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The Importance of Nutritional Therapy in Diabetic Pregnant Women

Eosefina-Gina Botnariu[1,2]; Liliana Gheorghe[1,3]; Alina Plesa[1,4]; Irina Iuliana Costache[1,5]

[1]*University of Medicine and Pharmacy ''Gr. T. Popa'' Iasi.*

[2]*Saint Spiridon'' Emergency Hospital, Department of Diabetes, Nutrition and Metabolic Diseases.*

[3]*Saint Spiridon'' Emergency Hospital, Department of Radiology and Medical Imagistics.*

[4]*Saint Spiridon'' Emergency Hospital, Institute of Gastroenterology and Hepatology.*

[5]*Saint Spiridon'' Emergency Hospital, Department of Cardiology.*

***Corresponding Author(s): Eosefina-Gina Botnariu & Liliana Gheorghe**

Department of Diabetes, Nutrition and Metabolic Disease, Faculty of Medicine, 'Grigore T. Popa',University of Medicine and Pharmacy, Universitatii St. 16, 700115 Iasi, Romania.

Email ginabotnariu66@gmail.com & lgheorghe123@gmail.com

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Abstract

During pregnancy many metabolic changes occur, whether it is about gestational diabetes or pre-pregnancy diabetes. The estimated energy requirement during pregnancy, in women with gestational diabetes, is not different from that of non-diabetic pregnant women; the dietary modifications has the role of avoiding glycemic excursions and excessive weight gain. The pregnant woman with diabetes should take special care to ensure that it is adequate in macro- and micro-nutrients. There is an increased need for calories (+350 cal/day from the 2nd trimester) to meet the demands of growth of the fetus, growth of the placenta, normal maternal size. The macronutrients should be in adequate proportion. Low-carbohydrate (45% of total calories) and high-fiber diets in pregnancy offer a lot of benefits on glycemic control. The diet should be improved with vitamins and antioxidants. The implementation of an educational program for women with gestational diabetes is of particular importance, both for mother and child.

Keywords: Diabetes; Pregnancy; Diet; Gestational diabetes.

Introduction

Pregnancy is a special period in every women's life which proves her maturity and ability of give birth, ensure the growth and development of a child.

During pregnancy many metabolic changes occur, whether it is about gestational diabetes or pre-pregnancy diabetes. Gestational Diabetes (GD) is responsible for doubling the risk of injuries at birth for the fetus, but also for tripling the maternal risk. GD can be associated with multiple morbidities, which occur both in the mother and in the fetus [1,2,3].

High blood pressure may complicate 1 in 10 pregnancies, and women with GD have a significantly increased risk of developing high blood pressure [3,4].

Mother may develop diabetic retinopathy (which is well known as the leading cause of blindness) and diabetic nephropathy, which may be aggravated by pregnancy. Data from medi-

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cal literature have shown that the glomerular filtration rate increases by 30-50% during pregnancy and with it, the urinary elimination of proteins [4,5].

Patients with kidney disease or retinopathy already diagnosed, have a much higher risk of complications during pregnancy, due to the chronic feature of hypertension. According to some studies, 40% of pregnant women with gestational diabetes develop hypertension [5].

Hypertension and diabetes can induce intrauterine growth restriction in fetus, preeclampsia, detachment of the normally inserted placenta and myocardial infarction in mother [5].

McEnzie - Sampson et al [6], in a retrospective cohort study, showed that women with gestational diabetes have an increased risk of developing post-natal cardiovascular disease, even at 25 years after birth.

Fetal risk is increased in mothers with gestational diabetes and pre-pregnancy diabetes. According to some authors, there is a miscarriage rate of 9-14%. Suboptimal metabolic control doubles the risk of miscarriage (when HbA1c > 11%), but excellent metabolic control lowers the miscarriage rate [7]. Two thirds of the anomalies present at birth are represented by cardiovascular and central nervous system anomalies, and the persistence of a glycated hemoglobin A1c > 7% in mother may increase the risk of fetal malformation, as some authors have shown [3,8,9]. Although children of diabetic mothers have an accelerated intrauterine growth, in some cases intrauterine growth restriction of the fetus may occur, being especially related to pre-existing vasculopathy, in women with type 1 diabetes diagnosed before pregnancy [9,10].

Also, maternal obesity during pregnancy can accelerate the risk of fetal macrosomia [11], as women with gestational diabetes who had suboptimal weight during pregnancy are at risk of giving birth to a low-weight fetus. High pre-pregnancy body weight and excessive weight gain during pregnancy are dangerous too, because may increase the risk for GD, pre-eclampsia and fetal macrosomia [12,13,14].

