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Serum magnesium levels during pregnancy and their correlation with maternal demographic characteristics: A cross-sectional study

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Abstract

Background and objective: The rate of low magnesium levels in pregnancy varies significantly between regions, shaped by dietary practices, socioeconomic factors, and healthcare access. This study aimed to determine the prevalence of hypomagnesaemia in pregnant women attending a tertiary public hospital and any maternal associated factor in relation to magnesium levels.

Methods: A cross-sectional study was conducted on 930 pregnant women across all trimesters at Maternity Teaching Hospital, Erbil, Kurdistan Region, Iraq, from 3rd January 2023 to 3rd January 2024. Serum magnesium concentrations (mg/dL) were determined using the Cobas Integra analyzer. These levels were correlated with demographic characteristics and weight.

Results: The mean serum magnesium level was 1.86±0.22 mg/dL (median 1.88, range 0.47-2.7 mg/dL). Hypomagnesemia was observed in 4.3% (n=40) and hypermagnesemia in 3.3% of participants. Serum magnesium levels showed a trend towards decreasing with advancing gestational age, although differences between trimesters were statistically significant. No significant association was found between hypomagnesemia and educational level or occupation.

Conclusion: Hypomagnesemia was infrequent in pregnant women at the studied hospital and was not linked to education, socioeconomic status, or body weight.

Keywords: Hypermagnesemia, Serum magnesium, Pregnancy.

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Introduction

Maternal health status before, during and after pregnancy period is essential for the well-being of both the mother and the developing fetus (1). Magnesium as one of the critical micronutrients and one of the most prevalent cations in the body plays numerous vital physiological functions (2-4) including metabolic processes, muscular functioning, and DNA synthesis. It also regulates blood pressure, metabolism of glucose, and fetal bone development throughout period of pregnancy (2). It has a crucial role in the activity of about 80% of enzyme functions of metabolic processes (5).

Therefore, any disturbance of its level will be a matter of concern due to its potential effect in body's homeostasis and cardio-metabolic lines through variety of pathological processes throughout the progression of conception and pregnancy. (1) Studies indicate a potential association between maternal hypomagnesemia and adverse pregnancy outcomes such as preeclampsia and fetal growth restriction, fetal neurodevelopment and long-term cardiovascular health (6-9).

Pregnancy, due to its high demand of Magnesium has been recognized as one of the most common causes of magnesium deficiency, other causes may include inadequate dietary intake or gastrointestinal absorption, loss through the gastrointestinal or renal system (10).

The rate of low magnesium levels in pregnancy varies significantly between regions, shaped by dietary practices, socioeconomic factors, and healthcare access. Researches from low- and middle-income countries showed that deficiencies are highly prevalent, with rates reaching up to 78%. This high prevalence is attributed to inadequate dietary intake, poor nutritional education, and limited access to prenatal cares or supplements (11).

In contrast, high-income countries generally report lower prevalence rates due to better healthcare access, including prenatal supplementation and fortified diets (11). The relationship between maternal demographics such as age, parity, and socioeconomic status with serum magnesium levels during pregnancy remains a topic of debate. As in some researches it has been found that no meaningful differences in magnesium levels across different maternal ages, parities, or socioeconomic statuses noted, suggesting that these factors might not be universally equally affecting the magnesium level. These discrepancies could arise from variations in population characteristics, study designs, and cutoff values for defining hypomagnesemia (12-16).

Such conflicting findings regarding the prevalence rate any associated factors

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in relation to magnesium level during pregnancy underline the need for more extensive, standardized research to clarify these associations. Understanding these dynamics is essential for improving maternal and neonatal outcomes and tailoring interventions to populations most at risk.

This study was conducted to determine the prevalence of hypomagnesaemia in pregnant women attending a tertiary public hospital and any maternal associated factor in relation to magnesium levels.

Patients and Methods

Study design and setting: The current study designed as a cross-sectional study, in which serum magnesium level during pregnancy investigated on 930 pregnant women. The study duration was one year which carried out at the 3rd of January 2023 to the 3rd of January 2024 at outpatient clinic of Maternity Teaching Hospital in Erbil city, Kurdistan region, Iraq.

Power of sample size estimation:

The Epi Info7 computer program (Available from: https://www.cdc.gov/epiinfo/support/downloads.html) was used to estimate the sample size. The following information was entered into the program: The prevalence of Magnesium deficiency was set at 16.25% (15), the degree of absolute precision was set at 2.5%, and the confidence level was set at 95%. Accordingly, the estimated sample size was 836, for convenience 930 cases were taken.

Inclusion criteria: The study included healthy pregnant women aged 18 years or older who provided informed consent.

Exclusion criteria: The current use of magnesium supplements or other supplements, peptic ulcer disease treated with magnesium-containing antacids, multiple pregnancy, pre-existing diabetes, chronic hypertension, chronic kidney disease, sickle cell anemia, intrauterine growth restriction, immune deficiency diseases, or refusal to provide consent.

