

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,800

Open access books available

122,000

International authors and editors

135M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.

For more information visit www.intechopen.com



The Influence of Diet to Control the Metabolism in Gestational Diabetes Mellitus

Rebeca Monroy-Torres¹ and Jaime Naves-Sanchez²

¹University of Guanajuato, Department Medicine and Nutrition;

²IMSS-48, HMI-SSG

Mexico

1. Introduction

Gestational diabetes mellitus (GDM) is the intolerance to carbohydrates, first recognized during pregnancy. The prevalence of GDM has been increasing in the world and it affects more than 200,000 women every year.

This chapter emphasizes and discusses the role of the dietary and nutritional aspects of the GDM. First, we will do a general review about the transitional changes in food that are experienced worldwide, their phases-dietary habits, industrialization, globalization, culture, the media as television, video games which have led to changes in the eating patterns and how this diet style promotes a metabolic disease, which will be supported with Mexican evidence. Second, we will do a general literature review of the most important nutritional and dietetic recommendations, findings, calculation and prescription of a correct diet (Distribution of: proteins, lipids and carbohydrates), in combination with counseling nutritional importance. Next, we will compare two recommended diets for GDM with the evidence we got from our research. Moreover, we will discuss the advantages and disadvantages of the glycemic index and how a low and moderate one allows the control of blood glucose. The glycemic index is defined as the area under the curve of glucose response after eating a recommended amount of carbohydrates from a test food after a control food (white bread or glucose), and these had been considered part of the control of blood glucose. Besides, we present the methods for collecting diet information as a complement to improve the follow up and the adherence to GDM. Other important aspects to discuss are the importance of the preventive and promotional strategies in the medical nutrition therapy, physical activity, benefits, risk and the type of exercise for GDM, education, psychological support, insulin and drugs. The prevention and promotion should consider economical and social aspects because pregnant women use to change their food consumption because of economical influence. The health costs and long management of GDM mothers have a wide range of possible complications. These recommendations should result in adequate weight gain for the fetus and the woman. A deficit in the weight gain is associated with intrauterine growth restriction for the fetus. Dietary control is defined as a part of the comprehensive treatment of GDM and the diets low in carbohydrates, lipids, and proteins have demonstrated to reduce hyperglycemia and to prevent macrosomia compared with diets high in carbohydrates carbon.

The main goal of the dietary treatment is to maintain the maternal and fetal health and the diet with low carbohydrates help to the management of GDM, where the main goal is to achieve and to maintain blood glucose and glycated hemoglobin according to the practice guidelines for GDM and to avoid ketonuria. The adherence to dietary treatment is difficult in most patients when they intake lower amount of carbohydrates. The findings reported in the control of the GDM such as changes in weight gain, energy intake, and macronutrients are part of a basic treatment to prevent complications for the fetus and the pregnant mother. We will review of promotion and prevention activities as part of the dietary treatment. Finally, we hope that this information let discuss new alternatives for GDM.

2. Diet: Transitional changes

Since the last century, many countries have experienced changes in health and food patterns that are characterized by an increasing prevalence of chronic diseases. These chronic diseases are the principal cause of death and commonly happen particularly particularly in pregnant women and children. There are many factors that may explain these changes and one of the most important one to consider is the dietary habits because they explain the metabolic diseases (Avila A, et al., 1995; ENSANUT, 2006). As mentioned above, there are other factors that might explain these changes and the principal ones are the alterations in dietary habits that are considered important to explain the metabolic diseases (Avila A, et al., 1995; ENSANUT, 2006). For example, México is living an epidemiological transition that has occurred in recent decades. For instance, the most common causes of death in this transition are cardiovascular diseases, cancer, accidents and diabetes. Fifty years ago, most of the causes of death in the Mexican population were related to diarrhea and respiratory diseases. The research done at the Mexican National Institute of Nutrition supports the idea that the proportion of animal products in the diet of Mexicans has increased sharply. In addition, fast food, in most countries, is considered as a frequent choice for many people who live in the city. The epidemiological changes that have occurred in many countries are not homogeneous throughout the world; for instance, they vary according to geographical, regional and socioeconomical factors. Based on the studies carried by Romieu, et al., it is possible to observe the coexistence of over nutrition and under nutrition in the same population. In underdeveloped countries, it is possible to observe that about one-third of children under 5 years are stunted, and 20% of women are obese. (Romieu I, et al., 1997).

