results.

Ethical Approval- Before starting the collection of data, the authors obtained approval from the Ethical Committee of KGMU, Lucknow, India.

RESULTS

The study included a total of 414 pregnant females. The subjects were divided into categories based on their hemoglobin level: mild anemia, moderate anemia, and severe anemia. Our study revealed that the highest prevalence of mild anemia was 55.1%, followed by 30.9% for moderate and 14% for severe anemia. Through this observational study, we have uncovered a heightened

vulnerability to anemia among pregnant women residing in northern India, particularly among those aged between 18 and 45 years. The application of binary logistic regression analysis further demonstrates a correlation between the age of the mother and the risk of anemia during pregnancy, indicating that those under 25 are more susceptible. By comparing these three groups' blood parameters, an ANOVA test revealed significant variations in hemoglobin and MCH between them ($p<0.05$). This indicates notable differences in these two parameters among the groups. However, the subjects in the three groups were otherwise similar and can be considered comparable (Table 1). Furthermore, a correlation analysis was conducted to determine the level of similarity and linear relationship between the blood parameters of the subjects. It was found that the values of Hct and MPV were positively correlated with each other ($r^2>0.33$ and 0.25). This correlation is visually represented as a heat plot in Fig. 1, providing a clear overview of the relationship among the blood parameters.

Table 1: Baseline parameters of subjects

Variables	Mild (n=228) N(%)	Moderate (n=128) N (%)	Severe (n=58) N(%)	F/χ^2 value	*p*-value
Age (years) mean±SD	27.9±4.3	27.02±5.2	27.3±5.5	F= 1.48	0.23
18-25	79 (34.6)	63 (49.2)	30 (51.7)		
25-30	84 (36.8)	37 (28.9)	13 (22.4)	χ^2=10.19	0.027*
≥30	65 (28.5)	28 (21.8)	15 (25.8)		
		Gravida (n, %)			
1	80 (35.1)	42 (32.8)	10 (17.2)		
2	73 (32)	43 (33.4)	21 (36.2)	χ^2=7.5	0.11
≥3	75 (35.9)	43 (33.6)	27 (46.5)		
		Trimester (n, %)			
1st	15 (6.6)	3 (2.3)	3 (5.2)		
2nd	13 (5.7)	6 (4.7)	5 (86)		
3rd	194 (85.1)	115 (89.8)	49 (84.5)	χ^2=4.3	0.37
Post dated (>40 weeks)	6 (2.6)	4 (3.1)	1 (1.7)		
		Hematological parameters (mean±SD)			
Hb	10.8±0.85	8.93±1.16	6.01±1.2	F=359.4	0.001*
MCH	30.89±9.34	27.95±4.81	26.79±6.25	F=7.15	0.009*
MCHC	34.57±4.37	34.4±4.86	34.08±3.48	F=0.24	0.78
MCV	79.71±15.24	77.42±15.68	73.90±17.44	F=2.66	0.07
Platelets	1.77±0.81	1.81±0.85	1.62±0.91	F=0.76	0.46
HCT	35.99±40.4	26.66±5.96	27.98±37.05	F=2.13	0.12
MPV	12.04±9.92	11.4±10.6	9.72±1.3	F=0.69	0.50

Hb: hemoglobin, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration, MCV: Mean corpuscular volume, Hct: Hematocrit, MPV: mean platelet volume

SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Deo and Kumari, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.1.14

