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Original Article

Prevalence of Iron Deficiency Anemia and Serum Magnesium Among Pregnant Women in Zawia City

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ABSTRACT:

Background: Anaemia during pregnancy is associated with adverse maternal and child health. Investigations of anaemia and its predictors among pregnant women are needed for preventive measures. **Materials and Methods:** A cross-sectional study was conducted to investigate the prevalence and determinants of anaemia in different periods of pregnancy in Zawia, Libya. Clinical characteristics were gathered using a questionnaire. Serum ferritin, magnesium، and total binding iron concentration (TIBC) were measured using different laboratory methods. **Results:** Of the 140 women in the study, aged between 18 to 45 were 70.7% had anaemia (haemoglobin [Hb] <11 g/dl), 35.0% had serum iron low<37 and 67.9% had serum ferritin low < 30 mg/dl, 75.0% had higher TIBC, 77.1% magnesium deficiency (<1.80 mg/dl). Anaemic pregnant women had significantly lower levels of serum ferritin and serum magnesium. 58% of lowered hg levels of pregnant women had lower Mg leve.ls There were significant positive correlations between Hb and serum magnesium (r=0.192, p=0.010). **Conclusion:** The role of magnesium as a possible contributing factor to anaemia in pregnancy has important implications for theprevention and treatment of these women.

Keywords: Anemia, HG, Magnesium, Pregnancy, Iron deficiency.

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INTRODUCTION:

Anemia is a condition characterized by a reduced number of red blood cells or an insufficient oxygen-carrying capacity to meet the body's needs. Its prevalence and severity vary based on factors such as age, sex, altitude, smoking status, and stage of pregnancy [1,2]. Globally, anemia remains a major public health concern, affecting populations in both low- and high-income countries. Iron deficiency accounts for approximately 50% of anemia cases in women [3], with other causes including infections, deficiencies in folate, vitamins B12, A, and C, and genetic disorders such as thalassemia and sickle cell disease [4,5].

Among the various forms of anemia, iron deficiency anemia (IDA) is the most common, particularly during pregnancy. It features microcytic, hypochromic red blood cells and is linked to impaired iron absorption or inadequate intake [6]. Pregnant women are particularly susceptible due to the increased iron demands necessary for fetal development and red cell expansion. The recommended dietary allowance (RDA) of iron increases from 18 mg in nonpregnant women to 27 mg during pregnancy [7,8].

Symptoms of IDA—such as fatigue, pallor, and shortness of breath—stem from tissue hypoxia caused by reduced hemoglobin. In severe or chronic cases, especially during pregnancy, cardiovascular manifestations such as tachycardia and cardiac hypertrophy may occur [9, 10, 11]

Magnesium, essential for over 600 enzymatic processes, also plays a significant role in red blood cell production and hemoglobin synthesis [12,13] Magnesium deficiency, more prevalent in women due to hormonal influences, has been associated with anemia and other pregnancy complications [14,15] Because most magnesium is stored intracellularly, traditional serum measurements may not accurately reflect deficiency; red cell magnesium is a more reliable indicator [16,14]

Objective of the study:

- The main objective of this study is to find out the prevalence of anemia among pregnant women and deficiency of magnesium and its associated factors (such as education, balanced diet, and milk drinking) among pregnant women in Zawia City.
- To estimate anemia based on blood haemoglobin level in pregnant women.
- To assess the magnesium associated with anemia among pregnant women

MATERIAL AND METHODS

Selection of sample

140 Samples collected from pregnant women attending Zawia teaching hospital (women's clinic), during the period from July 2022 to October 2022. Biochemical tests of the obtained samples were performed in the hospital laboratories and the private Zawia Central Lab.

Questionnaire

Participants were interviewed at the Zawia Medical Central and Zawia Central Lab, and explain any questions that participants may find difficult. A standardized questionnaire (appendix 1) was used in this study, containing general information including: name, age, sex, and clinical profile: tea drinking rate, drinking milk, how often pregnant, eating fresh and vegetables, and if they suffer from any illness.. Information obtained was: treatment, family history of iron deficiency anemia, serum magnesium of pregnant women, and other diseases and complications. All participants were given informed consent before participation.