The dynamic of the epidemiological aspects in many countries provides challenges and opportunities for studying dietary habits. These dietary habits can serve as the base for conducting studies about how the diet can modify the occurrence of chronic diseases, and the impact on the nutritional health can be investigated as well (Romieu I, et al., 1997; Ávila A, et al., 1995). Other than dietary habits, there are more factors to be considered at risk for developing obesity such as: excessive consumption, physical activity, sedentary and hereditary factors. Many countries have had an apparent economical development during the last decade and has contributed to the lifestyle, eating habits, customs, behaviors, etc. The diet of developed countries consist of cereals, legumes, fruits and vegetables. These changes are similar to those of the industrialized countries (high-energy diet, protein, animal fat and low fiber). This is the price we have had to pay for the globalization that our world is facing because this is the result of the free trade agreement in developed countries. Moreover, the powerful influence of the North American culture has affected the entire world. One example of this is the payment-saving culture „pay less, get more“ so it is

cheaper to be obese. The same phenomenon operates in fast food restaurants and convenience stores, among others.

The industrialization of a city has as a consequence that some products contain raw poor materials disguised with flavors that result in products of low nutritional value but tasty. They are also well supported with good marketing strategies and are aimed especially to children. Another important finding is that some Latin American countries spend from 20 to 30% of their income in food and they have the highest consumption of soft drinks in the world; hence, soft drinks have replaced water consumption. In addition to this, the presence of obesity in the family is an important factor to be considered because if both parents are obese then, the risk of obesity in children is 80%. Television and video games are other factors of great influence. In countries where the habit of reading is replaced by television and video games, it has been observed that there is an adjustment in children's behavior and habit consumptions of some products. For example, 85% of the commercials on TV promote soft drinks, desserts and fried food (Ramirez JA, et al., 2003).

Sciences such as demography and epidemiology help to understand the phenomenology behind food and nutrition in a systematic way. Where the diet habits are related with the culture, traditional habits, climate, available foods, etc. These habits do not change immediately. Transitional nutrition has five phases or periods that the majority of societies experienced and these are (Nielsen, S & Popkin, B, 2003):

- a. Stage of "*food gathering*". The diet is high in carbohydrates and fiber but low in fat. This stage is characterized by the hunting and gathering of food.
- b. Stage of "*starvation*". It occurred with the early development of agriculture when food was less varied and linked to periods of extreme food shortages.
- c. Stage of "*increased consumption of fruits, vegetables and animal products*". Starches begin to be less important in the basic diet. This stage is related to the industrial and the second agricultural revolution.
- d. Stage of "*Presence of chronic degenerative diseases*". It increases with the prevalence of obesity as a result of the consumption of diets high in fat, cholesterol, refined carbohydrates, small amounts of polyunsaturated fatty acids and fiber and physical inactivity. In this stage there is an increase in the population that migrate to big cities where home and work are located far away from traditional markets.
- e. Stage of "*behavioral change*". This stage is characterized by the adoption of healthy diets, physical activity and the abandonment of traditional diets. Here, the consumption of cereals and tubers is very important. In this stage, there is a tendency to a global homogenization of the type of food that is consumed. Then, an intake of high energy, total fat, saturated fat and simple sugars is required. Moreover, physical activity decreases due to changes in occupational activities, transportation facilities, these contributed to increase the chronic diseases (diabetes mellitus, hypertension and atherosclerosis) related to overweight and other nutrition aspects.

Finally, it is necessary to say that each country goes through these periods of transition at different times and with a different speed.

The main characteristic of transactional nutrition is that these changes occur more rapidly in middle or low income countries than in the high-income ones. In low income countries, there is a negative impact in their economical growth due to that the fact that they spend more money in getting food of low nutritional value such as oils and fat of poor nutritional quality.