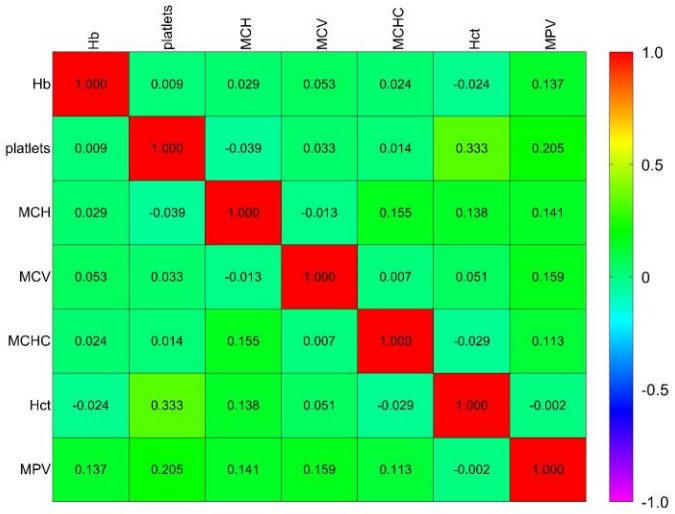

Fig. 1: Correlation matrix of baseline blood parameters

Table 2 illustrates unfavorable health consequences for both mothers and fetuses. In general, pregnant women who experience anemia face a greater likelihood of encountering adverse outcomes, excluding instances of fetal growth restriction, placental complications, delivery method, and fatal consequences such as low birth weight and abortion, respectively ($p<0.05$).

Table 2: Maternal complication and fetal outcomes by severity of anemia during pregnancy

Parameters	Mild (n=228), N (%)	Moderate (n=128), N (%)	Severe (n=58), N (%)	*p*-value
Maternal complications during pregnancy				
Cholestasis	13 (5.7)	5 (3.9)	1 (1.7)	NS
GDM	15 (6.5)	4 (3.1)	0 (0)	NA
Heart diseases	1 (0.44)	1 (0.78)	0 (0)	NA
Hypertension	23 (10.1)	9 (7.0)	4 (6.8)	NS
Hypothyroidism	11 (4.8)	3 (2.3)	0 (0)	NA
APH	5 (2.2)	8 (6.3)	4 (6.8)	NS
Placental complications	45 (19.7)	35 (27.3)	19 (32.7)	<0.05*
Post dated	5 (2.2)	4 (3.1)	1 (1.7)	NA
PROM	20 (8.7)	10 (7.8)	3 (5.1)	NA
Urinary complications	8 (3.5)	3 (2.3)	2 (3.4)	NA
Other complications	67 (29.4)	35 (27.3)	9 (15.5)	NS
Mode of delivery				
Vaginal	87 (38.2)	39 (30.5)	12 (20.7)	0.029*
LSCS	141 (61.8)	89 (69.5)	46 (79.3)	
Fetal outcomes				
FGR	15 (6.5)	11 (8.6)	15 (25.8)	<0.05*
Baby weight (Kg)				

SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Deo and Kumari, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.1.14

<2.5	93 (40.8)	65 (50.8)	19 (32.7)	0.001**
>2.5	118 (51.7)	59 (46.1)	11 (18.9)	
IUD/abortion	17 (7.4)	4 (3.1)	28 (48.3)	

NS: Not significant; NA: Not applicable; *: p<0.05; **p<0.01. GDM: Gestational Diabetes Mellitus, APH: Anti partum hemorrhage, PROM: Premature rupture of membranes, FGR: Fetal growth restriction, IUD: Intrauterine death

Further, the morphological subtyping analysis indicated that the majority of cases exhibited normocytic normochromic anemia, as opposed to microcytic hypochromic anemia, in both mild (60.5% vs 39.5%) and moderate anemic pregnant women (55.5% vs 44.5%) (Fig. 2). However, this proportion was reversed in severe cases, with a prevalence of 84.5% for microcytic hypochromic anemia. Anemic women are more prone to preterm delivery due to insufficient blood supply for fetal intrauterine development.

Maternal iron deficiency anemia in early pregnancy poses a significant risk of preterm delivery. A post hoc analysis uncovered a clear association between anemia severity and preterm delivery. It was observed that varying levels of hemoglobin have a positive impact on preterm delivery. Women with severe levels of anemia are more likely to experience premature delivery compared to those with mild or moderate levels (preterm delivery: mild-27%, moderate-27%, severe-37%, p<0.01 for all comparisons) (Fig. 3) where significance was different alphabets show significant variation at p<0.05.