Blood sample collection

5 mL of venous blood samples were taken in tubes containing EDTA and gently mixed 3- 4 times. Each

tube was labeled by a sticker containing a number, the name of the subject, the time of collection, and the place of collection. The remainder of the blood sample was added to a plain tube to get serum for biochemical analysis.

For serum iron, TIB, ferritin, and magnesium, venous blood was drawn in a plain blood tube containing clot activator and immediately centrifuged at 3000 RPM

for 5 minutes to obtain serum and immediately analyzed. Cobce e 411 (Roche) used to measure ferritin, iron, TIBC, magnesium, analysed using Intigera (Roche Intigera 400 plus) and Sysmex – for the measurement of CBC.

Table 1: Normal ranges for healthy adult females (Hillman et al, 2005).

Blood indices	Females
WBC X 10^9/ L	4.5- 11.0
RBC X 10^{12} /L	3.5- 5.5
Hb (g/dl)	12- 16
PCV (HCT) %	36- 46
MCV (ft)	80-100
MCH (pg / cell)	25.4- 36.6
MCHC (%)	31-36
PLT X10^9 / L	150- 400

Statistical analysis

All data obtained were calculated and analyzed by using Microsoft Office Excel 2010 version 25 software. Continuous variables were expressed as Mean ± SD and qualitative variables were expressed as frequency and percentage. Independent sample t-test analysis was used to compare between means, with values of P ≤0.05 and ≤0.001 being considered statistically significant.

Complete blood count (CBC)

Blood samples were transferred to the hospital laboratory for CBC (complete blood count), and the CBC was analyzed using the Sysmax machine. All hematological parameters for each subject were recorded on a strip paper from the Sysmax machine. Each strip of paper was numbered. The time consumed to get a one-strip ranged between half to one minute. All obtained data of blood parameters for each woman were stored in the computer. Blood indices such as WBC, RBC, Hb, HCT, MCV, MCH, and MCHC.

RESULT:

The distribution of pregnancy duration within the study cohort is illustrated in Figure 1. A total of 140 pregnant women were recruited and subsequently screened across different stages of gestation to ensure a comprehensive representation of pregnancy progression. Among these participants, 23.6% (33) were in the first trimester, characterized by early embryonic development and rapid physiological changes. The second trimester encompassed the largest proportion of the sample, accounting for 42.9% (60) of the participants, marking a period of continued fetal growth and relative physiological stability. The remaining 33.6% (47) of the women were in the third trimester, a critical phase of fetal maturation and preparation for parturition. The distribution highlights that the majority of subjects were in the second trimester, providing an extensive window for the assessment of gestational biomarkers and physiological parameters during a pivotal stage of pregnancy. The distribution of samples across age groups was variable. Approximately 45% of the samples (63 participants) were aged between 25-31 years, while only three patients (2.1%) belonged to the 39-45-year age group. The other two age groups had similar numbers of patients Figure 2