This is done with the purpose of getting cheaper food that can be obtained faster by people. However, the use of this kind of food promotes the appearance of cardiovascular diseases.

Changing of food consumption has altered in many countries because, they prefer to buy prepared food than to cook it at home. As a result, the consumption of oilseeds, vegetable oils, fish and seafood has been decreasing but there is an increment in the consumption of animal fat, alcoholic beverages, meat and eggs consumption. These habits increase the costs and the quality of ingredients in food (Ortiz-Hernández, L, et al., 2006; Monroy-Torres R, et al., 2010). The changes mentioned above are part of the evidence that has been gathered from the population that lives in urban areas, people employ in the tertiary sectors and the actual role of woman (Ortiz-Hernández L, et al., 2006).

The determinants of the are located mainly in both, the social organization and the technological progress of the society (Ortiz-Hernández, et al., 2006). Another determinant that is also important to consider is the educational level. During the periods of 1988-1994 and, 2007-2008, the prevalence of childhood obesity in United State increased at all income and educational levels (CDC, 2010).

According to diet and disease, 20 years ago, it was discovered that low birthweight was associated with an increased risk of adult diabetes and cardiovascular disease (CVD). A hypothesis was formulated with this information, which states that the exposure to undernutrition in early life increased the risk to develop these disorders in the metabolic programming. In order to solve the problem caused in the metabolic programming, it has been proposed another hypothesis that claims that it would be important to improve the nutritional state from the pre gestational stage to the gestational stage and finally the nutritional attention to the new born to prevent common chronic diseases in the future. The research done with low birth weight children in many countries shows that they have increased CVD risk factors. The scientific findings gotten from maternal nutrition have contribute to understand the role of specific nutrients in the maternal diet, like low maternal vitamin B12 status, which predicted the increased of adiposity and insulin resistance in children, especially if the mother had a folate deficiency. Both maternal undernutrition and gestational diabetes cause problems (glucose excess) They have also been associated with increased adiposity and insulin resistance in children. In underdeveloped countries, it has been noticed that undernutrition and overnutrition coexist. Recent intervention studies in developed countries have shown that CVD risk factors in the offspring can be improved by supplementing undernourished mothers during pregnancy. Of course, results differ according to the population, the intervention and the post-natal environment (Fall C., 2009).

3. Evidence in the diet management of gestational diabetes mellitus

Dietary therapy is the most important factor to be consider in the treatment of GDM. Therefore all women with GDM must receive counseling from a dietitian. Recommendations have to be individualized after a dietary evaluation of each patient. The two main objectives for the treatment of GDM are to achieve normoglycemia and to provide the required nutrients for normal fetal growth and maternal health. A third objective that is also considered to be important, is to prevent excessive maternal weight gain, particularly in women who are overweight or have gained excess weight in pregnancy.

Few trials have analyzed the efficacy of dietary therapy for GDM. A cluster randomized controlled study supports that Medical Nutrition Therapy (MNT) for GDM is recommended by the American Diabetes Association (ADA, 2010). The MNT is a lifestyle intervention that

consists of an integral component of diabetes prevention, management, and self-management education (Goldhaber-Fiebert JD, et al., 2003).

A recommended diet for the glucemia control in GDM must be low in carbohydrates, with a percentage between 35% and 50%; lipids from 30% to 40% and 20% of protein, of the total calories. This distribution has proved to reduce hyperglycemia and prevent macrosomia, when compared with diets high in carbohydrates (Franz M, et al., 2002).

These recommendations must include a nutritional counseling because the excessive restriction of carbohydrates (< 120g) increases the risk of ketonuria, low birth weight and defective supply of glucose to the fetus impact on the neurological development (Pastor JG, et al, 2002; ADA, 2007; ADA, 2003, 2010; Major CA, et al, 1998). Besides the aforementioned, it is necessary to say that low carbohydrates diets make it difficult for patients to adhere to the treatment.