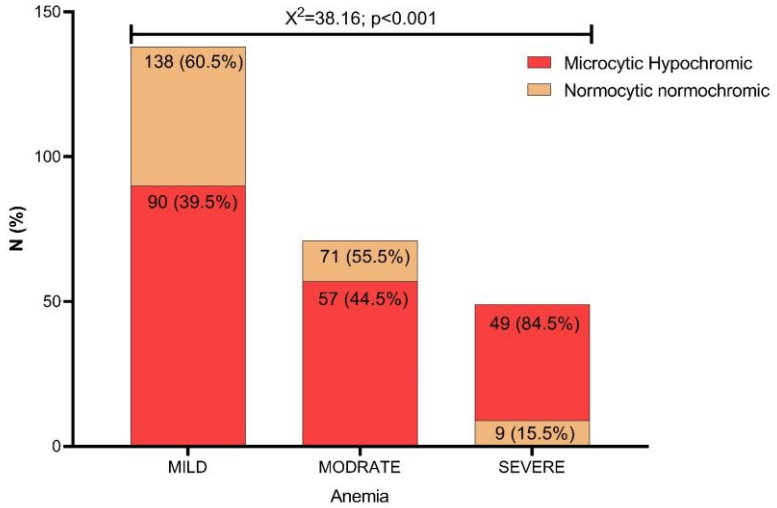

Fig. 2: Distribution of type of anemia in mild, moderate and severe

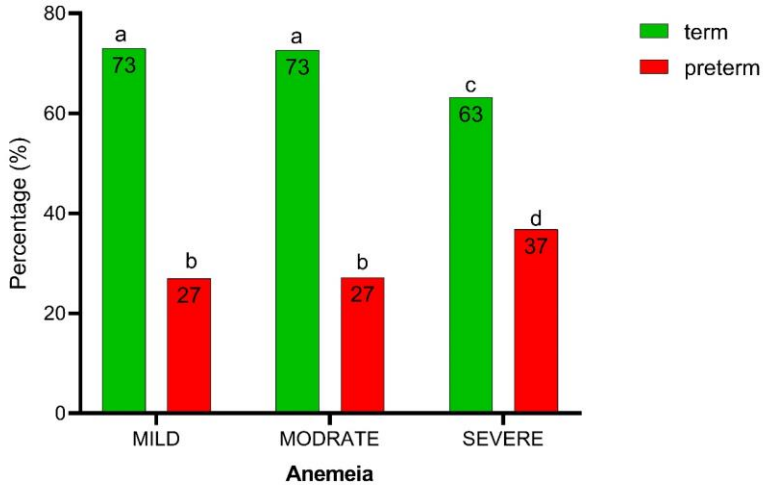

Fig. 3: Effect of Maternal anemia on fetal development concerning premature and full-term births

SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Deo and Kumari, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.1.14

DISCUSSION

During pregnancy, the epidemiological characteristics of anemia emphasize the necessity for a public health intervention in India. To begin with, multiple sources of data substantiate the escalating trend of anemia in pregnant women in India [10,11]. The prevalence of anemia, per the global estimates provided by the World Health Organization, averages 56% worldwide, with regional variations ranging from 35% to 75% [2]. In India specifically, the prevalence of anemia stands at more than 55% [12]. Our study revealed that the highest prevalence of mild anemia was 55.1%, followed by 30.9% for moderate anemia and 14% for severe anemia. Fortunately, we did not find many pregnant women suffering from severe anemia, which is a positive indication. However, the high occurrence of moderate and mild anemia in our study has raised concerns and calls for immediate action to reduce the overall burden of anemia among pregnant women in this area. Parasitic infections, such as malaria and intestinal worms, are primarily responsible for severe cases of anemia [13]. The low incidence of severe anemia suggests that our strategies to control infectious diseases are effective in this region.

