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(RESEARCH ARTICLE)

Pattern of magnesium, selenium and chromium in pregnant women attending antenatal clinics at Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Ebonyi State, Nigeria

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Abstract

Pregnancy is associated with increased metabolic demands and heightened vulnerability to environmental factors, making adequate micronutrient status essential for optimal maternal and fetal health. This study evaluated the serum concentrations of magnesium (Mg), selenium (Se), and chromium (Cr) among pregnant women. A cross-sectional case-control study was conducted involving 120 pregnant women (test group) and 60 apparently healthy non-pregnant women (control group). Serum concentrations of Mg, Se, and Cr were determined using Atomic Absorption Spectrometry (AAS), while data were analyzed using the Statistical Package for the Social Sciences (SPSS). The results showed that serum Mg (0.661 ± 0.182 mg/L vs. 0.870 ± 0.598 mg/L) and Cr (0.471 mg/L vs. 1.506 ± 0.257 mg/L) concentrations were significantly lower in pregnant women than in the control group ($p < 0.05$). In contrast, serum Se concentration was significantly higher among pregnant women (0.115 ± 0.012 mg/L) compared with non-pregnant controls (0.050 ± 0.018 mg/L; $p < 0.05$). The observed reductions in Mg and Cr suggest increased utilization or altered metabolism during pregnancy, whereas the elevated Se concentration may reflect physiological adaptation or dietary influences. These findings indicate that depletion of Mg and Cr may predispose pregnant women to adverse pregnancy outcomes, including pre-eclampsia and gestational diabetes mellitus. Routine monitoring of trace element status during pregnancy may facilitate early identification of deficiencies and support appropriate nutritional interventions.

Keywords: Magnesium; Selenium; Chromium; Maternal and Fetal Health.

1. Introduction

Pregnancy is a critical physiological state characterized by profound metabolic and hormonal changes that increase the demand for essential nutrients required for maternal adaptation, placental function, and fetal growth and development. Adequate intake and optimal body stores of essential minerals are indispensable for maintaining maternal health and ensuring favorable pregnancy outcomes. Among these, magnesium (Mg), selenium (Se), and chromium (Cr) play important roles in several biochemical and physiological processes that support successful pregnancy.

Magnesium is an essential intracellular cation involved in more than 600 enzymatic reactions, including energy metabolism, protein synthesis, neuromuscular transmission, and muscle relaxation. During pregnancy, magnesium contributes to uterine muscle function, vascular tone regulation, and glucose metabolism. Magnesium deficiency has been associated with pre-eclampsia, gestational hypertension, gestational diabetes mellitus, preterm labour, muscle cramps, and cardiac arrhythmias[1,2]. Similarly, selenium is an essential trace element that forms an integral component of several antioxidant enzymes, including glutathione peroxidases and thioredoxin reductases, which protect maternal and fetal tissues against oxidative stress. Selenium also plays vital roles in thyroid hormone metabolism, immune

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regulation, and fetal neurological development. Reduced selenium status during pregnancy has been associated with miscarriage, preterm birth, impaired fetal growth, and thyroid dysfunction[3-4].

Chromium is another important trace element that enhances insulin action by improving insulin receptor activity and glucose utilization. Adequate chromium status has been linked with improved glucose homeostasis and may reduce the risk of gestational diabetes mellitus, although evidence regarding its physiological role during pregnancy remains limited[5-6]. Collectively, these essential minerals contribute to healthy fetal development, placental function, antioxidant defence, and maternal metabolic homeostasis. Conversely, deficiencies may predispose pregnant women to adverse obstetric outcomes including pre-eclampsia, gestational diabetes mellitus, low birth weight, intrauterine growth restriction, preterm delivery, and increased maternal morbidity[1,2,7].

The nutritional demands of pregnancy are further complicated by physiological adaptations such as haemodilution, increased maternal blood volume, enhanced placental nutrient transfer, and accelerated fetal growth, all of which increase the utilization of essential minerals. In low- and middle-income countries, particularly those in sub-Saharan Africa, these physiological demands are frequently superimposed on poor dietary intake and limited access to micronutrient-rich foods, thereby increasing the likelihood of maternal micronutrient deficiencies[8].

In Nigeria, deficiencies of essential minerals remain a significant public health concern among pregnant women. Poverty, household food insecurity, inadequate dietary diversity, and limited access to nutrient-rich foods such as dairy products, nuts, seafood, whole grains, fruits, and green leafy vegetables contribute substantially to poor maternal nutritional status. Pregnancy-related symptoms, including nausea, vomiting, and food aversions, further reduce dietary intake, particularly during the first trimester[9]. In addition, cultural beliefs and food taboos that discourage the consumption of certain nutritious foods during pregnancy may further compromise maternal micronutrient intake[10]. Low birth preparedness, inadequate antenatal attendance, and delayed healthcare-seeking behavior also increase the likelihood of poor pregnancy outcomes[11]. Consequently, deficiencies of magnesium, selenium, and other trace elements remain common among pregnant women, particularly in resource-limited settings[2,3,8].

