Iraqi Journal of Natural Sciences and Nanotechnology IJNSN

Al-Sibd Center for Research and Scholarly Publishing

Journal Homepage : https://publications.srp-center.iq/index.php/ijn

Clinical Study and Comparison of Magnesium and Antioxidants Between Mothers and Neonate by ICP-OES and Elisa Technique in Basrah Southern of Iraq

Athraa M. Ali*, Iqbal J. Alassadi , Hassan T. Abdulsahib

Department of Chemistry, College of Science, University of Basrah, Basrah, Iraq

Corresponding Author: khalidhassan.123@gmail.com

Keywords:
Maternal–neonate medicine;
Magnesium;
TAOC; MDA.
Elisa; ICP-OES.

Abstract

The extent and clarity of the putative maternal and neonatal antioxidant effects related to magnesium intake during pregnancy are currently restricted. Objectives: The primary objective of this research is to investigate the potential correlations between levels of magnesium exposure in maternal and cord serum. Additionally, the study sought to explore any potential links between maternal magnesium exposure levels and neonatal outcomes. The research was carried out in the urban area of Basrah, spanning from March 2022 to July 2022, including two distinct cohorts.: the first was the mother and the second was the neonate. The study included measuring the mother's magnesium concentration, total antioxidant capacity (TAO), and the oxidant malonaldehyde (MDA), and comparing it to the umbilical cord blood, which represents the blood of the newborn. The results indicated that the concentration of (TAO) in the mother is higher than that in the neonate, while the concentration of magnesium in the neonate is higher than its concentration in the mother. Magnesium status is relevant to neonate growth during pregnancy and newborn growth during the perinatal period. Furthermore, magnesium is able to influence neonate programming and disease presentation in childhood or adulthood. In order to study its role in neonate health, this review focuses on the balance of this mineral, analyse its normal values, the causes of hypomagnesemia that causes increased (MDA), and the diseases associated with changes in the value of magnesium during pregnancy. The data presented here clearly indicate an association between magnesium status and disease that begins in utero and extends into childhood and adulthood.

Introduction

Oxidative stress is a detrimental phenomenon that has the potential to cause harm to many cellular components. Oxidative stress is a significant contributor to the pathogenesis of chronic and degenerative ailments, including but not limited to cancer, arthritis, ageing, autoimmune disorders, cardiovascular illnesses, and neurological disorders. The human body has many physiological mechanisms to mitigate the detrimental effects of oxidative stress via the synthesis of endogenous antioxidants. These antioxidants may be generated internally or obtained from external sources such as dietary intake or supplementation [1]. The primary functions of antioxidants include the mitigation of excessive free radicals, safeguarding cellular structures against their detrimental impacts, and aiding in the prevention of various diseases [2]. The antioxidant process may operate via one of two mechanisms: the concept of chain-breaking or prevention has been discussed in the literature [3]. Biomarkers associated with oxidative stress Malondialdehyde (MDA) is a compound that serves as a biomarker for oxidative stress. Trace elements, such as magnesium, play a crucial role in human nutrition, especially during intrauterine development. Insufficient levels of magnesium in bodily tissues can have detrimental effects on fetal weight at birth. This has been supported by studies conducted by [4,5,6]. During pregnancy, there is an increased need for magnesium; yet, a significant proportion of pregnant women fail to fulfil this heightened demand. Hypomagnesemia is a commonly recognized condition in pregnant women, occurring with notable frequency in both developing and industrialized nations. The occurrence of magnesium deficiency during pregnancy has been linked to increased health risks for both the mother and the newborn. These risks include restricted fetal growth, intrauterine growth restriction, gestational diabetes, preterm labour, and symptoms such as calf muscle cramps, neuromuscular disorders, enhanced uterus contractions, and pre-eclampsia. Insufficient magnesium consumption during pregnancy may potentially have significant implications on long-term health outcomes, including the development of metabolic syndrome in later stages of life. To mitigate the potential negative consequences, it is advisable to provide pregnant women with guidance on augmenting their consumption of foods rich in magnesium, such as legumes, nuts, seeds, leafy vegetables, or including magnesium supplements into their dietary regimen. Based on the available evidence, it is suggested that magnesium might play a significant role in the "neonate origin" theory of several human disorders, such as the susceptibility to developing metabolic syndrome throughout infancy or adulthood [6,7,8]. The study examines the alterations in blood concentrations of magnesium and total antioxidant capacity (TAC) in both maternal and neonatal subjects, as well as the variations in serum levels. The identification and measurement of biomarkers is associated with oxidative stress. Malondialdehyde (MDA) is a chemical compound that is often used as a biomarker for oxidative stress and lipid per Zinc. It is a crucial micronutrient for the human body that plays a vital role in facilitating optimal bone development and participates in several intracellular enzymatic mechanisms. Magnesium has been recognized for its significance in the field of obstetrics, as it serves as a vital ingredient for the overall health and development of the neonate. There is a potential correlation between magnesium deficiency and the occurrence of pre-eclampsia, pre-term delivery, and low birth weight. According to a study conducted by [9], there is evidence to suggest that a lack of magnesium during pregnancy has a substantial impact on the death and morbidity rates of newborns. The findings of the current research indicate that the assessments of blood magnesium across the three trimesters of pregnancy demonstrated a modest decline in serum magnesium levels during the second trimester. However, this decline did not reach statistical significance. A comparable outcome was documented in Argentina. In general, a decrease in blood magnesium levels during the second trimester of pregnancy may be attributed to factors such as haemodilution, renal clearance changes that occur throughout pregnancy, and the utilization of minerals by the developing foetus [4,10].