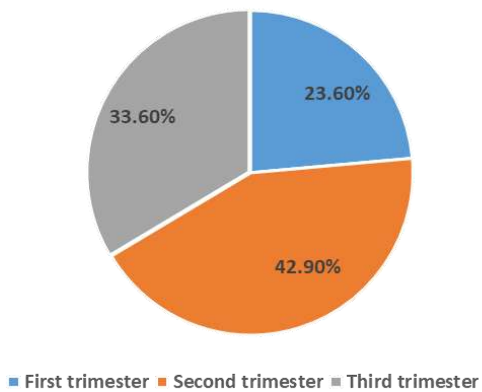

Figure 1. Distribution of pregnancy duration among t collected samples

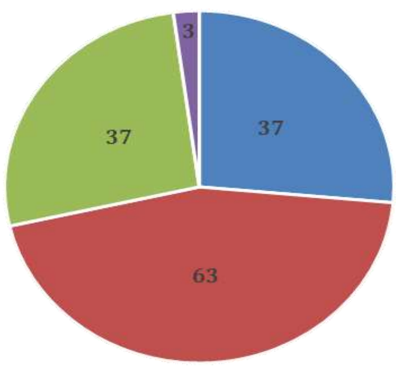

Figure2. Distribution participants among of age groups

The biochemical and hematological parameters showed significant variability among the patients, as reflected by high standard deviations (see Table 2). This suggests diverse nutritional and physiological statuses within the cohort. For example, the mean hemoglobin was 10.01 g/dL (±1.57), indicating varying levels of anemia or iron deficiency. Serum iron averaged 68.74 µg/dL (±47.88), with notable differences among individuals. TIBC had a mean of 426.41 µg/dL (±180.50), and serum ferritin averaged 29.62 ng/mL (±38.15), both showing wide distributions. RBC count was 3.65 million/mcmm (±0.51), and magnesium levels averaged 1.82 mmol/L (±0.31). Overall, these variations highlight the heterogeneity in nutritional and health status among pregnant women, which could influence maternal and foetal health outcomes.

Table 2: The mean and ± S.D of the hematological and biochemical parameters of the collected samples.

Figure2. Distribution participants among of age

Total samples	Hb	Iron	TIBC	Ferriti	RBC	MG
Mean	10.0	68.74	426.4	29.62	3.65	1.82
Std. Deviation	± 1.5	± 47.8	± 180.5	± 38.1	± 0.5	± 0.3

Analysis of the hematological and biochemical data from the collected samples indicates distinct patterns within the study population. Specifically, a significant proportion—70.7%—exhibited hemoglobin (Hb) levels below the normal threshold, suggesting a high prevalence of anemia among the participants, whereas only 29.3% had Hb within the normal range Figure 3. Notably, no samples demonstrated low serum iron levels; instead, 65.0% of participants maintained normal iron concentrations, indicating that iron deficiency was not universally prevalent despite the high incidence of anemia.Interestingly, a substantial 67.9% of the subjects showed low serum ferritin levels, which often reflect depleted iron stores, contrasting with the relatively normal serum iron levels observed in the same group. This disparity may imply that iron stores are reduced even when circulating iron appears adequate, highlighting potential early stages of iron depletion or dysregulated iron metabolism. Regarding serum magnesium (Mg), a majority—77.1%—exhibited levels below the normal reference range, pointing toward widespread magnesium deficiency within the cohort. Conversely, only 22.9% presented with magnesium levels within the normal range, underscoring a significant deficiency concern that could have implications for maternal health, including neuromuscular and metabolic functions. These findings collectively reveal notable hematological and biochemical alterations in the study population, warranting further investigation into underlying causes and potential health impacts Figure 3.