Data collection:

The study conducted on healthy pregnant women who visited the outpatient in maternity teaching hospital in Erbil city in their routine visits were interviewed by the researcher after explaining the aim of the study and insuring confidentiality. Data were collected utilizing an explicit English questionnaire designed and provided information about age, occupation (categorized in to: unskilled manual worker, semi-skilled manual worker, skilled manual and non-manual, assisted professional, skilled professional or senior manager and unemployed, education level (categorized into: illiterate, primary,

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intermediate, high school, diploma, college).

The calculation of gestational age was based on the first day of the last menstrual period, with confirmation provided by early first-trimester ultrasonography. Participants were then stratified into the three trimesters of pregnancy: first (≤13 weeks), second (14-26 weeks), and third (27-40 weeks). Pre-pregnancy weight of the women was recorded in kilogram.

Estimation of Magnesium Levels:

Blood samples were collected from pregnant women at the outpatient clinic of Maternity Teaching Hospital and subsequently transported to a private laboratory. Serum magnesium concentrations (mg/dL) were estimated using end-point colorimetric method by COBA Mira Roche Diagnostic System Analyzer.

Reference ranges for magnesium levels were established as follows:

Non-pregnant: 1.5 to 2.3 mg/dL

First trimester: 1.6 to 2.2 mg/dL

Second trimester: 1.5 to 2.2 mg/dL

Third trimester: 1.1 to 2.2 mg/dL

Magnesium levels for each participant were then compared to the trimester-specific reference ranges to determine their magnesium status (16-18).

Statistical analysis: Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 25). The chi-square test of association was used to compare the proportions of two or more groups. Fisher's exact test was used (instead of the chi-square test) when the expected frequency (value) was less than 5 of more than 20% of the table's cells. The Kruskal-Walli's test was used to compare the mean ranks of three groups. The normality of data was checked using the Shapiro-Wilk test; accordingly, non-parametric tests were used when indicated. A P-value of ≤0.05 was considered statistically significant.

Ethical approval: The study protocol was approved by the research ethics committee/college of medicine/Hawler medical university on June 27, 2022. Participant autonomy was ensured through a comprehensive informed consent process, and strict measures were implemented to maintain data confidentiality. All applicable regulations regarding ethical research practices were adhered to.

Results

The total number of women participated in this study was 930. The mean serum magnesium level was 1.86±0.22mg/dl, the median was 1.88mg/dl, and the range was 0.47-2.7 mg/dl.

Results showed that 40 women (4.3%) had hypomagnesemia, and only 3.3% had hypermagnesemia (Figure 1).

The prevalence of hypomagnesemia was 7.4% in the first trimester,

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decreased to 5% in the second trimester, and then to 1% in the third trimester as presented in Table 1.

The more the gestational age, the less the serum magnesium level. The mean magnesium of women in the first trimester was significantly higher than that of the second trimester, and that of the third trimester, as presented in Table 2.

Table 1. Prevalence Of Hypomagnesemia by Trimester

	Low	Normal and high	Total	
Trimester	**No. (%)**	**No. (%)**	**No. (%)**	**P-value***
First	28 (7.4)	352 (92.6)	380 (100.0)	
Second	8 (5.0)	153 (95.0)	161 (100.0)	
Third	4 (1.0)	385 (99.0)	389 (100.0)	<0.001*
Total	40 (4.3)	890 (95.7)	930 (100.0)	

*Calculated by Chi-Square test

Table 2. Means Of Serum Magnesium Level by Trimester

	N	Mean Mg mg/dl	(SD)	P*	Trimesters	P-value **
First trimester	380	1.89	(0.21)		1st X 2nd	0.034
Second trimester	161	1.85	(0.22)	< 0.001	1st X 3rd	<0.001
Third trimester	389	1.84	(0.22)		2nd X 3rd	0.428
Total	930	1.86	(0.22)			

*Calculated by Kruskal Wallis. **Calculated by post-hoc test (Bonferroni).

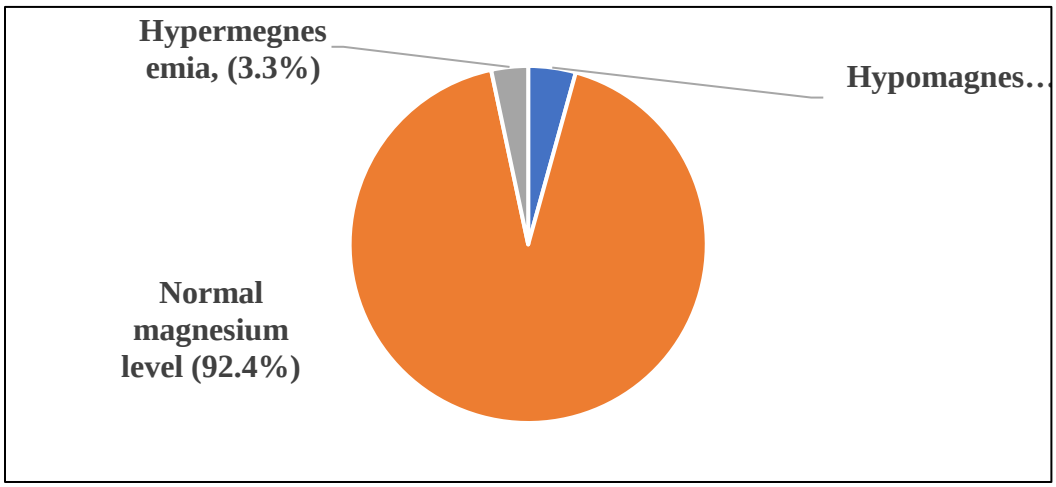

Figure 1. Distribution of Magnesium status among study samples

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Hypomagnesemia prevalence peaked at 5.6% in women weighing 70-79 kg and again in those weighing 90 kg or more, with a low of 2.2% in the 80-89 kg group. However, these differences were not statistically significant. Hypomagnesemia was not significantly associated with either educational level or occupation (Table 3).