These findings align with a study by Mridul Malakar *et al.* [14] in the Lakhimpur district of Assam. They reported a prevalence of 61% for moderate anemia, followed by 29.5% for mild anemia and 2.3% for severe anemia. In this observational research, we have discovered an increased susceptibility to anemia in pregnant women living in the northern regions of India. Specifically, we found that women between 18 and 45 are more prone to this condition. Using binary logistic regression analysis, we have also demonstrated a relationship exists between the age of the mother and her risk anemia during pregnancy, which varied depending on the severity of anemia. This analysis revealed that a great vulnerability in women under the age of 25. Regardless of the severity, we observed three adverse outcomes associated with anemia during pregnancy: microcytic hypochromic condition, placental complications, and mode of delivery. Microcytic hypochromic or Microcytic anemia refers to a condition with an abundance of small, frequently hypochromic red blood cells observed in a peripheral blood smear. This type of anemia is typically identified by a low MCV, usually below 83 microns cubed [15]. Among the various causes, iron deficiency is the most prevalent reason behind microcytic anemia. The absence of iron stores in the bone marrow stands as the most conclusive test to distinguish iron deficiency from other microcytic states, such as anemia of chronic disease, thalassemia, and sideroblastic anemia. However, for other adverse outcomes such as preterm birth, intrauterine death (IUD), and FGR, we found increased risks among those with moderate or severe anemia compared to those with mild anemia or normal hemoglobin concentrations.

Anemia in young women necessitates particular attention, given that they are the demographic most prone to becoming pregnant. The prevalence of anemia in India has reportedly been rising, with several factors potentially contributing to this trend [16]. The advancement of prenatal care and increased focus on maternal anemia have led to the identification and clinical diagnosis of more pregnant women affected by anemia. Furthermore, dietary habits in India have undergone significant changes in recent decades, characterized by a nutritional landscape that encourages the consumption of energy-dense but nutrient-deficient foods [16]. Interestingly, iron supplements are not regularly recommended to pregnant women in India. A study indicated that around 70% of anemia cases among pregnant women in India were linked to insufficient iron levels [17].

Additionally, there has been a growing trend among women to strive for a slender physique in recent years. Previous research has established that anemia can be associated with placental or delivery-related conditions, such as placental abruption, which is also linked to preterm birth [18]. Our study showed that pregnant women with anemia, regardless of severity, were more likely to experience unfavorable outcomes, such as these diseases connected to the placenta. These results are in line with previous research [18-21]. On the other hand, there was a correlation between mild anemia during pregnancy and reduced risk of stillbirth and foetal growth restriction.

In terms of fetal outcomes, our study found that pregnant women who experience anemia face a greater likelihood of encountering adverse outcomes of fetal growth restriction, placental complications, preterm delivery, and fatal consequences such as low birth weight and abortion among pregnant women with anemia. It is worth noting that mild anemia during

pregnancy was linked to decreased risks of fetal growth [19] restriction and still birth.

CONCLUSIONS

The study concludes that pregnant women with anemia, regardless of the severity level, were more prone to experiencing adverse outcomes. The majority of cases exhibited normocytic normochromic anemia, as opposed to microcytic hypochromic anemia, in mild and moderate anemic pregnant women. In severe cases, this proportion was reversed, with a prevalence of 84.5% for microcytic hypochromic anemia. Anemic women are more prone to preterm delivery due to insufficient blood supply for fetal intrauterine development. Maternal iron deficiency anemia in early pregnancy poses a significant risk of preterm delivery. It was observed that the risk of developing anemia was particularly high in females under 25. The study also revealed that severe anemia during pregnancy was closely associated with complications related to the placenta, which in turn led to morbidity.

More research is needed to confirm optimal hemoglobin concentration for ensuring optimal health for both the mother and the developing fetus. However, caution should be exercised when dealing with low levels of hemoglobin during pregnancy until a better understanding of their impact on both mothers and fetuses is achieved.

CONTRIBUTION OF AUTHORS

Research concept- Dr. Sujata Deo
Research design- Dr. Sujata Deo
Supervision- Dr. Sujata Deo
Materials- Dr. Sujata Deo & Dr. Pratibha Kumari
Data collection- Dr. Pratibha Kumari
Data analysis and Interpretation- Dr. Sujata Deo & Dr. Pratibha Kumari
Literature search- Dr. Pratibha Kumari
Writing article- Dr. Pratibha Kumari
Critical review- Dr. Sujata Deo
Article editing- Dr. Pratibha Kumari
Final approval- Dr. Sujata Deo

REFERENCES

[1] Balarajan Y, Ramakrishnan U, Ozaltin E., Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet, 2011; 378(9809): 2123-35.