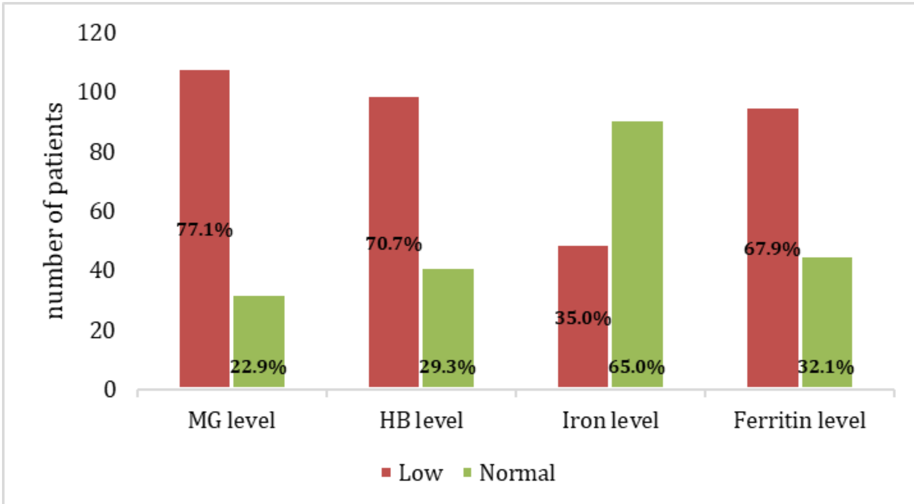

Figure 3. Distribution of low vs. normal hematological/biochemical values in pregnant women (percentages within columns reflect patient proportions per parameter

The hemoglobin levels among pregnant women exhibited variation across different age groups. As shown in Figure 4, the prevalence of low hemoglobin (HB) was notable within specific age cohorts. In the 18–24 years age group, 17.9% (25 patients) of women had reduced HB levels, indicating anemia. The highest proportion was observed in the 25–31 years group, where 31.4% (44 patients) of women were anemic, suggesting a peak in anemia prevalence within this age range. In the 32–38 years cohort, 20.0% (28 patients) of women experienced low HB levels, while only 1.4% of women in the 39–45 years age group had reduced HB. These findings suggest that the 25–31 years age group comprises the largest segment of pregnant women affected by anemia in this study, highlighting a potential age-related trend in hemoglobin status during pregnancy.

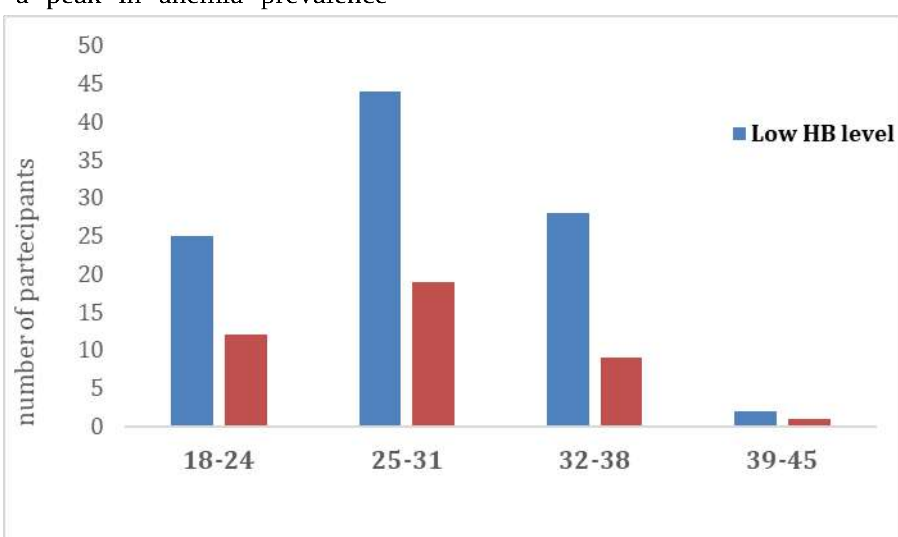

Figure 4. Distribution of age groups with HB level

The data presented in figure 5 illustrates the distribution of four biochemical parameters—Magnesium, Hemoglobin, Ferritin, and Iron—across different pregnancy trimesters. The chart highlights variations in these parameters throughout pregnancy. For instance, women with low magnesium levels, along with low hemoglobin and ferritin, reach their peak during the second trimester, while the lowest values are observed in the third trimester among women with normal hemoglobin, based on patient numbers. The highest number of patients with low iron and hemoglobin levels occurs during the second trimester compared to other groups. Hemoglobin levels are predominantly low during the second trimester in relation to the other parameters and the overall pregnancy period. Additionally, Ferritin levels consistently remain higher in women with normal hemoglobin across all trimesters.