Nigeria continues to experience one of the highest maternal mortality burdens globally. Although the maternal mortality ratio declined slightly from approximately 1,047 per 100,000 live births in 2020 to 1,020 per 100,000 live births in 2022, the country still contributes nearly one-third of global maternal deaths[12]. High rates of grand multiparity, teenage pregnancy, and home deliveries further contribute to adverse maternal and fetal outcomes within the region[13-15].

Although several studies have evaluated maternal micronutrient deficiencies during pregnancy, most have focused on iron, zinc, folate, and calcium, while comparatively little attention has been given to magnesium, selenium, and chromium, particularly among pregnant women in southeastern Nigeria. Therefore, this study was designed to determine the serum concentrations of magnesium, selenium, and chromium among pregnant women attending antenatal clinic in Ebonyi State, Southeastern Nigeria.

2. Materials and Methods

2.1. Study Design and Study Population

This was a hospital-based cross-sectional case-control study conducted at the antenatal clinic of Alex Ekwueme Federal University Teaching Hospital, Abakaliki (AEFUTHA), Ebonyi State, Nigeria. The study was designed to evaluate the serum concentrations of magnesium (Mg), selenium (Se), and chromium (Cr) among pregnant women and compare them with those of apparently healthy non-pregnant women.

A total of 180 participants were recruited, comprising 120 pregnant women (test group) selected by simple random sampling and 60 apparently healthy non-pregnant women (control group). Five milliliter (5 mL) of venous blood was collected aseptically from each participant using standard venipuncture techniques into plain sample containers. The blood samples were allowed to clot at room temperature and centrifuged to obtain serum. The separated sera were stored at −80°C until magnesium, selenium, and chromium the time of analysis.

2.2. Inclusion Criteria/Exclusion criteria

The study included pregnant women attending the antenatal clinic of Alex Ekwueme Federal University Teaching Hospital, Abakaliki, without history of gestational diabetes mellitus, chronic hypertension, renal disease, thyroid disease, hepatic disease, on supplements or any other herbal extract that could affect minerals were included in the test group. Only apparently healthy age-matched non pregnant women living within the same community were included as the control group.

2.3. Laboratory Analysis

Serum concentrations of magnesium (Mg), selenium (Se), and chromium (Cr) were determined using Atomic Absorption Spectrometry (AAS) as described by[16]

2.4. Statistical Analysis

Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS) software version 25.0 (IBM Corp., Armonk, NY, USA). Independent t-test was used to compared the mean difference between the test and control group whereas Pearson correlation was use to check the relationship between the parameters assayed within the test group. The results were expressed as mean ± standard deviation (SD) and statistical significance was established at $p < 0.05$.

2.5. Ethical Considerations

Ethical approval for the study was obtained from the Research and Ethics Committee of Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Ebonyi State, Nigeria (AE-FUTHA/REC/3/2026/653). Written informed consent was obtained from all participants before enrolment and participation was entirely voluntary.

3. Result

Table 1 shows the results of the selected trace elements in the test and control groups. The mean serum selenium concentration was significantly higher in the test group (0.115 ± 0.012 mg/L) compared with the control group (0.050 ± 0.018 mg/L) ($p < 0.001$). Mean magnesium level was significantly lower in the test group (0.661 ± 0.182 mg/L) than in the control group (1.871 ± 0.598 mg/L) ($p < 0.001$). Similarly, the mean chromium concentration was significantly lower in the test group (0.471 ± 0.222 mg/L) compared with the control group (1.506 ± 0.257 mg/L) ($p < 0.001$).

Table 1 Serum Selenium, Magnesium and Chromium Levels Between Test and Control Groups

Parameter (mg/L)	Test	Control	p-value
Selenium (Se)	0.115 ± 0.012	0.050 ± 0.018	<0.001*
Magnesium (Mg)	0.661 ± 0.182	1.871 ± 0.598	<0.001*
Chromium (Cr)	0.471 ± 0.222	‘1.506 ± 0.257	<0.001*

Values are presented as mean ± standard deviation. *Mean difference significant at p≤0.05

Table 2: shows the correlations of the selected trace elements in the test group. Selenium showed a weak negative correlation with magnesium ($r = -0.338$, $p = 0.068$) and a weak positive correlation with chromium ($r = 0.166$, $p = 0.382$). Magnesium and chromium also demonstrated a weak negative correlation in the test group ($r = -0.139$, $p = 0.464$) ($p > 0.05$).

Table 2 Correlations of Serum Selenium, Magnesium and Chromium Levels in Test group (n=120)

Parameter Pair	Test (r)	p-value
Se vs Mg	−0.338	0.068
Se vs Cr	0.166	0.382
Mg vs Cr	−0.139	0.464

r – Pearson Correlation Coefficient, *Correlation significant at p<0.05; Se=Selenium, Mg=Magnesium, Cr=Chromium

4. Discussion

This study evaluated the serum concentrations of magnesium (Mg), selenium (Se), and chromium (Cr) among pregnant women in Abakaliki and compared the findings with those of apparently healthy non-pregnant women. The results demonstrated significantly lower serum magnesium and chromium concentrations, but significantly higher serum selenium concentrations, among pregnant women. These findings suggest that pregnancy is associated with alterations in essential mineral metabolism, most likely due to increased maternal physiological demands, placental transfer of nutrients, haemodilution, and fetal growth requirements.

