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Nutritional Management of Gestational diabetes mellitus

Stanislava Ivanova[1], Kalin Ivanov[1], Radiana Staynova[2] , Vanja Rangelov[1], Lili Stoilova[1]
[1] Faculty of Pharmacy, Department of Pharmacognosy and Pharmaceutical Chemistry, Medical University of Plovdiv, Plovdiv, Vasil Aprilov Blvd. 15-A, Bulgaria

[2] Faculty of Pharmacy, Department of Pharmaceutical Sciences, Medical University of Plovdiv, Plovdiv, Vasil Aprilov Blvd. 15-A, Bulgaria

Abstract
This paper reviews the nutritional strategies for management of gestational diabetes mellitus (GDM). Literature search was done through Medline/PubMed, Scopus Database, Web of Knowledge search as well as an internet-based search with predefined keywords. The present review is based on a total of 67 publications.
We have found that the scientific evidences for making nutrition recommendations for these patients are limited. We have found also some conflicting guidelines and opinions surrounding dietary management of GDM. In a pregnancy complicated by GDM the excellent glucose control is essential. Usually nutrition strategies for management of GDM are foundational for appropriate weight gain, adequate nutrient intake, foetus development and glucose control.

Keywords: GDM, Gestational diabetes mellitus, food supplements, inositol, myo-inositol, pregnancy

1. Introduction

According to standards of Medical Care in Diabetes it is recommended to be performed screen for undiagnosed type 2 diabetes at the first prenatal visit in those women with hight risk factors. Gestational diabetes mellitus (GDM) is defined as glucose intolerance first recognised during pregnancy (table 1). Risk factors for developing GDM are: family history, obesity, previously GDM, glycosuria, hypertension and polycystic ovarian syndrome [1-3]. Some researchers suppose ethnicity to be also a risk factor - Aboriginal women in Australia, Middle Eastern (Lebanese, Syrian, Iranian, Iraq or Afghanistan) women and Pacific Islanders. In the last few decades there is a rise of obesity and glucose intolerance among women of reproductive ages. The cases of GDM have also risen globally [1, 2]. The maternal nutritional status is an important factor for foetal growth: under- nourishment is associated with many risks for the baby but an over nourishment of the foetus associated with maternal obesity and diabetes usually leads to foetal overgrowth [1-8]. Pregnant woman with low-risk status for GDM are limited to those women meeting all of the following characteristics: age under 25, normal weight before pregnancy, no family history of diabetes, no history of poor obstetric outcome [15].

Pregnancy is considered as diabetogenic condition because placental lactogen and gestational steroid hormones induce peripheral insulin resistance and enhance foetal nutrition by diverting glucose, amino acids and fatty from maternal to foetal tissues [1, 6, 7]. Many researchers consider that children exposed to GDM in utero are at high risk of developing obesity and many other health problems [8]. Adequate nutrition strategy is essential during pregnancy because it is of great importance not only for the maintaining the health of the mother, but also for the foetus development and the child's health after birth [9-13]. A nutritionally deficient and unbalanced diet has a negative effect on pregnant women's personal health and affects the development of the foetus, as well as the outcome of the pregnancy, and creates a risk for the offspring to suffer from a number of diseases in maturity [14].

Table 1. Classification of diabetes

TYPE	ADDITIONAL INFORMATION
Type 1	• results from β-cell destruction; • usually leading to absolute insulin deficiency;
Type 2	• results from a progressive insulin secretory defect on the background of insulin resistance;

Other specific types of diabetes	• due to other causes: genetic defects in β-cell function, genetic defects in insulin action, diseases of the exocrine pancreas; • drug/ chemical-induced (example: treatment of HIV/AIDS or treatment after organ transplantation)
GDM	GDM is considered as diabetes diagnosed during pregnancy that is not clearly overt diabetes [16-19]

2. Material and methods:

Literature search was done through Medline/PubMed, Scopus Database, Web of Knowledge search as well as an internet-based search with predefined keywords. The present review is based on a total of 67 publications.