The main physiopathological maternal-fetal changes during pregnancy [3,15,16,17]

During pregnancy, hyperglycemia generates a complex series of hormonal actions, such as the release of glucagon, somatomedins, catecholamines, all of which induce an increase in blood sugar and additional release of insulin from the pancreas.

Compared to non-pregnant women, pregnant women tend to develop hypoglycemia (values of blood glucose between 65-75 mg/dL) between meals and during sleep; hypoglycemia is more frequent and more serious as the pregnancy continuously advances.

The level of placentary hormones (estrogens, progesterone and chorionic somatomammotropin) increases in the 2nd and 3rd trimester of pregnancy, inducing peripheral insulin resistance and stimulating the additional release of insulin (the level of insulinemia increases even by 50% in the third trimester third pregnancy). In women with GD, these changes induce maternal and fetal hyperglycemia, with the appearance of recurrent postprandial hyperglycemia, changes that have negative repercussions on the fetus, inducing the acceleration of its growth, but also episodes of fetal hyperinsulinemia. Fetal hyperinsulinemia is responsible for fetal macrosomia because it stimulates excessive storage of nutrients. At the same time, the energy excess, associated with the transformation of glucose into fat, induces oxygen depletion in the fetal tissues (fetal hypoxia) and increases the level of catecholamines, blood pressure, remodeling and cardiac hypertrophy, high release of erythropoietin and reactive polycythemia. The high value of the hematocrit is responsible for the increase in the viscosity of the fetal blood and the appearance of post-natal hyperbilirubinemia.

The normalization of the glycemic profile during pregnancy reduces the rate of occurrence of fetal macrosomia, but maintains a postprandial glycemia higher than 160 mg/dl and increases the rate of fetal macrosomia by 35%.

The energy requirement during pregnancy

The estimated energy requirement during pregnancy, in women with gestational diabetes, is not different from that of non-diabetic pregnant women; the dietary modifications has the role of avoiding glycemic excursions and excessive weight gain in mother. Thus [14,18,19]:

- In semester 1: it is not recommended to increase the caloric requirement
- in semester 2: 340 calories supplément
- 3: Supplement of 452 calories

The amount and distribution of carbohydrates must take into account: the feeling of hunger, the level of blood sugar, the weight gain and the level of ketonemia [18,19].

Carbohydrates

A minimum consumption of 175 g of carbohydrates per day by the mother is recommended to ensure, for the fetal brain, the minimum required amount of 33 g of glucose per day.

Carbohydrates are mainly responsible for post-postprandial hyperglycemia, which is directly related to fetal macrosomia [20]. Carbohydrate restriction is usually recommended (these represent 30-40% of the total amount of calories/day). According to some authors, carbohydrate restriction, higher fat and protein meals may induce large birth weight, in women with pre-pregnancy insulin-resistance, by increasing lipolysis and circulating free fatty acids, which are transferred to fetus [21].

The importance of glycemic index and dietary fibers

Some studies conducted on small samples of women with GD showed that, in the groups of women who followed the low-carbohydrate diet (45% of the daily energy intake), postprandial blood glucose was significantly lower [20, 21].

There are few studies in the literature regarding the importance of low-carbohydrate and high-fiber diets in pregnancy. These studies demonstrated that reducing the amount of carbohydrates induced a decrease in the number of patients with GD who required the initiation of insulin therapy [22,23], and in some people they even extended the period without insulin treatment [24]. There are no data on the diet compliance of pregnant women with GD [25,26,27].

Dietary fats

Dietary fats usually represent 30-40% of the total caloric intake of pregnant women. Exceeding the amount of dietary fat induces the danger of weight gain. The recommendation is to consume 25-30% lipids of total calories/day [20,21].

The use of monounsaturated fatty acids in the diet of pregnant women seems to have an adjuvant effect in improving blood pressure values. Other studies have demonstrated that supplementing the diet with omega 3 fatty acids led to a significant decrease in insulin resistance (assessed by the HOMA method), but also in the reduction of high-sensitive C-reactive protein, without having an effect on plasma glucose, the sensitivity index to insulin or lipid profile [27].

In addition, the association of omega-3 acids with vitamin E has beneficial effects, in women with gestational diabetes, not only on glycemic homeostasis, but especially on serum levels of triglycerides, VLDL and HDL cholesterol, without proving any effect on LDL levels and total cholesterol [27,28].

The role of proteins

Most nutrition guideline recommend a protein intake of 10-20% of daily calories, corresponding to 60-80 g of protein/day, to ensure a good foetal supply and avoid maternal muscle breakdown [24,29,30].

