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# A Comparative Study of Micronutrient Levels in Pregnant Women With and Without Gestational Diabetes

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**ABSTRACT**

**Introduction***:* Gestational diabetes is a multifactorial disease that genetic and environmental factors affect insulin sensitivity. This study was designed with consideration towards the importance of micronutrients in carbohydrate metabolism.
**Methods:** The present case-control study was performed on 100 pregnant women referred to Imam Reza Hospital in Mashhad, Iran. Fifty pregnant women with gestational diabetes as defined by the American Diabetes Association guideline were considered as the case group and 50 non-diabetic pregnant women formed the control group. Maternal demographic information was recorded in the checklist . Serum levels of zinc, copper, selenium and chromium were measured in both groups. After data collection, they were processed with spss16 software.
**Results:**The mean age of diabetic and non-diabetic pregnant mothers was ± 32.33 5.92 and 5.38 ± 26.32 years respectively, and their mean weight was 10.81 ± 82.87 kg in the case and 10.6 ± 73.18 kg in the control group. Maternal weight and age in the gestational diabetes group were significantly higher. (both $p < 0.05$). There was a significant difference between the case and control groups in terms of family history of diabetes in first-degree relatives; history of formula fed mothers during infancy, gravid > 3 ,and low gestational age were all more common in women with gestational diabetes ($p < 0.05$). In contrast to chromium, serum levels of zinc, copper and selenium were higher in the group with gestational diabetes.
**Conclusion:** No significant relation was observed between serum zinc, copper, chromium and selenium levels with gestational diabetes.

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## Introduction

Pregnant women can suddenly or for the first time during pregnancy develop glucose intolerance, which is called gestational diabetes(1). Insulin-dependent diabetes and gestational diabetes can both cause problems for the neonates including congenital defects; increased obstetric complications; increased birth trauma in the neonate; and heart, respiratory, renal and cerebral complications; metabolic disorders (hypoglycemia, hypocalcemia, hyperbilirubinemia); coagulation disorders; and polycythemia. These factors have a significant effect on neonate mortality and morbidity(2, 3) Therefore, recognizing the contributing factors in diabetes and monitoring them can prevent or

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reduce the incidence of complications in neonates. A wide range of vitamins, minerals and nutrients are effective in regulating blood glucose and including some of these micronutrients in the regimen of diabetics may reduce the damage caused by the disease. Chromium supplementation in humans has been shown to improve glucose tolerance and lead to lower fasting blood sugar, increased insulin function (4). Zinc is important to the production of insulin by beta cells and has protective effects against the destruction of these cells. Its deficiency is a predisposing factor for diabetes and is associated with undesirable effects on the fetus(5, 6).

Selenium is another micronutrient that as an essential element plays an important role in the function of antioxidants such as glutathione peroxidase (7). On the other hand, due to the structure of insulin like , its anti-diabetic function has been proposed(8). In recent years, human and animal evidence has shown a significant relation between copper levels and abnormal glucose metabolism (9). Given the importance of these micronutrients, we decided to study the levels of selenium, chromium, zinc and copper in pregnant women with gestational diabetes compared to healthy pregnant women.

## Materials and Methods

The present case-control study was performed on 100 pregnant women who were referred to Imam Reza Hospital in Mashhad, Iran. Fifty healthy pregnant women were considered as a control group and the case group included 50 pregnant mothers who were diagnosed with gestational diabetes by definition. For women with gestational age of 24-28 weeks, a glucose tolerance test was performed after 8-14 hours of fasting and the presence of gestational diabetes was diagnosed after drinking a solution containing 75 grams of glucose.

Normal results in level of fasting blood glucose were defined as <5.1 mmol / L (92 mg / dL) at baseline, <10.0 mmol / L (180 mg / dL) at 1 h, <8.5 mmol / L (153 mg / dL) at 2 h. and if one or more of the tests in pregnant women were outside of normal range, it was considered as a positive case of gestational diabetes (10).

Conscious consent was obtained from all participants in the study. Maternal demographic information including age, weight, and height as well as parity, positive family history of diabetes in direct relatives, employment and history of other diseases and consumption of formula during infancy were recorded in the checklist. Weight was measured by scales (Seca, Germany, precision 15 gr) in stand position and height was measured by standard meter in stand position.