According to the American Diabetes Association (ADA 2010), a good diet control must, apart from getting glycated hemoglobin values (HbA1c) less than 6% and avoiding ketonuria (Standards of Medical Care in Diabetes-2008) maintain the capillary blood glucose concentrations in ≤ 95 mg/dl (Preprandial); ≤ 140 mg/dl (1-h postmeal); ≤ 120 mg/dl 2-h (postmeal). Regarding to plasma-referenced capillary blood glucose, the values suggested are ≤ 105 mg/dl (Preprandial), ≤ 155 mg/dl (1-h postmeal), ≤ 130 mg/dl (2-h postmeal) (Standards of Medical Care in Diabetes-2008). With these recommendations, patients with GDM should have an adequate weight gain for them and the fetus as well. The weight gain recommendation is calculated based on prepregnancy weight or with the body mass index (BMI). A deficit in weight gain is associated with intrauterine growth restriction (Pastor, et al, 2002).

Monroy-Torres R. et al. studied the influence of an individualized diet of low glycemic index to control GDM in woman between 24 and 26 gestational weeks. The diet was structured with 52% of complex carbohydrates and food of low and moderate glycemic index with 30% fat and 18% protein (plus 10 grams). The findings from the study were that the pregnant women with GDM did not have adverse effects related to blood glucose, glycosylated hemoglobin and weight gain. The newborns did not develop macrosomia. The adherence observed was higher for calorie and macronutrient intake.

3.1 Glycemic index and glycemic load

According to Jenkins, the glycemic index (GI) is defined as the changes in blood glucose concentration after consuming food which then has to be compared with standard amount of carbohydrate of a control food (white bread or glucose) (Jenkins DJA, 1984). The food with low and moderate GI has been considered as a part of a glycemic control; where the increased in the percentage of carbohydrates up to 60% of total calories is allowed when and if food of low and moderate glycemic control is given (Fraser RB, et al, 1988). The consumption of processed food or food with low fiber content increases the glycemic index while the GI decreases with food high in fiber, fats, proteins and it depends on the cooking process. Moses R et al., 2006, compared the effects of a diet of low glycemic index with a diet of high GI. Both diets had 55% of carbohydrates. Women with GDM who had a diet with high glycemic index gave as a result that they had a newborn with high weight (large for gestational age) and higher ponderal index. Another important concept to discuss is the load Glycemic (LG) - that is the amount of carbohydrates in a specific food. The GI of food is not always easy to predict; for example, we could think that an ice cream has a high GI but it has low GI according to published charts. The reason is that an ice cream has fat and proteins, this combination decreases the digestion of glucose.

While the World Health Organization, the American Diabetes Association, Diabetes UK, and the Canadian Diabetes Association support both concepts (IG and LG), and many other health professionals consider that to use GI and GL is complex because both have many variables that change their values and responses in the blood glucose. This is why their use in the clinical practice is debatable (Franz M, 2003). Other explanation is that different tables; with GI and LG values for different food, show different values for GI among the existing tables which gives as a result that their use is consider controversial specially with new data has become available since the first tables were published in 2002 (Atkinson F, 2008; Foster-Powell K, 2002). However, the most important recommendation is to follow up the advice of the Standards of Medical Care in Diabetes 2008: choose a variety of grains, fruits, and vegetables, with an emphasis on whole grains and other high-fiber foods, to work with dietary and behavioral changes

3.2 Calculation and prescription of the diet

The American Diabetes Association consensus to manage GDM recommends to take into account the dietary calculation (ADA 2010) to consider the value of BMI. According to the clinical experience the diet prescription must be individualized (Jovanovic L, 2000). The diet may be calculated in a range between 1700 and 2000 kcal/day. It is important to avoid diets with caloric content lower than 1500 Kcal because the risk of ketonuria can be increased. The calculation and distribution of macronutrients can be as follows:

- Protein: 18% (range of 10 to 20%; add 10 g, of the gestational period)
- Fat: 30% (of these 7% saturated), range of 25 to 40% and reducing the intake of trans fat lowers LDL cholesterol
- Complex carbohydrates: 52% (range of 40 to 60%)

The American Diabetes Association (ADA, 2004) recommends to add 25 kcal per kilogram during pregnancy. A strategy to evaluate the adherence to energy consumption is to monitor weight gain which should not exceed 400 grams per week from the second trimester of pregnancy.