Pregnancy is characterized by profound metabolic and endocrine adaptations that influence the distribution, utilization, and excretion of micronutrients. Several physiological factors, including age, body composition, dietary intake, geographical location, soil mineral composition, genetic factors, and pregnancy itself, are known to influence circulating concentrations of essential minerals. Likewise, pathological conditions such as bacterial, viral, and parasitic infections, as well as chronic diseases including diabetes mellitus, may alter micronutrient metabolism through inflammatory responses, oxidative stress, and changes in nutrient utilization[8,17-20]

The significantly higher serum selenium concentration observed among pregnant women contrasts with findings from several previous studies that reported reduced selenium concentrations during pregnancy[21-23] . However, our findings agree with [24], who reported no significant difference in selenium levels between pregnant and non-pregnant women under certain nutritional conditions. Elevated selenium concentrations have also been reported among HIV-negative pregnant women compared with HIV-positive pregnant women[25] and among normotensive pregnant women compared with women with pre-eclampsia[26]. The higher selenium concentration observed in this study may reflect adequate dietary intake of selenium-rich foods, regional environmental characteristics, or differences in soil selenium content. Selenium enters the human food chain primarily through plants, and its concentration in foods largely depends on soil composition, agricultural practices, seasonal variation, and geographical location. Earlier studies have demonstrated considerable regional variation in selenium concentrations in soil, water, and agricultural products across Nigeria[27-28]. As Abakaliki is predominantly an agrarian region with substantial agricultural activities, locally produced foods may contribute to relatively higher selenium intake among the study population.

The significantly lower serum magnesium concentration observed among pregnant women is consistent with reports by Odigie *et al* [29] and Enaruna *et al* [30]. Magnesium is an essential cofactor in numerous enzymatic reactions involved in energy production, protein synthesis, neuromuscular function, electrolyte balance, and vascular regulation. During pregnancy, maternal magnesium requirements increase to support fetal skeletal development, placental growth, and maternal tissue expansion. Consequently, reduced circulating magnesium concentrations may result from increased fetal demand, haemodilution, and enhanced renal excretion. Magnesium also interacts synergistically with calcium, vitamin D, zinc, iron, and vitamin B6 to regulate bone mineralization, muscle function, and blood pressure. Magnesium deficiency has been associated with pre-eclampsia, gestational hypertension, low birth weight, preterm labour, and other adverse pregnancy outcomes[31]. The reduced magnesium concentration observed in this study may therefore have important implications for maternal and fetal health.

The present study also demonstrated significantly lower serum chromium concentrations among pregnant women than among non-pregnant controls, corroborating the findings of Gunton *et al* [32]. Chromium plays an important role in carbohydrate metabolism by enhancing insulin sensitivity and facilitating glucose utilization. Pregnancy is associated with progressive insulin resistance, particularly during the second and third trimesters, which may increase maternal chromium requirements. Consequently, reduced chromium concentrations during pregnancy may reflect increased metabolic utilization and placental transfer to the developing fetus. Similar reductions in chromium concentrations have been reported among women with gestational diabetes mellitus[33], suggesting that chromium deficiency may contribute to impaired glucose metabolism during pregnancy. Furthermore, chromium concentrations have been shown to decline with advancing gestational age, while excessive environmental chromium exposure has been associated with adverse pregnancy outcomes, including preterm birth[34]. These findings underscore the importance of maintaining adequate chromium status throughout pregnancy.

Overall, the findings of this study demonstrate that pregnancy is associated with significant alterations in essential mineral status. The reductions in serum magnesium and chromium concentrations may increase susceptibility to pregnancy-related complications such as gestational diabetes mellitus, hypertensive disorders of pregnancy, and impaired fetal growth. Conversely, the elevated selenium concentration observed may indicate adequate dietary intake or favourable environmental exposure within the study area. Nevertheless, because serum mineral concentrations are influenced by dietary intake, supplementation, gestational age, and environmental factors, further longitudinal studies involving larger populations are warranted to elucidate the determinants and clinical significance of these alterations during pregnancy.

5. Conclusion

This study demonstrated that pregnancy is associated with significant alterations in serum concentrations of essential micronutrients. Pregnant women exhibited lower serum magnesium and chromium levels but higher selenium levels than non-pregnant controls, suggesting altered mineral metabolism during pregnancy. These changes may increase the risk of pregnancy-related complications, including gestational diabetes mellitus, hypertensive disorders, and impaired fetal development. Routine assessment and appropriate nutritional management of essential micronutrients may contribute to improved maternal and fetal health outcomes.

Recommendation

Routine monitoring of serum magnesium, selenium, and chromium during antenatal care is recommended to facilitate early detection of micronutrient imbalances. Nutritional counselling and appropriate supplementation, where indicated, should be incorporated into antenatal care to optimize maternal and fetal outcomes.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

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Statement of informed consent

Written informed consent was obtained from all individual participants before enrolment and participation was entirely voluntary.

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