To prepare a sample from both the case and control groups, 6 cc of blood was taken from peripheral arteries and poured into a dry tube. Its serum was separated and frozen at the end of sample collection, and all of them were measured for their levels of micronutrients including zinc, copper, selenium and chromium. Sampling was done before delivery.

After data collection, they were processed with spss16 software and with t-test, Mann-Whitney and frequency distribution were analyzed. P value less than 0.05 was considered significant.

## Results

The mean age of diabetic and non-diabetic pregnant mothers was 32.33 ± 5.92 and 26.32 ± 5.38 years respectively (p <0.01). Their mean weight was 82.87 ± 10.81 and 73.18 ± 10.6 kg, respectively, which was significantly higher in diabetic mothers than non-diabetics (p <0.01) but the difference was not significant in maternal height (Table 1).

**Table 1:** *Comparison of mother's characteristics in case and control groups*

| variable | Case group | Control group | P value |
|---|---|---|---|
| **Maternal age (year) (mean ± SD)** | 32.32±5.92 | 26.32±5.38 | < 0.01 * |
| **Maternal weight (kg) (mean ± SD)** | 82.87±10.81 | 73.18±10.6 | < 0.01 * |
| **Maternal height (cm) (mean ± SD)** | 160.82±3.56 | 161.54±3.86 | 0.3 * |
| **Employee mothers N(%)** | 4(8%) | 1(4%) | 0.2** |
| **Gravid >3 N(%)** | 13(26%) | 10 (5%) | 0.01** |
| **history of formula fed mothers during infancy N(%)** | 4 (8%) | 0 | 0.04** |
| **Familial history of diabetes N(%)** | 11(22%) | 1(2%) | 0.02** |
| **History of mother's disease N(%)** | 48(96%) | 49(98%) | 0.29** |
| **gestational age <37week N(%)** | 10(20%) | 3(6%) | 0.01** |

**T test* *** Chi squre*

There was a significant difference between the case and control groups in terms of family history of diabetes in close relatives, history of mothers formula feeding during infancy , gravid > 3 and low gestational age were more common in women with gestational diabetes ($p < 0.05$) (Table 1).

Serum levels of zinc, copper, selenium and chromium between the two groups of gestational diabetic and non-diabetic pregnant mothers were compared, but there was no significant difference between the two groups. ($p > 0.05$) (Table 2).

**Table 2:** *Comparison of micronutrient levels in case and control groups*

| variable | Case group | Control group | P value |
|---|---|---|---|
| **Copper(micg/l) (mean ± SD)** | 1671.14±336.15 | 1665.60±441.61 | 0.8* |
| **Selenium(micg/l) (mean ± SD)** | 98.20±22.82 | 94.68±17.84 | 0.3* |
| **Zinc (micg/dl) medium** | 69.20 | 67.57 | 0.58** |
| **Chromium(micg/l) medium** | 0.63 | 0.67 | 0.65** |

*T test ** Man witni

## Discussion

Gestational diabetes is a multifactorial disease in which genetic and environmental factors affect insulin sensitivity (11). Several studies have found that obesity and maternal weight gain can lead to a higher risk of gestational diabetes and preeclampsia (12). The results of this present study also found that the pregnant women with gestational diabetes had higher average weight than the control group.

In addition, we identified in our study that the mean age of mothers in the group with gestational diabetes was significantly higher than the control group. This finding was consistent with previous studies and maternal age over 30 years was reported as a risk factor for gestational diabetes (13, 14).

In other words, our findings are consistent with previously conducted studies in finding that maternal weight gain and age increase the risk of gestational diabetes. Our research showed that factors such as gravid >3, mothers having been formula fed during infancy, family history of diabetes and preterm birth in the gestational diabetes group were significantly more than non-diabetic mothers.

In a meta-analysis published in 2017, a positive family history of diabetes was identified as one of the most important risk factors for gestational diabetes (15). Abu-Heija et al. showed that with increasing parity, the incidence of gestational diabetes will increase, so that the incidence of gestational diabetes increased from 3.5% in nulliparous women to 14.6% in women with parity greater than 4 and these results are consistent with ours (3).