3. Discussion:

According to statistical analysis there could be GDM occurrence of approximately 40% in overweight/obese women [10]. Bruno Raffaele and coworkers have performed a prospective, randomised, open-label, controlled study that demonstrate that a prescription of a detailed lifestyle programme in overweight/obese pregnant women influences the occurrence of GDM. These researchers have found that the adherence to a personalised, hypo caloric, low-glycaemic, low-saturated fat diet started early in pregnancy prevents GDM occurrence, in women with high pre-pregnancy body mass index (BMI)≥ 25 kg/m2 [10]. Other recent studies also have demonstrated that specialised nutrition strategies seem to be related to a lower risk for GDM [12]. Carol A Major and coworkers have performed a trial to evaluate the effect of carbohydrate restriction on perinatal outcome in patients with diet-controlled GDM. Pregnant with diet-controlled GDM were divided non-randomly into two groups. The groups were based on their dietary carbohydrate content: low dietary carbohydrate content (below 42%) and high dietary carbohydrate content (between 45% and 50%). The researchers have found that low carbohydrate diet results in: improved glycemic control, less need for insulin therapy [26]. A well balanced healthy diet is very important for every part of population- it helps to maintain or improve overall health [20, 21]. Healthy nutrition is one of the main health protecting lifestyle factors [22] and also is an essential part of the management of GDM. Because every pregnancy is different a team of doctor gynaecologist and dietitian should create an appropriate diet for every woman with GDM, based on: calories need, weight, pregnancy status, foetus development, activity level.

Usually the nutrition strategies for woman with GDM include moderate in fat and protein diet. The food should provide controlled levels of carbohydrates through foods including fruits, vegetables, and complex carbohydrates (rice, cereals, others). The foods that have a lot of sugar (soft drinks, fruit juices, cakes, others) should be excluded.

The diet usually includes three small/moderate sized meals and one or more snacks daily. Meals and snacks should not be skipped.

Carbohydrates should be not more than half of the calories for the day. Vegetables should persist minimum in 3 of the meals for a day. Example one serving for one meal equals to: 1 cup leafy, green vegetables; 1 cup cooked or chopped raw leafy vegetables; 3/4 cup vegetable juice; or 1/2 cup of chopped vegetables, cooked or raw [11]. It is better to choose fresh vegetables without added sauces, fats, or salt. The diet should include 2 medium whole fruits daily, because they have more fibres than fresh juices. Milk and diary products could persist in 3 of 4 of the meals daily. It is better to choose low-fat or nonfat milk or yogurt without added sugar or artificial sweeteners. Rich protein food like fish, meat, eggs should be consumed two times daily (about 1.1 g/kg per day) [54-55]. The consumption of fats should be balanced. Fats are important nutrients so should not be excluded from diet. It is recommended for a pregnant woman with GDM to record everything she eats during the day to track dietary compliance. Recent studies suggest that the use of food supplements (multiple micronutrient supplements) gives many benefits during a normal pregnancy, GDM pregnancy, could reduce the risk of preeclampsia and improve pregnancy outcomes [13]. Food supplements are also an essential part of diet for woman with GDM. Supplementation strategies should be done according the individual needs. According to the European Community Directive of 2002 (Directive 2002/46/EC) food supplements are defined as substances that contain

concentrated nutrients or other elements with a nutritional or physiological effect, alone or in combination, distributed in certain dosage forms designed to enrich diet [23, 15]. Some of the most important food supplements for woman with GDM are (table 2): folic acid, multivitamins, vit. D, myo-inositol and others.