Materials and Methods

A total of 108 pairs consisting of mothers and neonates were included in the study, all of whom sought care at the Basra Maternity Hospital during the months of March 2022 and July 2022. The age range of the individuals varied from 16 to 42 years. The research included exclusion criteria for women with several forms of infertility, including tubal obstruction, male infertility, endocrine disorders such as thyroid condition, adrenal disorder, diabetes mellitus, and pituitary disorder. A volume of three milliliters of venous blood was obtained using vacuum tubes containing gel/clot activator. The collected blood samples were then allowed to stand at room temperature for a duration of one hour to facilitate the development of clots. Following centrifugation at a speed of 2000rpm for a duration of ten minutes, the serum was carefully aspirated and then distributed into sterile tubes. The tubes were then kept at a deep freeze temperature. The repetition of freezing and thawing in the context of serological research immunoassay was avoided. The levels of total antioxidant (TAO) and malonaldehyde (MDA) in blood were evaluated using the competitive inhibition enzyme immunoassay method, specifically the enzyme-linked immunosorbent assay (ELISA). Moreover, the content of the trace element magnesium (Mg) was determined using inductively coupled plasma optical emission spectroscopy (ICP-OES). Various techniques were used to investigate the correlations between magnesium exposure variables during pregnancy and maternal antioxidant measures. Besides, multiple linear regression analyses were conducted to explore the relationships between magnesium exposure during pregnancy and newborn antioxidant parameters. SPSS analyses were used to investigate the impacts of exposure to metal combinations, namely arsenic, mercury, cadmium, and selenium. The findings of the study are shown as follows: The geometric averages of magnesium exposure levels throughout the ninth month of pregnancy were (1.11±0.50 µg/L) and (1.02±0.48 µg/L) in cord serum. The geometric means of maternal levels of (TAO) and (MDA) during the third trimester were (15.89±10.65 U/ml) and (410.88±369.91 Pg/mL), respectively. In cord serum, the geometric means of TAO and MDA levels were (13.89±18.49 U/ml) and (417.96±356.28 Pg/mL), respectively.

Statistical analysis

Pearson and multiple linear regression analysis used to assess relationships between TAC,MDA and Mg and its related factors. The Statistical Package for Social Sciences version 20 used for data analysis, and considered a p-value <0.05 as significant