In our study also parity greater than 3 was strongly correlated with gestational diabetes. In results of Patelarou et al in a systematic review, it has been observed that short periods of breastfeeding or lack of breastfeeding will be a risk factor for type 1 diabetes in later life (16), and we also found this same correlation with gestational diabetes.

Some studies have expressed that mothers with gestational diabetes were at increased risk for preterm labor and birth of premature neonates (17), It was the same as other studies.

It should be known that copper, zinc, selenium, iron are essential components of enzymes such as glutathione peroxidase, Cu / Fe cytochrome C oxidase, or different types of superoxide dismutases and all of them are important in the body's antioxidant defense. On the other hand, these elements are also involved in glucose metabolism. (11). Zinc is mentioned as an important element for the synthesis of insulin hexamer and reducing the severity of insulin resistance in diabetes(18).

There is evidence of an increased need for zinc during pregnancy. Mishu et al. Reported a significant difference between zinc levels in women with gestational diabetes and the control group (19).

In our study, serum zinc levels in mothers with gestational diabetes were higher than in the control group mothers, but this difference was not significant. Moghadam and colleagues also did not observe a significant relation between zinc levels and gestational diabetes (20). The results of our research, despite the larger sample size, were consistent with the study of Hamdan et al. They also did not report a significant correlation between zinc levels in women with gestational diabetes and non-diabetics, but the remarkable point in their study was that the two groups were well correlated in terms of maternal age, parity, gestational age, hemoglobin and body mass index (21).

Our results are consistent with other Iranian studies. Chromium is also a micronutrient that has played a key role in carbohydrate metabolism and has been mentioned as a stimulator of insulin production signals. In the study of Akhlaghi and his colleagues, like ours, the level of chromium in mothers with gestational diabetes was lower than the control group, but the results did not show a significant variation between the levels of this micronutrient in the case and control groups (11).

There is much evidence that serum selenium levels decrease during pregnancy (22, 23). However, the results of investigations on the association between selenium levels and gestational diabetes are contradictory (24).

Some studies have shown that women withgestational diabetes have lower serum selenium levels than non-diabetic pregnant women (8, 25).

However Bleys et al showed that serum selenium levels in people with diabetes were higher than their control group, and therefore, in populations such as the US with sufficient serum selenium levels, selenium supplementation was not recommended to prevent primary or secondary diabetes (26). The results of our study are consistent with those findings and in our population, the serum level of selenium in diabetic women is higher than non-diabetics. This is also true in another research conducted in Iran (11).

However, investigations with a larger sample size are required. Conversely, in a systematic review which was performed in 2014, serum selenium concentrations were significantly lower in women with gestational diabetes than in the non-diabetic group, but did not show a cause-and-effect relation between selenium levels and gestational diabetes (24). Although Liu and colleagues found selenium deficiency to be common among Chinese women, their findings suggested that low levels of selenium in early pregnancy were not a strong risk factor for gestational diabetes and preterm birth (27).

Copper is another element in the body that is essential for normal human physiology and the function of 30 proteins involved in metabolism, including superoxide dismutase, ceruloplasmin, cytochrome c oxidase and dopamine beta-hydroxylase (28). In the meta-analysis of Qiu et al., serum copper levels were higher in diabetic patients than in healthy individuals (29).

In our study, serum copper levels were higher in mothers with gestational diabetes than in non-diabetic mothers, a finding in agreement with the study of Li et al, but in their study, this difference was more pronounced, which may be related to the larger sample size (9).

One of the limitations of our research was that dietary information for pregnant mothers in both groups was not available so we could not analyze the relation between nutritional factors and plasma micronutrient levels.

## Conclusion

This study found that the levels of micronutrients such as zinc, copper, chromium and selenium in the two groups of diabetic and non-diabetic pregnant mothers were not significantly different.

Given that these findings are consistent with other studies in the Iranian population, the primary causes of gestational diabetes may be due to diet, race, and other unknown causes, suggesting that studies with a larger sample size and multicenter along with a detailed evaluation of mothers' diets is needed to generalize this issue in our population, after which the use of supplements containing these micronutrients during pregnancy should be reconsidered.

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