According to the table 1, we can see how the range of carbohydrates varies between 40% and 55% or more of the total calories. The American Diabetes Association of the United States recommends that all pregnant women with overweight and / or GDM should receive a diet with 35-40 grams of carbohydrates (simple carbohydrates), from food with low glycemic index. However, a consumption of carbohydrates less than 40% is risky because it results in ketonuria (ADA, 2010).

Variables	ADA 2010	Euglycemic diets
*BMI: 80 -120 %	35 Kcal / Kg (ideal weight)	30 Kcal / Kg (ideal weight)
*BMI: 121 -150%	35 Kcal / Kg (ideal weight)	24 Kcal / Kg (ideal weight)
*BMI: >= 151 %	35 Kcal / Kg (ideal weight)	12 Kcal / Kg (ideal weight)
Protein requirement	20 % of total calories	20 % of total calories
Fat intake	< 25 % of total calories	>= 40 % of total calories
Saturated fat intake	<7% of total calories	
Carbohydrates requirements	> 55 % of total calories	< 40 % of total calories
Cholesterol Requirements	300 mg/d	< 800 mg / d

* Relationship of BMI based on the percentage of body fat

Table 1. Comparison of diets recommended in GDM

We can observe in table 1 that the range of carbohydrates varies from less than 40% to over 55%. The American Diabetes Association of the United States recommends that all pregnant women with overweight and/or GDM must receive a diet with 35-40% of carbohydrates and food with low GI. The percentage of calories, that depends on carbohydrates, is reduced, a 20% of proteins and 30% of fat is recommended. This is done to keep the balance of macronutrients. In fact, it is advisable that the distribution to be similar to a normal diet but it is important to have considered the quality of food and macronutrients (ADA 2004; 2010). It is important to control the intake of carbohydrates because they are the first nutrient that affects the postprandial glucose levels in addition to breakfast carbohydrate load.

During pregnancy, hormone levels of placental lactogen, cortisol, progesterone and prolactin increase and this affects the insulin to lower blood glucose levels. Therefore, breakfast carbohydrate load of 15 to 30 g is recommended. The total daily carbohydrates and calorie intake should be individualized according to glucose control. When a dietitian designs a meal plan, carbohydrates intake should be distributed during the day in a three time meal and two or three small meals (snacks) (Sheard, N.F., et al., 2004). For example, a diet of 2000 calories where the carbohydrates can represent a 40% of total calories; that in grams is equivalent to 200 grams, the total calories should be distributed during day as follow:

- Breakfast 7.5- 10% (15- 20g)
- Snack 10% (between breakfast and lunch)
- Lunch 35%
- Snack 15% (between lunch and dinner)
- Dinner 20%
- Evening Snack 10%

The minimum amount of carbohydrates required to prevent the starvation activation systems (ketosis) of fasting is between 100 and 150 grams per day. According to the Food and Nutrition Board in 2002, 130 grams per day of carbohydrate is enough to satisfy the glucose requirement of the brain (FNB, 2005). Moreover, this recommendation should provide a list of food of low and moderate glycemic index (≤ 55 and from 59 to 69, respectively). Each country has different patterns of food exchange that are based on the consumer habits and customs of each population. For example, Mexico has the Mexican Food System Equivalents (Marvan L, et al., 2008), it is an educational system that is provided to patients with GDM to explain the amount of food intake from different food groups. To understand better the amounts and real food portions, the dietitians often used food replicas. Based on what it was meal times explained above, food should be distributed depending on the glucose control in six or seven meals (three main meals and three or four snacks) (Jovanovic L, 2000, Monroy-Torres R, et al., 2008). Dietary and nutritional advice, lifestyle counseling and restricted food should be provided to patients in a written list. Adding proteins and fat to the meal plan for woman with GDM will not raise the postmeal glucose levels and to satisfy the woman's hunger during the day (Monroy-Torres R, et al., 2008).