Results and discussion

All female participants in this research were less than 43 years of age. The present findings indicate a substantial proportion of pregnant women within the age range of 16-42 years, accounting for around 50.0%. The findings of a new research are inconsistent with several reviews that acknowledged pregnant ladies. A prior conducted investigation [11] has shown that there was a greater age seen among pregnant women as well as in the umbilical cord. According to the study conducted by [12], it was found that... As shown in table 1 and table 2. The quantities of total antioxidant capacity (TAO) were measured in the blood of both mothers and neonates using the enzyme-linked immunosorbent assay (ELISA), as shown in table 3 and figure 1. The group of neonates had the lowest level of total antioxidant capacity (TAO) at (13.89±18.49), while the group of mothers had the greatest level at (15.89±10.65). However, this difference was not statistically significant, as shown by (p-value=0.33). The study conducted by [13] revealed a noteworthy decrease in total TAO during pregnancy, with statistical significance (p-value < 0.001). A reduction in total antioxidant capacity (TAO) may suggest an impairment in the antioxidant system which is maybe caused by a decrease in specific antioxidants. When doing a review of existing literature, one encounters publications that lack definitive findings. In a study conducted by [5], the findings indicated that habitual abortion is influenced by systemic oxidative stress with lipid peroxidation being a significant expression of this process. This occurs when both the mother and conceptus rely on a restricted availability of trace elements and vitamins. The presence of these impairments will result in a relative functional insufficiency of thioredoxin reductase, a crucial mechanism required for the proper functioning of RNA and DNA. The number 8. Furthermore, these inadequacies may contribute to heightened oxidative stress during pregnancy, potentially resulting in the development of preeclampsia and eclampsia. The number 8. Consequently, oxidative stress will result in heightened activation of the antioxidant system and a diminished degree of overall antioxidant capacity. This elucidates the rationale for the observed reduced total antioxidant capacity (TAO) levels in our cohort of pregnant women. There are several ramifications associated with diminished antioxidant systems during pregnancy. The potential correlation between diminished levels of antioxidants and decreased placental efficiency and calcification warrants further investigation. The number 12 is the subject of discussion. Additionally, it has the potential to induce fetal deformity, contribute to pregnancy problems such as preeclampsia and eclampsia, and exacerbate obstructive conditions [14]. The statistical analysis shown in table 4 and figure 2 demonstrates the enzyme-linked immunosorbent assay (ELISA) that was used to identify the amounts of MDA in the blood samples obtained from both the mother and the foetus. The group of neonates exhibited the greatest level of (MDA) (417.96±356.28 Pg/l) compared to the group of mothers, which had the lowest level (410.88±369.91 Pg/l). However, this difference was not statistically significant (p-value = 0.88). The present investigation, which is in agreement with the previous clinical studies [5], demonstrates that patients had substantially elevated levels of the oxidative stress biomarker (MDA) in circulation compared to the control group ($p<0.05$). Preterm birth, defined as delivery occurring before to 37 weeks of gestation, is associated with increased rates of infant death and morbidity. The majority of preterm births are of spontaneous nature. Spontaneous premature Laboure, also known as preterm premature rupture of membranes (PROM), is initiated by the rapid ageing of the placenta due to oxidative stress. This oxidative stress leads to damage in the intrauterine tissue, particularly the neonate membranes originating from the placenta. Moreover, it results in a malfunction in the vascular, endocrine, and immunological systems [15]. Preterm birth has been shown to be associated with reactive oxygen species (ROS), which contribute to an imbalance in redox homeostasis, characterized by an altered equilibrium between pro-oxidants and antioxidants. According to preterm, delivery is associated with elevated levels of oxidation metabolites, including malondialdehyde, in both the placental and maternal blood [16]. Additionally, there is a concurrent reduction in antioxidant levels, including GSH, selenium, and GSH-T, in comparison to term birth. The topic of interest pertains to the concentration of magnesium. In comparing the levels of magnesium (Mg) between two groups, namely women and their children, it was observed that the highest level was found in the neonate group (1982.69±398.47 µg/ml). On the other hand, the lowest level was found in the mother group (1895.71±435.81 µg/ml). This difference was found to be statistically significant, with a (p-value of ≤0.001), as indicated in the statistical analysis presented in table (5). In a recent clinical investigation conducted by [17], it was discovered that the decrease in magnesium (Mg) levels seen during pregnancy may be attributed to inadequate water consumption as a prevalent occurrence. This phenomenon has a similar impact to that of excessive sodium intake, leading to heightened excretion of Mg in order to elevate the salinity of urine. The present study aligns with earlier research in supporting this assertion. In addition to other clinical research, it is advisable to only investigate the use of magnesium sulphate for neonate neuroprotection in women who are experiencing impending preterm delivery at a gestational age of less than 30 weeks. According to the aggregated results of several studies used in this meta-analysis, it is advisable to begin therapy by administering an intravenous loading dose of 4–6 g of magnesium sulphate, followed by a subsequent maintenance dose ranging from 1–3 g. Diverse timing of delivery was observed including both bolus and extended durations lasting between 10 and 30 minutes. The use of magnesium sulphate during the antenatal period resulted in a decreased likelihood of mortality or the development of cerebral palsy, as well as the inability to ambulate without help at the age of 2 years. In recent research conducted by [18], the focus was on investigating the significance of magnesium in pregnancy and its potential impact on the neonate programming of adult diseases. The acceptability of certain actions or behaviours is a subject of consideration. In the present research, a correlation analysis was conducted to examine the relationship between trace elements and two variables, Total Antioxidant Capacity (TAO) and Malondialdehyde (MDA). The results indicated that there was a significant association between Cadmium (Cd) and TAO. However, no significant differences were identified between other trace elements and both (TAO) (MDA), as shown by p-values greater than 0.005. Recent research has revealed a significant reduction in the levels of certain trace elements and magnesium among pregnant women, in comparison to the control group represented by the umbilical cord. This observation implies a potential association between magnesium and the aetiology and progression of preeclampsia. Nevertheless, it is important to interpret the outcome. The found decrease in trace element levels may be attributed to dietary insufficiencies. Nevertheless, our findings align with the research conducted fawett and hax in1999 which observed a decrease in zinc levels among women diagnosed with eclampsia. Additionally, established a correlation between magnesium shortage and the occurrence of pre-eclampsia. However, it is important to interpret these results cautiously. This is because we did not analyse the dietary factors [19,20].