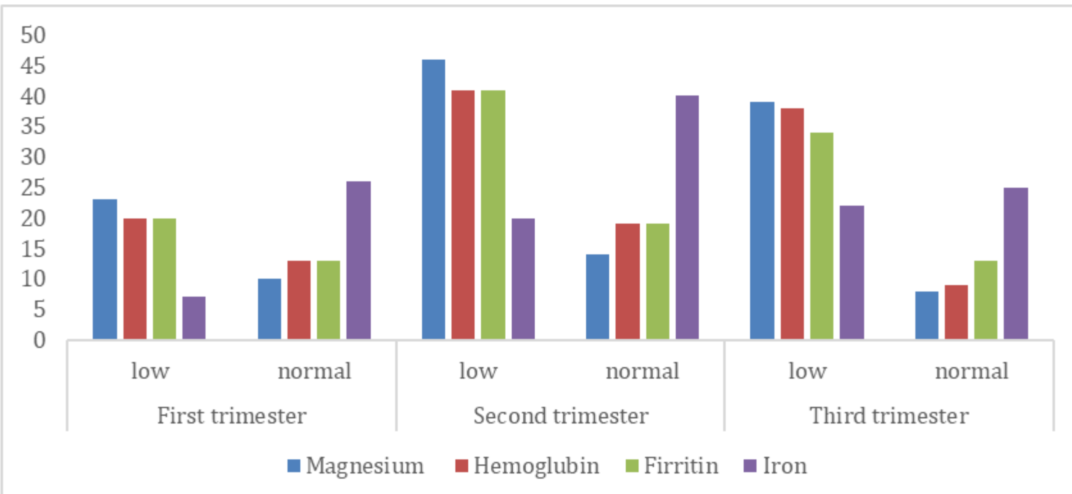

Figure 5. illustrates the distribution of four key biochemical parameters—magnesium, hemoglobin, ferritin, and iron—across different pregnancy trimesters.

Variation in Low/Normal Test Results (%) by Trimester is stated in Table 3. "The table displays the percentages of 'low' and 'normal' results for four blood tests (Magnesium, Hemoglobin, Ferritin, and Iron) across pregnancy trimesters. Magnesium, Hemoglobin, and Ferritin show lower levels in the second trimester (32.9%, 29.3%, and 29.3%, respectively), with overall low results at 77.1%, 70.7%, and 67.9%. In contrast, Iron has predominantly normal results (65%), with low levels peaking in the third trimester (15.7%). The first trimester consistently has the lowest deficiency rates for all tests. This suggests that deficiencies are most common in the second trimester, except for Iron, which remains largely normal throughout pregnancy.

TIBC distribution levels among pregnant women across trimesters are shown in Table 3. Results indicated that most of the patients had high TIBC during the pregnancy period. In the first trimester, 1.4% have low, 3.6% have normal, and 18.6% have high TIBC; in the second trimester, those figures are 2.1%, 9.3%, and 31.4% respectively; and in the third trimester, 0.0%

have low, 8.6% have normal, and 25.0% have high TIBC. Overall, 3.6% of the women had low, 21.4% had normal, and 75.0% had high TIBC levels, with the second trimester exhibiting the highest percentage of high TIBC. In general, 3.60% of the sample study have low TIBC, 21.4% of the sample study have normal, while 75.0% of the sample study have high TIBC.

Table 3. Variation in Low/Normal Test Results (%) by Trimester for Magnesium, Hemoglobin, Ferritin, and Iron

test	% of patient in 1st trimester		% of patient in 2nd trimester		% of patient in 3rd trimester		Total %	
	Low	Normal	Low	Normal	Low	Normal	Low	Normal
Magnesium	16.4%	7.1%	32.9%	10%	27.9%	5.7%	77.1%	22.9%
Hemoglobin	14.3%	9.3%	29.3%	13.6%	27.1%	6.4%	70.7%	29.3%
Ferritin	14.3%	9.3%	29.3%	13.6	24.3%	9.3%	67.9%	32.1%
Iron	5%	18.6%	14.3%	28.6%	15.7%	17.9%	35%	65%

