

Serum chromium levels in gestational diabetes mellitus

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ABSTRACT

Objective: To measure serum chromium level in women with gestational diabetes mellitus (GDM) from Chennai, South India. **Materials and Methods:** Thirty women with gestational diabetes, 60 age matched controls. Inclusion criteria: Gestational age 22-28 weeks, age group 20-35 years. **Exclusion Criteria:** Gestational age beyond 28 weeks, malnutrition or presence of infection. Serum chromium was measured using inductive couple plasma emission spectrometer. **Results:** Serum chromium levels of women with GDM, 1.59±0.02 ng/ml (range: 0.16-4.0 ng/ml) were lower than in controls (4.58±0.62 ng/ml; range 0.82-5.33 ng/ml) ($P < 0.001$). However, there were no significant differences among cases and controls when subdivided by parity. **Conclusions:** Women with GDM from a South Indian city had lower levels of serum chromium compared to pregnant women without GDM. Studies may be done whether chromium supplementation is useful in this group of women.

Key words: Asian Indian, ethnic, insulin resistance

INTRODUCTION

Diabetes mellitus is common both in rural and urban India; it was diagnosed earlier than in the west and shows a trend to increase over time, especially among young women.^[1-3] We showed that women with polycystic ovary disease [PCOS], an insulin resistant state, have earlier onset of carotid artery intimal medial thickness, a surrogate of vascular abnormality.^[4] In addition women with PCOS have greater psychological stress, which could contribute to the pathogenesis of future insulin resistance and diabetes mellitus.^[5]

Gestational diabetes mellitus and diabetes in pregnancy present with varying phenotypes, contributing to adverse

maternal and fetal outcomes.^[6] Insulin is employed to control hyperglycemia during pregnancy which is difficult. In addition, the use of insulin is associated with risk of hypoglycemia, additional weight gain as well as difficulties in delivering care.

Therefore, adjuvant agents were used to control glucose levels and ameliorate the cluster of metabolic abnormalities. Among the many metal supplements, chromium has been the most well studied. Early studies showed positive outcomes in glycemic control, reducing risk factors and complications.^[7,8] More recent reports did not replicate the findings.^[9,10]

The latter results^[9,10] may appear surprising, considering the biochemical, biological and experimental evidence for chromium having an important role in glucose metabolism through the insulin signaling pathways.^[7,8]

One of the reasons attributed to the negative results in clinical trials is the possible difference of the effect of chromium among populations who are chromium sufficient versus those who are chromium deficient, and differences in ethnicities.^[9] We measured the serum levels of

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chromium in women with gestational diabetes mellitus and compared them with pregnant women without gestational diabetes.

MATERIALS AND METHODS

Subjects

Consecutive women with gestational diabetes mellitus (n = 30) attending the Department of Endocrinology, Institute of Obstetrics and Gynecology, Chennai were recruited into the study. Matched control women (n = 60) were selected, of similar age, gestational age and without any pregnancy-related complications.

Inclusion criteria: gestational age 22-28 weeks, age group 20-35 years. Exclusion criteria: gestational beyond 28 weeks, malnutrition, presence of infection, or other metabolic and endocrine disorders.

The protocol was approved by the Institute Ethics committee. Informed consent was obtained from each individual.

Methods

Anthropometric data, signs were recorded and systemic and obstetric evaluation done.

Fasting blood samples were obtained for biochemical assessment. Besides routine parameters, serum insulin and chromium were also estimated.

Measurement of serum chromium

Serum chromium was estimated using an inductive couple plasma emission spectrometer, which is a sequential plasma emission instrument. The basis for measurement is that atoms or ions in an energized state spontaneously revert to a lower energy state, and in doing so, emit a photon. For quantitative emission spectrometry, it is assumed that the emitted energy is proportional to the concentration of atoms or ions. The instrument had a first order of 0.013 nm, with a spectral range of 189-800 nm. The relative standard deviation for precision was <2%.

The sample is fed to the plasma (plasma is a cloud of electrons and argon ions at high temperature), which dissociates the sample. A monochromator grating diffracts the light, which is collected by a photomultiplier, and a computer displays the result.