Table 1:Summary of the Age Residence and fetus weight distribution of the studied groups

Parameters		Study Groups		
		Mother		
		N	%	Mean±Sd
Age (years)	16-25	54	50.0	26.60±6.66
	26-35	38	35.1	26.70±6.58
	≥35	16	14.9	26.79±6.85
	Total	108	100.0	
Mean age ± SD* (yrs.)		26.79±6.85		

Residence	Rural	63	58.4	
	Urban	45	41.6	
Child weight	≤2.5 kg	4	3.70	3.05±0.42
	3 kg	94	87.05	3.04±0.41
	4kg	10	9.25	3.09±0.41

Table 2; Summary of the total concentration of antioxidant and magnesium according to age distribution in study group.2

Parameter		**Mother Age groups (Years)**			**P-value**
TAO	**N**	**54**	**38**	**16**	**0.08**
	M±SD	**13.66±10.77**	**17.92±10.03**	**18.88±10.32**	
MDA	**N**	**54**	**38**	**16**	**0.1**
	M±SD	**429.70±351.36**	**317.65±373.72**	**543.09±394.36**	
Mg	**N**	**54**	**38**	**16**	**0.78**
	M±SD	**1873.29±409.92**	**1900.68±524.50**	**1959.56±276.24**	

The highest concentration observed that (TAO), (MDA) and (Mg) frequency were mostly founded at (>35) ages, case group with (n= 16), while as shown in table (2)

Table 3: Summary of the Total concentrations of (TAO) in mothers and neonate

TAOC concentration (U/ml)		**P-value**
Mothers	neonate	
15.89±10.65	13.89±18.49	0.33

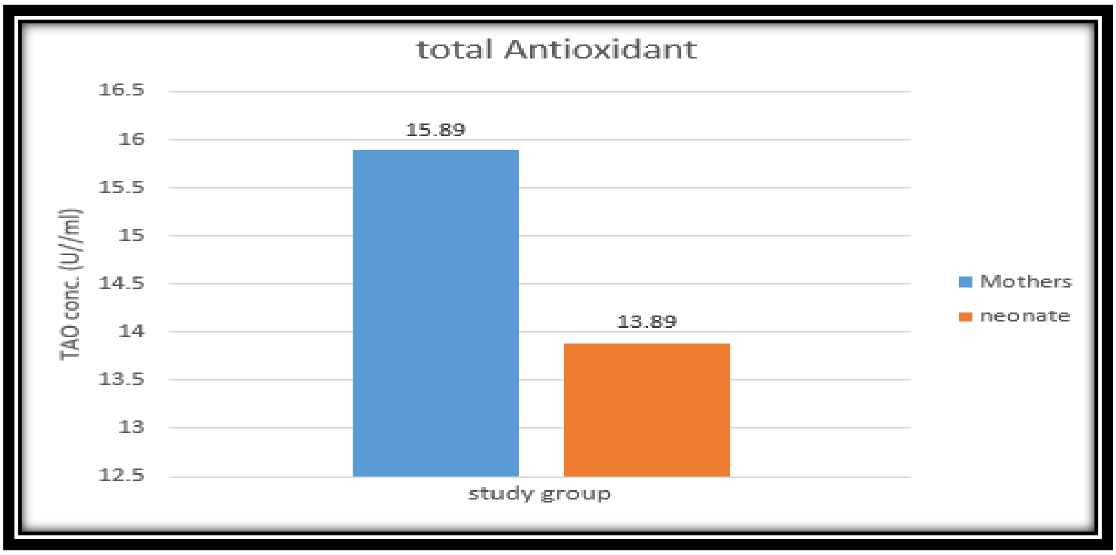

Figure -1 This figure depicts a concentration of (TAO) level among the (mothers) and (neonate)