Table 2. Food supplements during pregnancy

Food supplement	Purpose
Folic acid	• 400 mkg of folic acid supplements daily both before and during early pregnancy to prevent neural tube defects [27].
Vitamin C	• antioxidant activity; • reduces the risk of preeclampsia.
Vitamin E	• antioxidant activity; • reduces the risk of preeclampsia.
Vitamin D	• necessary for the absorption and metabolism of calcium [27-29]; • support the immune system; • some researcher consider that low vitamin D intake is linked with insulin resistance and diabete [27, 30, 31, 45, 47].
Inositol (*myo*-inositol) fig.1	• it accelerates the dephosphorylation of glycogen synthase and pyruvate dehydrogenase[37]; • associated with a reduction in the fasting blood glucose concentration [38,39]; • prevention of GDM [43].
Omega-3 fatty acid	• beneficial effects on insulin resistance, but do not affect plasma glucose [46, 56, 65]
Selenium suppl.	• beneficial effects on glucose metabolism and biomarkers of oxidative stress [57,58].
Others	

Inositol is a derivative of cyclohexane with 6 hydroxyl groups. There are 9 isomers of inositol (myo-inositol, scyllo-inositol, muco-inositol and others). Foods rich of inositol are fresh fruit and vegetables, nuts, cereals, legumes [40,41].

Recent studies have identified myo-inositol as a potentially new and novel treatment for GDM [37-40]. The researchers Costabile and Unfer have reported a significant decrease of glycemia in a faster and steady way at fasting, one hour and two hours after-meal post oral treatment with 4 g of myo-inositol/ 3 times per day. Another study confirm that the intake of folic acid and myo-inositol increase the index of composite whole body insulin sensitivity (from 2.80 +/- 0.35 to 5.05 +/- 0.59 mg(-2)/dl(-2)) [44].

GDM patients are at hight risk of developing pre-eclampsia [40, 42] and for this reason it is essential to be included in the nutrition strategy antioxidant food supplements (vit. E, A, C).

Supplementation with vitamin D for women with GDM is also very important: it gives many beneficial effects on glycemia and total and LDL-cholesterol concentrations [45]. The intake of Omega-3 fatty acid gives also beneficial effects on insulin resistance [46]. Several recent studies have demonstrated that probiotics give some benefits in prevention of GDM and also affect glucose metabolism and weight gain among patients with GDM [48- 52, 63, 64].

Woman with GDM should receive medical care from a physician-coordinated team like: physicians, nurses, nutrition specialists, pharmacists. These medical specialists should work collaborative and with approach that is individual for different patients. The medical care is essential for the quality of life and self-management education of woman with GDM. It is very important for these patients to receive diabetes self-management education according to national standards. The management plan usually is formulated as a collaborative therapeutic alliance among the patient and family, the physician, and other members of the health care team [15,16, 23, 53]. The influence that health care providers and health education may have on habitual dietary practices during pregnancy is growing [24]. Recent studies demonstrate that the educational approach has the potential to improve patient's quality of life [17, 53, 59, 60, 61, 62, 65]. When diet alone is ineffective at maintaining

fasting glucose values below 5.5 mmol L^{-1} and 1 h postprandial below 7 mmol L^{-1} insulin treatment is required [27, 32]. A small percentage of women with GDM would require insulin early in pregnancy: usually these patients are those most metabolically compromised [27, 33-36].

4. Conclusion:

Well balanced diet is an essential factor for health outcomes of all pregnant women. Nowadays GDM is a common complication of pregnancy. In a pregnancy complicated by GDM the glucose control is foundational. The management of GDM includes: controlling maternal hyperglycemia with diet alone or combination between diet and insulin, regular blood glucose measurement. The effective self-management of the GDM is an essential part of the quality of life of these patients. Nutrition strategies for GDM include regular meals and snacks that contain a large component of slowly absorbed carbohydrate, intake of food supplements. Usually the diet for GDM avoid excessive maternal weight gain because many of the women with GDM are obese, which further compromises pregnancy outcome.

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First Author: Stanislava Ivanova, PhD
Second Author: Kalin Ivanov, PhD
Third Author: Radiana Staynova
Fourth Author: Vanja Rangelov
Fifth Author: Lili Stoilova