Nutrition in the preconception period and during pregnancy has a particular impact on fetal weight. Cuco et al [31] showed, in a study, that supplementing the protein ration by 1g during the preconception period, but also during weeks 10, 26 and 38 of pregnancy, causes an increase in fetal weight by 7.8-11.4g; a high-fat, high-protein diet during pregnancy may cause insufficient development of fetal pancreatic cells, which may induce fetal insulin deficiency. This shows that high-protein diets can induce decreased fetal birth weight. The consumption of more than 84 g of protein/day by the mother can induce a decrease in fetal weight, being more harmful than a low-protein diet, and the optimal protein consumption during pregnancy is considered moderate.

Another studies [32,33] presented the advantages of consuming vegetable proteins (soy) on the nutritional status of women with GD compared to the predominant consumption of animal proteins, showing that, in the context of consuming 0.85g protein/day, those in the soy protein group had an improvement in glycemic homeostasis, oxidative stress biomarkers, triglycerides, but also a reduction in the incidence of fetal hyperbilirubinemia and the hospitalization rate of newborns.

Vitamin D

Some authors [Zhang et al, cited by 34,35]have shown that high doses of vitamin D (50,000 IU every 2 weeks) greatly improve insulin resistance in women with GD.

Other authors have shown that vitamin D supplementation, in the second semester of pregnancy, reduces the risk of glucose intolerance and gestational diabetes in the third semester [36].

Inositols

Inositols belong to group B vitamins. They are naturally found in cereals, corn, vegetables, meat, especially in liver [37].

Some studies have suggested that inositols may play an important role in glycemic control. Thus, in syndromes accompanied by insulin resistance, such as polycystic ovary syndrome and gestational diabetes, an increased elimination of myoinositol metabolites was found, which correlated positively with blood glucose levels, suggesting that dietary supplementation with myoinositol can have a positive effect in increasing insulin sensitivity [38,39]. Some meta-analyses have highlighted the important role of myoinositol in the prevention of GD [40,41], but, nevertheless, there are no recommendations for the use of myoinositol in the prevention of GD in women of reproductive age.

Sweeteners

There are few data on the use of sweeteners during pregnancy. Those approved by the Food and Drug Administration and the European Food Safety Agency, for pregnant women, are the non-caloric and alcoholic ones. Allowed: aspartame (except in cases of phenylketonuria), K-acesulfame, sucralose, stevia and fruit extracts [42].

The American Medical Association recommends that women avoid saccharin during pregnancy, because the fetus may not eliminate this substance correctly and in a timely manner [43].

General recommendations for women with GD

The pregnant woman with diabetes should take special care to ensure that it is adequate in macro- and micro-nutrients. There is an increased need for calories (+350 cal/day from the 2nd trimester) to meet the demands of growth of the fetus, growth of the placenta, normal maternal size and for the additional task of carrying the weight of the fetus and maternal tissues and the increased rate of basal metabolism. The protein requirement during pregnancy is an additional 23 g/day (i.e., 55 + 23 = 78 g/day). This is required for meeting the growth needs of the enlargement of the uterus, mammary glands, placenta, growth of fetus, increase in circulating blood volume, plasma proteins, amniotic fluid synthesis, and transfer of amino acids from the mother to fetus.

Since blood sugar levels are higher in the morning due to the predominance of counter-regulatory hormones, at breakfast, carbohydrate should be limited to 1-2 portions. During pregnancy, to determine the portion of carbohydrates, it is necessary to carry out the glycemic profile.

It is recommended to eat foods with fiber, e.g. whole grains, vegetables, as their consumption greatly reduces the glycemic load of a portion.

Women with GD should consume 120-150 g of meat, poultry, beef (lean), lean pork or fish, but also butter or egg, low-fat cheese, vegetable foods rich in protein (e.g. soy). It is recommended to eat healthy fats such as olive oil, nuts, less saturated fat (butter, cream, high-fat meats, bacon and sausages). Consuming trans fats (found in all foods that list “partially hydrogenated”) is not recommended [43, 44].

Implementation of educational programs, for woman with gestational diabetes has a great importance, both for mother and child. There are some successful studies which are trying to suggest the importance of managing GD by using special applications on smartphones or tablets [45].

The impact of this educational program would be huge, not only on the state of health, but also on the perception of future mothers about the meaning of healthy nutrition.

The educational program can have a particularly important role in the prevention/aggravation of some diseases, in reducing hospitalization costs, but above all. can greatly improve the quality of life in diabetic pregnant women.

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