The concentrations of antioxidant (TAO) were detected from serum of mother and fetus by ELISA Technique. Among the two groups of women, the highest percent of (TAO) level was found in the group (mother) of (15.89±10.65 U/ml), while the lowest percent was found in neonate group, (13.89±18.49 U/ml), statistically this difference was non –significant.

Table 4: Summary of the Total concentrations of MDA in mothers and neonate

MDA concentration (Pg/ml)		**P-value**
Mothers	neonate	
410.88±369.91	417.96±356.28	0.88

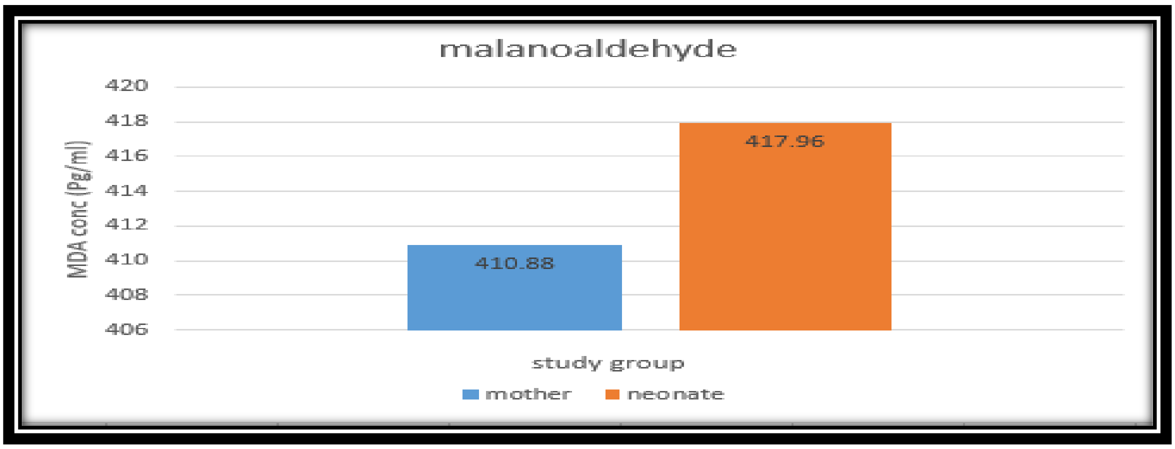

Figure -2 This figure depicts a concentration of (MDA) level among the (mothers) and (neonate)

The concentrations of Arsenic were detected from serum of mother and fetus by Elisa Technique. Among the two groups of women, the highest level of (MDA) was found in the group mother of (417.96±356.28 Pg/ml), while the lowest level was found in mother group, (410.88±369.91 Pg/ml), statistically this difference was non–significant P-value (0.88).

Table 5: Summary of the Total concentrations of (Mg) in mothers and neonate

Mg concentration (µg/L)		P-value
Mothers	neonate	
1895.71±435.81	1932.69±398.47	≤0.001