Table 3. Prevalence Of Hypomagnesemia by Women's Weight, Educational level, And Occupation

	Magnesium level			
	Low No. (%)	**Normal and High No. (%)**	**Total No. (%)**	**P-value**
Weight (kg)				
<70	16 (4.6)	335 (95.4)	351 (100.0)	
70-79	13 (5.6)	218 (94.4)	231 (100.0)	
80-89	5 (2.2)	227 (97.8)	232 (100.0)	
≥ 90	6 (5.2)	109 (94.8)	115 (100.0)	0.276*
Educational Level				
Illiterate	6 (2.5)	238 (97.5)	244 (100.0)	
Primary	15 (5.7)	248 (94.3)	263 (100.0)	
Intermediate	0 (0.0)	71 (100.0)	71 (100.0)	
High school	10 (6.0)	157 (94.0)	167 (100.0)	
Diploma	0 (0.0)	13 (100.0)	13 (100.0)	
College	9 (5.3)	161 (94.7)	170 (100.0)	
Master	0 (0.0)	2 (100.0)	2 (100.0)	0.145**
Occupation				
Unskilled manual worker	0 (0.0)	7 (100.0)	7 (100.0)	
Semi-skilled manual worker	1 (10.0)	9 (90.0)	10 (100.0)	
Skilled manual and non-manual	2 (9.50	19 (90.5)	21 (100.0)	
Assisted professional	1 (1.8)	54 (98.2)	55 (100.0)	
Skilled professional or senior manager	1 (9.1)	10 (90.9)	11 (100.0)	
Unemployed	35 (4.2)	791 (95.8)	826 (100.0)	0.281**
Total	40 (4.3)	890 (95.7)	930 (100.0)	

*Calculated by the chi-square test. **Calculated by Fisher's exact test.

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Discussion

Maintaining optimal magnesium levels during pregnancy is important, as its concentrations are associated with adverse neonatal outcomes. This emphasizes the importance of magnesium monitoring to ensure levels remain within a safe and healthy range throughout gestation (18).

Current study of 930 pregnant women found that serum magnesium levels decreased as pregnancy progressed ranging from 1-7.4%, with hypomagnesemia being most prevalent in the first trimester.

This contrasts sharply with findings from a 2021 study, which reported significantly higher hypomagnesemia rates of 34.0% and 78.9% using different serum magnesium cut-off values. This discrepancy highlights the potential impact of differing study populations, diagnostic thresholds, and other methodological variations on observed prevalence (19).

The present study revealed that women in the 70-79 kg weight range had the highest hypomagnesemia prevalence reinforces Zhao et al.'s (2020) findings on the relationship between body weight and magnesium metabolism. This suggests that weight may play a significant role in magnesium deficiency, potentially through dietary habits or absorption problems, which could be managed with specific nutritional therapies (20, 21). While our study suggests a relatively low and statistically non-significant variations across weight ranges, (Orlova et al., 2021) research underscores the potential for substantially higher rates of hypomagnesemia in pregnant women, reinforcing the critical need for consistent magnesium monitoring throughout gestation, regardless of weight. Further research is necessary to elucidate the factors contributing to these variations and establish more definitive guidelines for magnesium assessment during pregnancy (19).

The current study, observed no significant association between socioeconomic status and magnesium levels during pregnancy. This finding differs with the results of Anand et al., (2022), who investigated serum magnesium levels in preterm labor and their relationship to socioeconomic factors. Their study manifested that lower maternal serum magnesium levels were associated with both preterm labor and poor socioeconomic status, suggesting that socioeconomic states may influence magnesium levels during pregnancy. This discrepancy may be attributed to differences in study populations, such as the inclusion of women with preterm labor, or variations in the definition and assessment of socioeconomic status. Further investigation into the complex interplay between socioeconomic factors and magnesium homeostasis during gestation is indicated (20).

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The fact that a large portion of prenatal facilities are providing inadequate nutritional education (22), indicates a necessity for enhanced education. Therefore, magnesium supplementation or a magnesium rich diet should be recommended during pregnancy to help prevent nutritional deficiencies (15).

Furthermore, randomized controlled research conducted by Zarean and Tarjan (2017), discovered that taking magnesium supplements while pregnant may lower the chances of experiencing a number of issues during pregnancy (23).

Conclusion

This study revealed that hypomagnesemia was infrequent in pregnant women, and was not linked to education, socioeconomic status, or body weight.

Competing interest

The authors declare that they have no competing interests.

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