Table 4. Distribution of TIBC level within the pregnancy duration

Pregnancy duration	TIBC level						Total	
	Low		Normal		High			
	Count	%	Count	%	Count	%	Count	%
First trimester	2	1.4	5	3.6	26	18.6	33	23.6
Second trimester	3	2.1	13	9.3	44	31.4	60	42.9
Third trimester	0	0.0	12	8.6	35	25.0	47	33.6
Total	5	3.6	30	21.4	105	75.0	140	100.0

The percentage of patients with low and high magnesium levels, categorized by education level, balanced diet, and milk consumption, is shown in Figure 6. For education, a higher percentage of patients with high magnesium have low education, while a lower percentage have high education. Regarding diet, both low and high magnesium levels are more prevalent among those who have a balanced diet compared to those who don't. Regarding milk consumption, no definitive correlation with magnesium levels can be established, as a higher percentage of patients with both low and high magnesium reported consuming milk

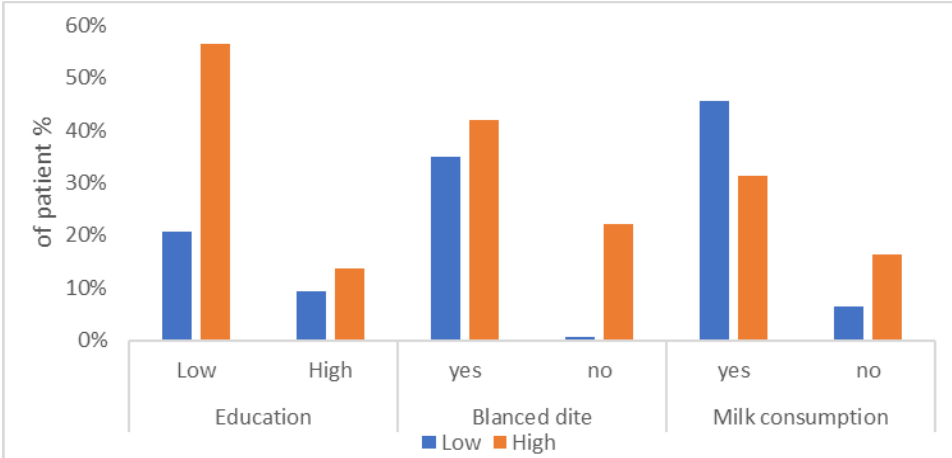

Figure 6. Magnesium Levels Relative to Education, Diet, and Milk Consumption

However, possible relationship between MG levels and HG. Data in Table 5 illustrates that 58.6% of the pregnant women who have low HG have low MG, while 16.6% of the pregnant women who have normal HG have low MG. That means, the highest percentage of low MG was with pregnant women with a lower level of HG.

Table 5: Distribution of Hb level with MG level

Hb level	MG level				Total	
	Low		Normal			
	Count	%	Count	%	Count	%
Low	82	58.6%	17	12.1%	99	
Normal	26	18.6%	15	10.7%	41	
Total	108	77.1	32	22.9	140	100.0

DISCUSSION:

Iron deficiency anemia in pregnancy elevates the risk of preterm birth, low birth weight, postpartum depression, and fetal mortality [17]. This study aimed to assess iron deficiency anemia (low hemoglobin and iron levels) among pregnant participants. Results indicated that 75% were anemic, with the highest prevalence in the 25-31 age group [18]

During pregnancy, iron utilization increases to support fetal growth and maternal erythropoiesis [19,20]. Maternal fatigue, a key symptom of iron deficiency anemia, is strongly linked to postpartum depression [21,22].

Iron deficiency anemia is also associated with premature birth, low APGAR scores, and impaired neonatal cognitive, motor, and language development [23] . Historically, anemia has been a major contributor to maternal mortality

This study defined anemia using hemoglobin concentrations of <110 g/l in the first trimester and <105 g/l in the second and third trimesters [24]. Serum iron levels and a s-ferritin cut-off of <50μg/l were used based on WHO recommendations [25, 26]

Assessing iron status during pregnancy is complex due to hemodynamic changes affecting iron indices [27]. Hemodilution reduces hemoglobin, serum iron, and s-ferritin concentrations [28].