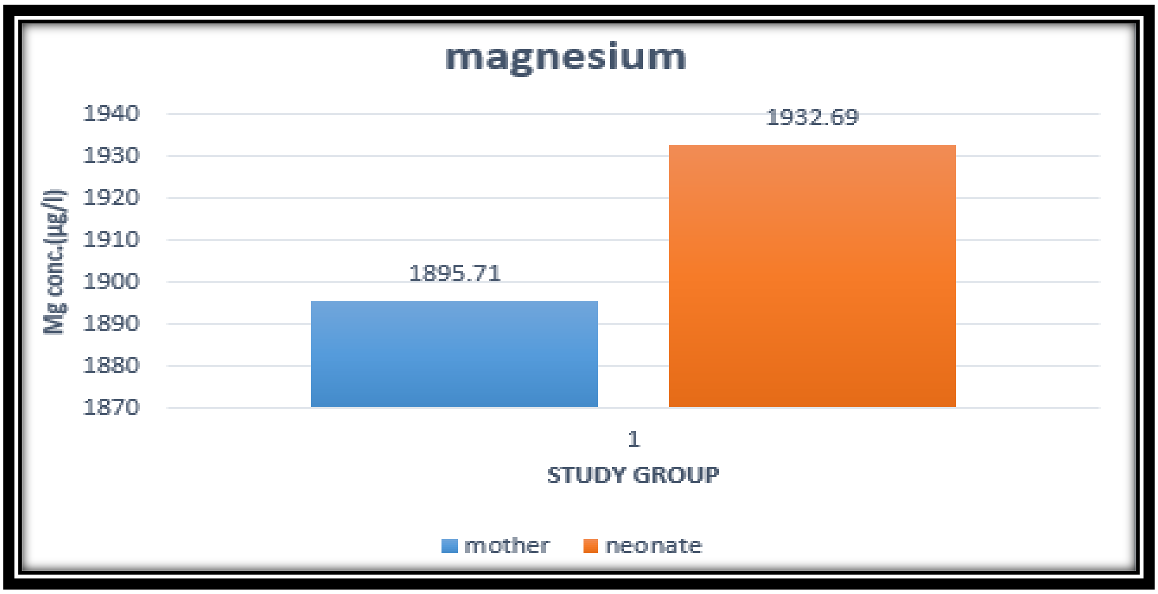

Figure -3 This figure depicts a concentration of (Mg) level among the (mothers) and (neonate)

The concentrations of Magnesium were detected from serum of mother and fetus by ICP-OES spectroscopy Technique. Among the two groups of women compared with their child group, the highest level of (Mg) was found in the group (neonate) of (1982.69±398.47 µg/l), while the lowest level was found in mother group, (1895.71±435.81 µg/l), statistically this difference was highly – significant **P-value (≤0.001)**

Correlation Analysis

Table 6: Summary of the correlation between TAO, trace element (Mg)

		Mg
TAOC	r	-.031*
	P-value	.655
	N	216

*Correlation is non-significant at P-value >0.05

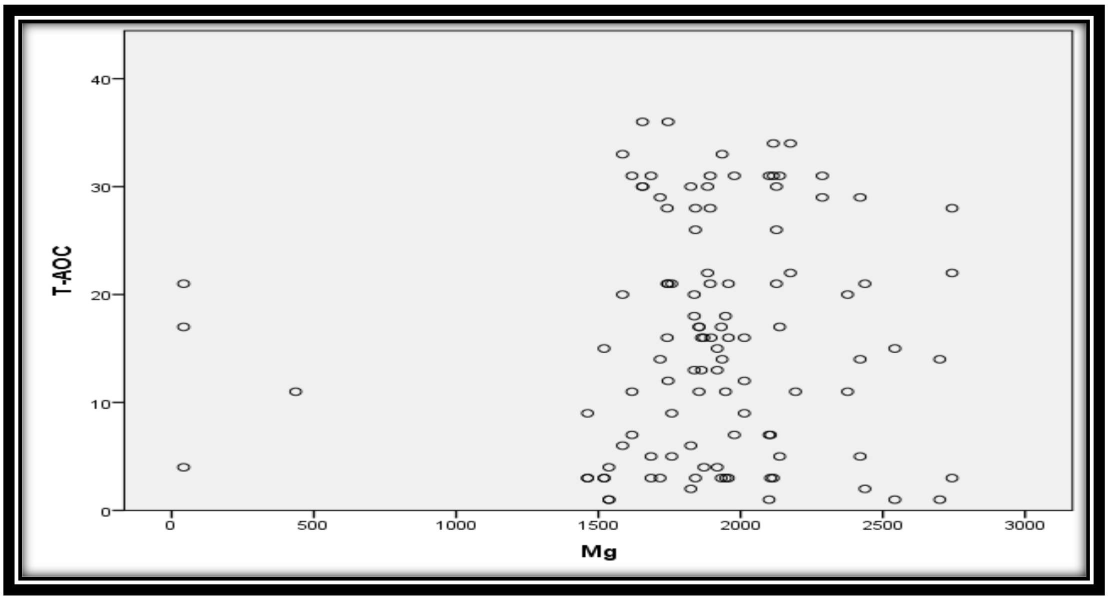

Figure -4 This figure depicts a correlation of (TAO) and (Mg)

The correlation analysis among parity all parameter (TAO) and (Mg) in all studies pregnant female performed and precented in table (6) both serum (TAO) and (Mg) showed significant negative correlation with parity (r -.031, P0.655) respectively.