The methods to collect dietary information vary in their accuracy and ease use. The 24-hour recall is one of the easiest methods to collect information from the patient's intake. It consists of obtaining information from food and fluid intake from a previous day (24 hours) and it is based on the assumption that the intake described is typical of a daily intake. However, the method has important problems; for example, the patient may not be able to

recall the eaten food or not to estimate the amount of food eaten. On the other hand, the method offers the advantage of analyzing the average consumption of energy, carbohydrates, fats and proteins from the diet. This allows to analyze to the amount of food and the adherence to the diet from the beginning and to follow it up. Another method is the Food-frequency-questionnaire that is often used in combination with the 24-hour recall. The food-frequency-questionnaire provides a list of food or food group where the patient can have different options to answer like: rarely, never, frequently, occasionally, daily, weekly and monthly. The Food-frequency-questionnaire is only recommended to use only at the beginning and the end of GDM treatment and this method is useful to evaluate changes in the eating habits and to analyze the diet of patients within the next parameters: *adequate, complete, balanced, enough and varied* - these define a recommended diet. A diet is recommended for GDM when it has all these parameters: a) Enough: means to cover the energy requirements according to the individual characteristics like age, weight, physical activity and physiological conditions, b) *balanced*: means to intake nutrients based on references amounts (52% of complex carbohydrates, protein in 18%, fat in 30%); c) Complete: means to include at least three food groups at every meal and, d) varied: means to include different types of food within the same group, in a day (Marvan L, et al., 2008). Food records and postmeal monitoring of blood glucose can help to identify food that is less tolerated and to let individual nutrition and food recommendations changes (Sheard, N.F., et al., 2004).

If the modification of the food plan alone does not prove to achieve and maintain normoglycemia, then insuline therapy is needed. To achieve the goals with the use of insulin, women must eat the correct amounts of carbohydrates and they must eat at regular meal times (ADA, 2010), all above information is important to avoid unnecessary hypoglycemia risk. Exchange lists or counting carbohydrates are the methods that help patients with GDM select and decide themselves what to eat according their glucose levels and their insulin therapy. Since insulin is the therapy of choice for most diabetic women, several authors suggest to apply the method of carbohydrate counting or exchange lists during the first nutrition interview. In table 2, you can see the recommendations of a dietary treatment in combination with insulin that depend on the response to the glycemic control (Standards of Medical Care in Diabetes-2008).

Preconception stage	First strategy	Second strategy
Normal	Diet	Diet + Insulin
GDM controlled with insulin	Diet + Insulin	
GDM controlled hypoglycemic drugs	Diet + Insulin	Diet+ Insulin
GDM controlled with diet	Strict Diet	Diet+ Insulin

Adapted: Monroy-Torres-Sanchez Naves R & J, 2011

Table 2. Recommendations of dietary treatment in combination with insulin in GDM

The ADA (2010) mentions that all women should receive individualized counseling to provide adequate calories and nutrients during pregnancy. This counseling must help achieve the goal and maintain the blood glucose (fasting 105 mg/dl , 1 hr 155 mg/dl , and 2 hrs 130 mg/dl) and glycated hemoglobin (HbA1c)in 6%. For obese women, the treatment must be a 30%–33% of caloric restriction, it means near to 25 cal/kg per day is recommended, which should be calculated with the current weight. Carbohydrate should be restricted to 35%–40% of calories. There are also data that support the use of low carbohydrate diets in pregnancy, and for carbohydrates to be low, the glycemic index. In a nonrandomized study, there was evidence that women with GDM on a diet comprising less than 42% carbohydrate, had lower post-prandial glucose levels, were less likely to require insulin, and had a lower incidence of large for gestational age. A small study with randomized pregnant women with low GI or high GI diets found that the former resulted in lower glucose levels, a blunting of the pregnancy associated rise in insulin resistance, and lower birthweight. In another study of GI, women assigned to a low GI diet during pregnancy gave birth to infants who were lighter and had a lower incidence of large for gestational age, compared to women given a high GI diet. Additional dietary measures are usually based upon the general recommendations for diabetes mellitus. A reduction in simple carbohydrates and fat intake is advisable. Emphasis is given to spreading the dietary intake over six meals daily, with three main meals and three snacks in order to avoid large carbohydrate loads at any time. Except for saccharin, which can cross the placenta and is therefore not recommended, other noncaloric sweeteners may be used in moderation (Moses, R., et al, 2006).