The highest percentage of anemic women was observed in the second trimester, characterized by low hemoglobin and S-ferritin levels, while the lowest iron levels were seen in the last trimester. Iron requirements vary across trimesters, decreasing initially due to the cessation of menstruation, then increasing significantly in the second and third trimesters as fetal iron demands rise [29]. During the final 6-8 weeks, iron requirements can reach 10mg/dl or more. Dietary intake alone, even with optimal nutrition, may not meet these needs [20]

In developing countries, pre-existing anemia exacerbates the problem, with women entering pregnancy with depleted iron stores and suboptimal hemoglobin [30]. Normal ferritin levels do not always exclude iron deficiency due to pregnancy-related increases in acute-phase proteins [31]. and alterations in iron metabolism [32].

Magnesium is crucial during pregnancy for preventing premature uterine contractions and labor, increasing birth weight, supporting fetal bone development, and treating insomnia. In this study, 77% of participants had low magnesium levels, with the lowest levels observed in the second trimester.

Numerous studies indicate that pregnant women have lower serum magnesium levels compared to non-pregnant women [33,34, 35, 36]. This may be due to inadequate dietary intake, increased magnesium requirements, increased glomerular filtration rate, physiological haemodilution, and increasing parity [37]. Experimental studies suggest magnesium deficiency during pregnancy can have teratogenic effects and lead to parturition problems and delayed uterine involution [38].

The study found no significant correlation between education level and low magnesium. However, there was a significant relationship between magnesium levels and milk consumption and balanced diet, with the highest percentage of low magnesium observed in pregnant women who did not consume milk.

Lower magnesium levels were significantly associated with anemia (low hemoglobin). Recent findings indicate lower magnesium levels in anemic pregnant women compared to non-anemic women [38,39]. Maternal magnesium deficiency may impair placental development and decrease fetal growth [40, 41,42]

Limitations of this study include the lack of investigation into other factors, such as zinc, copper, and CRP, in relation to magnesium deficiency. The study also did not follow up with participants to determine maternal and perinatal outcomes related to anemia and magnesium deficiency.

CONCLUSION:

This study has confirmed that anaemia is a major health problem in pregnant women. It is more severe during pregnancy. Because of the high utilisation of ANC, the health care system has the potential to treat and prevent anaemia during pregnancy and thus minimise the associated consequences.

It is essential to provide prophylactics to all pregnant women. However, early booking should be encouraged and the logistics of drug supply improved, as well as retraining of health workers and improvement of performance supervision, as well as overall improvement of the quality of care in antenatal clinics. Counselling of women on the need for supplements should be emphasised.

The role of magnesium as a possible contributing factor to anaemia in pregnancy has important implications for prevention and treatment in these women.

It is well established that magnesium is essential for the normal development of the fetus. The relationship of these effects of magnesium deficiency to problems of pregnancy in humans is at present unclear, but should be explored.

A more specific study is recommended to determine the correlation between magnesium deficiency and iron deficiency in pregnant women, and the follow-up of the fetal state after delivery in the participating women.

Recommendation

1. Routine Screening: Hemoglobin and magnesium levels should be routinely assessed during antenatal visits to enable early detection and intervention.

2. Supplementation Protocols: Iron and magnesium supplements should be considered for pregnant women at risk, especially those with dietary insufficiencies.

3. Health Education: Pregnant women should receive counseling on nutrition, focusing on foods rich in iron and magnesium.

4. Policy Development: National guidelines should incorporate magnesium status monitoring as part of comprehensive maternal care.

5. Further Research: Longitudinal and interventional studies are needed to explore the effects of magnesium supplementation on maternal anemia and neonatal outcomes.

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