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Applied nutritional investigation

Gestational hyperglycemia, zinc, selenium, and antioxidant vitamins

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Abstract

Objective: Lower levels of selenium and vitamin E have been described in gestational diabetes, a condition similar to type 2 diabetes, but few data are available about zinc (known to be associated with diabetes) and gestational hyperglycemia. This study evaluated the dietary intake of antioxidant vitamins, zinc, selenium, and serum levels of zinc and selenium in women with gestational hyperglycemia and normoglycemia.

Methods: A food-frequency questionnaire was administered to 504 pregnant women (210 with hyperglycemia and 294 with normoglycemia). Serum levels of zinc and selenium were analyzed during pregnancy in a second cohort of 71 hyperglycemic and 123 normoglycemic women, with a mean age and body mass index similar to those in the first cohort.

Results: Dietary intakes of zinc and selenium were significantly lower in hyperglycemic patients. In multiple logistic regression analysis, intakes were negatively associated with gestational hyperglycemia (odds ratios of 0.89 for zinc and 0.97 for selenium) after multiple adjustments. There were no significant differences in vitamin intakes. In the second cohort of 194 patients, serum levels of zinc and selenium were significantly lower in patients who had impaired glucose tolerance and negatively associated with gestational hyperglycemia in a multiple logistic regression model (odds ratios of 0.93 for serum zinc and 0.92 for serum selenium).

Conclusions: Our data suggested a significant inverse association of dietary intakes and serum levels of zinc and selenium with gestational hyperglycemia. If future studies confirm these results, it might be a useful interventional approach to appropriate dietary counseling in order to evaluate the possible decrease in gestational metabolic abnormalities and their adverse consequences.

Keywords: Antioxidant vitamins; Gestational hyperglycemia; Micronutrients; Selenium; Zinc

Introduction

Gestational diabetes (GDM) is one of the most prevalent complications of pregnancy. It causes adverse consequences to the mother and the fetus and an increased risk for subsequent, overt type 2 diabetes [1]. GDM has a pathogenesis that is quite similar to that of type 2 diabetes, and it has been suggested these may be forms of the same disease.

Gestational hyperglycemia induces oxidative stress in the mother and the fetus that may be correlated to adverse fetal outcomes (fetal distress, macrosomia, or other congenital anomalies) [2]. Concurrently, lower levels of antioxidants such as selenium and vitamin E have been reported in GDM [3,4]. Less is known about the association of other antioxidant micronutrients with GDM. In type 2 diabetes, there is evidence of an abnormal metabolism of several micronutrients, and zinc is one of the essential elements whose status is altered in this condition [5–7].

The aims of the present study were to 1) evaluate dietary intakes of antioxidant vitamins, zinc, and selenium and

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serum levels of zinc and selenium in women with different degrees of gestational hyperglycemia and 2) verify whether, after adjustment for multiple confounders, these micronutrients were independent predictors of gestational hyperglycemia.

Materials and methods

First cohort

Patients

All pregnant women attending the Department of Obstetrics and Gynecology of the University of Turin (Turin, Italy) are routinely screened with a 50-g oral glucose tolerance test (OGTT) at 24 to 28 wk of gestational age (as calculated by ultrasound examinations performed during the first trimester of gestation). As previously described, all patients with a positive screening result (1-h serum glucose concentration ≥ 7.8 mM/L) underwent a 3-h OGTT with 100 g of glucose after 1 to 2 wk [8]. GDM was diagnosed when two serum glucose values were above the following levels: 5.3 mM/L after fasting, 10.0 mM/L at 1 h, 8.6 mM/L at 2 h, or 7.8 mM/L at 3 h, according to the criteria of Carpenter and Coustan [9]. The category “one abnormal value on the OGTT” was defined when just one glucose value was higher than these cutoff levels.

The study included all consecutive women screened from April 1999 to November 2000 in our department. Pregnant women known to have diabetes mellitus or a disease affecting glucose metabolism, active infections, chronic illness, or medical treatments (drugs or vitamin supplements) were excluded. A total of 126 women with GDM and 84 with one abnormal value on the OGTT were identified. During the first month of this period, all consecutive subjects with a normal glucose tolerance result (294 women) were considered control subjects.

All women gave their informed consent, and all procedures were in accordance with the Helsinki Declaration as revised in 1983.

Data collection

Height was measured at the time of screening, and patients supplied information on their prepregnancy weight. Body mass index (BMI) was calculated as prepregnancy weight (kg) divided by height squared (m^2). Physical activity was evaluated as previously reported [8].

Detailed dietetic interviews were performed with all patients by means of a semiquantitative food-frequency questionnaire adapted from Willett and Coll [10] with the following considerations: 1) subjects were Europeans; 2) we searched for diet influences on the occurrence of gestational hyperglycemia that was closely related to a short-lasting event, pregnancy, and different from chronic conditions (e.g., cancer or heart disease); and 3) an evaluation of dietary intake in the previous year was meaningless because women frequently change their dietary habits in pregnancy (more “healthy” habits, avoidance of some foods, etc.). An “ad hoc” questionnaire, designed by an expert dietitian, included a list of foods (60 items) most frequently consumed in northern Italy. Commonly consumed portions for each item were specified. Dietetic interviews were performed by three physicians who were trained in assessing habitual food patterns and blinded to results of the OGTT; other physicians communicated the results of the OGTT to patients after the dietary interview.

Photographs were used to compare different portions for each item. Patients were asked to indicate how often a day and how many days a week they consumed every specific food during the past week. Data on cooking methods were also collected. The food lists completed by the physicians were entered into a software program (Food Meter, Medimatica s.r.l., Martinsicuro, Teramo, Italy, 1990; modified in 1998 in the University of Turin according to food composition tables by the Italian National Institute of Nutrition) [11]. Subgroups of foods within the same category and with a similar composition were collapsed in single items. Every item carried the weighted mean of macronutrients or minerals and vitamins. The database contained all foods consumed by subjects.

The reliability of the reported energy intake was assessed by calculating the ratio of estimated energy intake to predicted basal metabolic rate using age- and sex-specific formulas derived by Schofield et al. [12]. A value of 0.88, which represented the 97.5% confidence interval (CI), was the cutoff for under-reporting [13]. The 18 under-reporters (3.6%), according to this formula, were equally distributed across the three categories of glucose tolerance.

Second cohort

Patients

To confirm the preliminary data obtained from the questionnaire analyses (see RESULTS), serum levels of zinc and selenium were determined in a second cohort of pregnant women (24 to 30 wk of gestational age). We identified 71 consecutive hyperglycemic patients (42 with one abnormal value on the OGTT and 29 with GDM) in the same department from December 2000 to June 2001. All consecutive normoglycemic women (n = 123) during the first 2 wk of this second period were enrolled as controls. This second cohort had clinical characteristics similar to those of the first one (Table 1).

Data on children’s birth weights and health statuses were obtained from clinical records by a trained physician who was blinded to the results of the OGTT. Infants were classified as large-for-gestational age and small-for-gestational age if their birth weights were above the 90th percentile or lower than the 10th percentile, respectively, according to neonatal anthropometric standards for sex and gestational age of the northern Italy population [14]. Births were de-