RESULTS

Serum chromium levels of women with GDM, 1.59+/-0.02 ng/ml (range: 0.16-4.0 ng/ml) were lower than in

controls (4.58+/-0.62 ng/ml; range 0.82-5.33 ng/ml) ($P < 0.001$) [Table 1]. However, there were no significant differences among cases and controls when subdivided by parity (primiparous vs multiparous women), although GDM women had lower values than controls, and there was a trend toward the level to be higher in multiparous women, though the differences did not reach statistical significance by comparison with parity [Table 1]. Serum chromium levels did not differ according to body mass index in GDM subjects (Data not shown).

DISCUSSION

The beneficial effect of chromium in glucose metabolism has had a long history: brewer's yeast was identified to potentiate the hypoglycemic activity in the 1920's; in 1957 chromium was identified to be the active component of glucose tolerance factor from brewer's yeast.^[8,11] The trivalent form of chromium (chromium picolinate) was found to be a better absorbed form of the ion.^[12] It was shown to act via chromodulin, a chromium-binding oligopeptide in the autoamplification of insulin signaling.^[13] Other effects of chromium include better insulin binding, increased receptor number, internalization, and improved beta cell sensitivity.^[14] It was also proposed to improve the plasma membrane fluidity.^[15]

These conceptual moorings were evaluated in both animal models and in humans. Rats given chromium picolinate were protected against microvascular complications.^[16] Chromium picolinate improved coronary flow and recovery of myocardial contractility and relaxation following ischemic reperfusion insult in a rat model.^[12] In the female mink, a significant effect was observed with a supplementation of herring oil, chromium picolinate and acetylsalicylic acid,^[17] paradoxically a combination of the three led to increased glucose levels, suggesting that adverse interactions may occur with a combination of dietary supplements. In contrast, humans with GDM had a positive effect with chromium supplementation.^[18]

Table 1: Comparison of serum chromium level in GDM and control women

Variable	Serum chromium (ng/ml)	P value
GDM (n:30)	1.59+/-0.02	<0.001*
Controls (n:60)	4.58+/-0.62	
GDM: Primi (n:10)	1.03+/-0.02	
GDM: Multi (n:20)	1.68+/-0.32	
Controls: Primi (n:20)	3.49+/-0.48	
Controls: Multi (n:40)	4.02+/-0.32	

*P value difference between GDM and controls as a group, No differences in P value when subdivided by parity, GDM: Gestational diabetes mellitus

Early studies, which suggested a beneficial effect of chromium on glycemic control, were later confirmed by double-blind designed studies.^[8] A study performed in India showed that chromium supplementation for 12 weeks improved glycemic control.^[19] Improved lipid profile with chromium in animal studies were confirmed in early human results.^[8] However, two recent studies did not show an improvement in either glycemia or lipid parameters.^[9,10]

In general, studies employing organically bound chromium as chromium picolinate showed better results than chromium used in the inorganic form, suggesting better absorption of the organic form.^[8] A variety of other combinations were employed, including cysteine,^[20] biotin,^[21] yeast,^[22] and niacin.^[23]

What could account for the discrepancy in results between the earlier positive association and the later studies, which showed no positive results with chromium supplementation? A variety of reasons were put forth: confounding factors such as changing chromium levels with age, occurrence of infection, which increases chromium excretion, glucose intake, and stress.^[22] In addition, measurement of chromium was difficult until the employment of atomic absorption method,^[11] which was used in the current report. Also, a distinction was made between chromium deficiency in the diet, versus tissue level deficiency^[24] and finally differences between chronic and acute chromium deficiency.^[9] Western populations, which showed a negative result with chromium supplementation were chromium sufficient, in contrast to Asian populations such as Chinese and Asian Indians who tend to be chromium deficient. These differences as well as ethnic variations may account for the disparate results in different studies from various geographical and ethnic regions.

In the current study we studied a homogenous population with GDM from southern India, using inductive couple plasma emission spectrometer to measure serum chromium and compared with a non-GDM matched population. We report that the level of chromium is lower in women with GDM. Considering the lack of comparable cost-matched pharmacological agents, the possible ethnic differences, a chromium deficient state, it is desirable to study,^[19] the effect of chromium picolinate in a large sample of women with GDM to assess its effect on glycemic and lipid levels.

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