Table 7:Summary of the correlation between (MDA) and trace element (Mg).

		Mg
MDA	r	-.134*
	P-value	.049
	N	216

*Correlation is non-significant at P-value >0.05

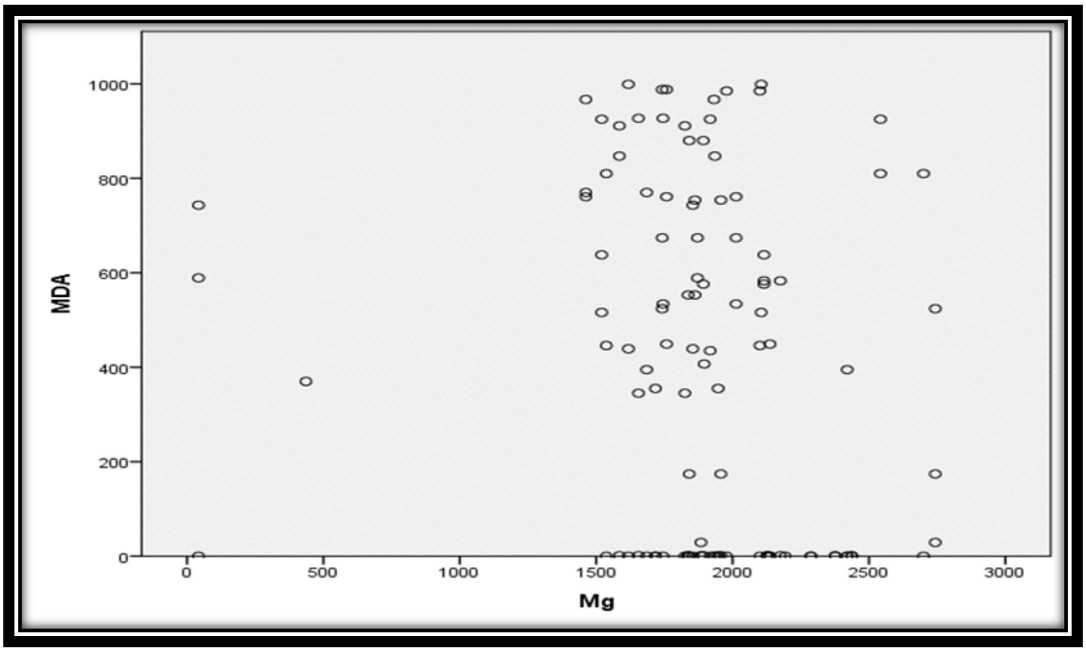

Figure -4 This figure depicts a correlation of (MDA) and (Mg)

The correlation analysis among parity all parameter (MDA) and (Mg) in all studies pregnant female performed and precented in table (7) both serum (MDA) and (Mg) showed significant negative correlation with parity (r -.134, P0.049) respectively.

Conclusion

The findings of our study indicate that there is an elevation in lipid peroxides (MDA) along with a decrease in antioxidant total anti-oxidant capacity (TAO) defense and trace element status (specifically magnesium) in both mothers and neonates. Furthermore, there appears to be a potential interrelationship between these parameters, which may contribute, at least partially, to the development of the observed pathogenesis. The study showed an inverse relationship between gestational age and capacity total antioxidants, and there was a clear relationship in terms of statistics between the mother's age and the antioxidants in the age group is 26-35 years among Iraqi women who are pregnant in the ninth month from pregnancy.

References

[1] Nehaya M. Al-Ubuda1 Lamia M. Al-Naama& Ali H. Al-Hashimi. Profile study of some oxidant and antioxidant levels in leukemic patients. Mini-review . MJBU, VOL 30, No.2, [2022].

[2] Enver Ciraci , Tugba Elgun , Asiye Gok Yurttas , Hazel Cagin Kuzey , Yagmur Ekenoglu Merdan , Muhammed Sait Toprak , Sermin Tetik. Evaluation of serum placenta-specific gene 8 protein, total antioxidant capacity, interleukin-10, interleukin-17A, interleukin-21 and interleukin-33 levels in Turkish women with gestational diabetes mellitus. 4 January [2024].