4. Preventive and promotional strategies

Medical nutrition therapy (MNT), including:

- Education
- Diet
- Physical activity
- Where justified, Insulin
- Psychological support to improve acceptance and adherence to disease treatment

We must consider that if GDM is not diagnosed at the early stage, mother' dietary habits and overall health in this period will have consequences in the short, medium and long term effecting the child as well. Regarding to the educational intervention, patients with GDM should know:

- What is GDM?
- The importance of metabolic control and risk of ketonuria
- Characteristics of recommended diet plan
- Self-monitoring techniques
- Goals of the blood glucose control
- Types of insulin, application techniques (where insulin is required)
- Importance of early intervention, monitoring and control postpartum
- Prevention of future type 2 diabetes mellitus

Weight loss is not recommended during pregnancy, even though the woman is obese. For during the GDM is necessary that weight gain should be in the lower ranks recommended,

according to the start value of BMI except in the adolescent woman , where the weight increment must be higher.

The objectives of a diet plan are:

- Get optimal metabolic control and to prevent hypoglycemia
- Adequate weight gain during pregnancy

Some studies recommend energy consumption between 1800 and 2200 kcal, bearing in mind that weight gain should be among the lower ranks. In adolescents, low weight or great complexion is recommended to increase energy requirements.

The exercise is useful to help control metabolism. The type of exercise for pregnant women is with the work that can be done with the upper extremities. However it is contraindicated in the following cases:

- Increased uterine contractions
- Multiple pregnancy
- During hyperglycemia and hypoglycemia
- history of stroke or arrhythmia
- Hypertension

4.1 Physical activity

Currently more pregnant women want to have their pregnancy in natural and healthy conditions. Exercising in pregnant women is controversial as to the changes presented in their body and the hormonal levels. A long time ago, pregnancy was experienced as an illness, and had several myths related to it, including the exercise. The scientific arguments to restrict physical activity during pregnancy suggest that exercise causes an increment in maternal body temperature and therefore in the fetus too, with increased release of catecholamines, decreased circulating glucose and decreased blood flow to the placenta. However, there are other scientific studies that show the benefits of a regular physical activity during pregnancy to maintain health. When it is a normal pregnancy is recommended that pregnant women continue to perform normal physical effort.

For athletes, it is recommended to decrease the intensity, especially during the second trimester of pregnancy and especially during the last month. Pregnancy increases the elasticity of the ligaments by the effect of hormones released during pregnancy. For this reason, it is advisable to practice sports that do not require jumping, excessive stretching and to use appropriate footwear. Some reported benefits of regular moderate physical activity during pregnancy are (Artal, R. & Toole, M.O ., 2003):

- Helps improve fitness and body image of pregnant women, contributing to increased weight.
- Maintains cardiovascular function.
- Improved glycemic control.
- Promotes the welfare state joins mother and a better mood by providing psychological benefits.
- Decreases stress and anxiety.
- Provides better labor
- Promotes weight recovery after childbirth.

In people with type 2 diabetes, there is a lot of evidence that suggests that regular physical activity improves insulin sensitivity, weight loss, thereby improves glucose control. Several studies have examined whether regular exercise is also beneficial in the management of GDM, for example, Jovanovic L, (Jovanovic L, 2000) randomized 19 women with GDM to a regime of diet alone, or diet with 20 minutes of supervised aerobic training three days per week for six weeks. This modest amount of physical activity resulted in lower fasting glucose levels, lower glucose responses to a glucose challenge, and a lower HbA1c. Another study randomized 29 women with GDM to 30 minutes of exercise (70% of maximal heart rate) of three to four times per week. In this case the glucose levels did not improve in those who exercised. The action might be through the activation of AMPK, a kinase that is activated during exercise, it is possible that exercise may act through the same molecular cellular pathway and therefore there are not additive effects of these two treatment regimens (Hardie DG, 2004).