[2] World Health Organization. Global anaemia reduction efforts among women of reproductive age: impact, achievement of targets and the way forward for optimizing efforts. Available at: https://www.who.int/publications/i/item/9789240012202, 2020.

[3] World Health Organization. Global Nutrition Monitoring Framework: operational guidance for tracking progress in meeting targets for 2025. Available at: https://www.who.int/data/nutrition/nlis/gnmf, 2017.

[4] World Health Organization. Prevalence of Anaemia in Women: A Tabulation of Available Information. Available at: https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children, 1992.

[5] Arlappa N, Meshram II, Balakrishna N, Harikumar R, Rao KM, et al. Prevalence of anaemia among different physiological groups in the rural areas of Maharashtra. Ind J Community Health, 2014; 26(3): 278-84.

[6] Bansal B, Takkar J, Soni ND, Agrawal DK, Agarwal S. Comparative study of prevalence of anemia in Muslim and non-Muslim pregnant women of western Rajasthan. Int J Res Health Sci., 2013; 1(2): 47-52.

[7] Levy A, Fraser D, Katz M, Mazor M, Sheiner E. Maternal anemia during pregnancy is an independent risk factor for low birthweight and preterm delivery. Europ J Obst Gynecol Repro Biol., 2005; 122(2): 182-86.

[8] Banhidy F, Acs N, Puho, E. H, Czeizel AE. Iron deficiency anemia: pregnancy outcomes with or without iron supplementation. Nutr., 2011; 27(1): 65-72.

[9] Haas JD, Brownlie T. Iron deficiency and reduced work capacity: a critical review of the research to determine a causal relationship. J Nutr., 2001; 131(2): 676S-90S.

[10] Kulkarni PY, Bhawalkar, JS, Jadhav AA. Anemia control program in india needs to be more comprehensive. Indian J Public Health, 2022; 66(3): 358-61.

[11]Finkelstein JL, Kurpad AV, Bose B, Thomas T, Srinivasan K, et al. Anaemia and iron deficiency in pregnancy and adverse perinatal outcomes in Southern India. Eur J Clin Nutr., 2020; 74(1): 112-25.

[12]Sharif N, Das B, Alam A. Prevalence of anemia among reproductive women in different social group in India: Cross-sectional study using nationally representative data. Plos One, 2023; 18(2): e0281015.

[13]White NJ. Anaemia and malaria. Malaria J., 2018; 17(1): 1-17.

[14]Malakar M, Malakar M. High prevalence of anaemia in pregnant women of Lakhimpur District of Assam. Indian J Basic Appl Med Res., 2014; 3(4): 314-21.

[15]Chaudhry HS, Kasarla MR. Microcytic Hypochromic Anemia. 2023 Aug 14. In: StatPearls [Internet]. Treasure Island (FL): Stat Pearls Publishing, 2023.

[16]Chaudhary V, Saraswathy KN, Sarwal R. Dietary diversity as a sustainable approach towards micronutrient deficiencies in India. Indian J Med Res., 2022; 156(1): 31.

[17]Toteja GS, Singh P, Dhillon BS, Saxena BN, Ahmed FU, et al. Prevalence of anemia among pregnant women and adolescent girls in 16 districts of India. Food Nutr Bull., 2006; 27(4): 311-15.

[18]Ananth CV, Vander-Weele TJ. Placental abruption and perinatal mortality with preterm delivery as a mediator: disentangling direct and indirect effects. Am J Epidemiol., 2011; 174(1): 99-108.

[19]Suryanarayana R, Chandrappa M, Santhuram AN, Prathima S, Sheela SR. Prospective study on prevalence of anemia of pregnant women and its outcome: A community-based study. J Family Med Prim Care, 2017; 6(4): 739-43.

[20]Benson CS, Shah A, Frise MC, Frise CJ. Iron deficiency anaemia in pregnancy: A contemporary review. Obstet Med., 2021; 14(2): 67-76.

[21]Ali AA, Rayis DA, Abdallah TM, Elbashir MI, Adam I. Severe anaemia is associated with a higher risk for preeclampsia and poor perinatal outcomes in Kassala hospital, eastern Sudan. BMC Res Notes, 2011; 4: 311.