[3] Daniela Saes Sartorelli, Mariana Rinaldi Carvalho, Izabela da Silva Santos, Lívia Castro Crivellenti, João Paulo Souza & Laércio Joel Franco. Dietary total antioxidant capacity during pregnancy and birth outcomes. Volume 60, pages 357–367, [2021].

[4] Komiya Y, Su L-T, Chen H-C, Habas R, Runnels LW. Magnesium and embryonic development. Magnes Res. 2014;27:1–8. doi: 10.1684/mrh.0356.[2014].

[5] Jamal Abdul-Barry, Sajda A. Al-Rubai, Qutaiba A. Qasim. study of oxidant-antioxidant status in recurrent spontaneous abortion hi-Qar Medical Journal (TQMJ): Vol(5) No(1):(35-46).[2011].

[6] Mohammad Tinawi. Disorders of Magnesium Metabolism: Hypomagnesemia and Hypermagnesemia; Vol. 4 No. 3 – June [2020].

[7] Tinawi M. Hypertension in Pregnancy. Arch Intern Med Res . 3 (1): 10-17.[2020].

[8] Osama Omar Yousif , Mea'ad Kadhum Hassan & Lamia Mustafa Al-Naama. Red Blood Cell and Serum Magnesium Levels Among Children and Adolescents With Sickle Cell Anemia. Biological Trace Element Research · December 2018

[9] Daniela Fanni,corresponding author C. Gerosa,V. M. Nurchi, M. Manchia,L. Saba, F. Coghe, G. Crisponi, Y. Gibo,P. Van Eyken, V. Fanos,and G. Faa. The Role of Magnesium in Pregnancy and in Fetal Programming of Adult Diseases. Published online: Biological Trace Element Research , 199:3647–3657[2021].

[10] Saja Muhanad Bayram, Lina A. Salih, Samia. A. Eleiwe. Study the correlation between Human Chorionic Gonadotropin Hormone and Some Biochemical Parameters in Iraqi Women with PregnancyInduced Hypertension." Iraqi Journal of Science, 2018, Vol. 59, No.4A, pp: 1786-1791

[11] Anglin Dent , Rajeevan Selvaratnam. Measuring magnesium – Physiological, clinical and analytical perspectives. Volumes 105–106, July–August [2022].

[12] Rahimzadeh, M.R.; Rahimzadeh, M.R.; Kazemi, S.; Moghadamnia, A.A. Cadmium toxicity and treatment: An update. Caspian J. Intern. Med. 8, 135–145[2017].

[13] Mariana Rinaldi Carvalho Lívia Castro Crivellenti Daniela Saes Sartorelli. Estimate of Dietary Total Antioxidant Capacity of Pregnant Women and Associated Factors . Vol. 44 No. 2,[2022].

[14] Elnaz Daneshzad,Hatav Tehrani,Nick Bellissimo,and Leila Azadbakht. Dietary Total Antioxidant Capacity and Gestational Diabetes Mellitus: A Case-Control Study, Article ID 5471316, 9 pages, Volume [2020].

[15] Keskin EA, Avsar AF, et al. Maternal plasma total antioxidant status in preterm labor. Journal of Obstetrics and Gynaecology Research.36(6):1185-8.[2010].

[16] Sen M. , Goenka L. , Jha D. , Raj V. , Charles S. , Mala K. , George M. The Utility of Plasma Transthyretin and Antioxidants as aBiomarker of Early Pregnancy Loss - A Pilot Study. January - March, / Vol 5/ Issue 1,[2019].

[17] Luma M. Tohala. Serum Magnesium and Copper Levels Amongst Pregnant Women in Mosul City. J. Sci., Vol. 23, No.1 pp 68-78, [2012].

[18] Daniela Fanni , C. Gerosa , V. M. Nurchi,M. Manchia,L. Saba,F. Coghe,G. Crisponi,Y. Gibo,P. Van Eyken,V. Fanos,G. Faa. The Role of Magnesium in Pregnancy and in Fetal Programming of Adult Diseases.199:3647–3657.[2021].

[19] David Calderón Guzmán, Norma Osnaya Brizuela, Maribel Ortiz Herrera, Armando Valenzuela Peraza, Ernestina Hernández Garcia, Gerardo Barragán Mejía and Hugo Juarez Olguin . Assessment of the Roles of Magnesium and Zinc in Clinical Disorders. 27 November, [2023].