Another study found that women with a prepregnancy value BMI of 25 and who were in the exercise program were less likely to require insulin. Therefore, it seems reasonable to recommend that when there is not medical or obstetric contraindication, women with GDM should maintain a sensible level of light and moderate intensity if there is physical activity during the pregnancy. The above studies provide enough evidence that moderate physical activity such as walking between 20 and 30 minutes each day, or three to four times per week, through this they can achieve the glycemic control. The diet should provide with adequate nutrition for pregnancy. Carbohydrates should be distributed throughout the day over main meals and snacks. Limiting carbohydrates at 40% of the total caloric intake and having a higher proportion of carbohydrates of lower glycaemic index decreases postprandial glucose levels and reduces the need for insulin therapy (Smith, C.S. & Van Andel, R., 2001; Artal, R. & Toole, M.O., 2003).

There is not enough evidence to support dietary or drug treatment in patients with gestational diabetes. Gestational diabetes and impaired glucose tolerance are associated with macrosomia and may be associated with an increased risk for cesarean delivery, shoulder dystocia, and birth trauma. Although preexisting diabetes has been shown to increase the risk of poor perinatal outcomes, it is not clear that data relating to preexisting diabetes can be extrapolated to patients with gestational diabetes.

Tuffnell and colleagues (Olwan N, 2009) researched the Cochrane Pregnancy and Childbirth Group trials register, the Cochrane Central Register of Controlled Trials, and bibliographies of relevant articles. They identified three studies of 223 women with impaired glucose tolerance; none of these studies was a randomized controlled trial comparing management strategies. Intensive management of gestational diabetes is time-consuming and resource-intensive. Overall, the evidence is insufficient to support the therapy for gestational diabetes. However, universal screening is the standard of care in most communities. When faced with abnormal results, most family physicians will opt to follow the consensus opinion of our specialist colleagues. For example, a study that analyzed the higher egg and cholesterol intakes found that they are associated with increased risk of type 2 diabetes mellitus. It was also observed that the higher egg and cholesterol intakes before and during pregnancy are associated with an increased risk of GDM. (Qiu C, et al., 2011).

Several lines of evidence indicate that realistic modifications of diet and lifestyle can prevent diabetes type 2. Some of the main determinants include lack of physical activity, hours of TV watching, low quality and energy dense diets, and high caloric sweetener intake. Caloric beverages have been recognized as an important source of energy and have been associated with an increased risk of overweight. (Schulze MB, 2005; Ludwig DS, 2001).

Lifestyle modification, to increase exercise and to modify diet habits are an effective way of to prevent and to delay the onset of type 2 diabetes in the future in women with GDM. One important aspect of combating the epidemics of obesity and type 2 diabetes has been through dietary strategies. Recently, very-low-carbohydrate diets have gained much popularity. Recently the effects of a diet lower in carbohydrates and higher in protein has been evaluated in obese and over-weight patients with type 2 diabetes for analyze the changes in blood glucose levels and in the insulin resistance. Because glucose is the major insulin secretagogue carbohydrate, its reduction would be expected to be beneficial in type 2 diabetes and the use of such diets. Although, as noted above, official recommendations generally continue to suggest low fat and high carbohydrate intake (Arora & McFarlane , 2005; Fioster GD, 2003) .

Efforts to change diets, physical activity patterns, and other aspects of lifestyle have traditionally attempted to educate individuals through schools, health care providers, worksites, and general media. These efforts will continue to play an important role, but they can be strongly reinforced by policy and environmental changes.

5. Conclusion

The control and prevention of GDM must be the principal goal. The dietary treatment must be based on the design and prescription of diets according to cultural habits, economical aspects and the diet must be accessible. The family, the health team and the society should be into the treatment of the GDM, mainly the prevention of diabetes mellitus type 2. To achieve this goal the authors suggest:

- To evaluate the best evidence in the dietary management of patients with GDM and to design programs that involve motivation.
- To monitor weight gain in pregnant women according to pre-pregnancy BMI and considering the biochemical markers, including glucose and glycated hemoglobin in order to adapt and correctly identify the nutritional treatment.
- To monitor not only fasting glucose, but the postprandial
- To increase surveillance and to monitor at intervals of 3 to 4 weeks in each appointment, for increasing the adherence to the diet.
- To perform several scientific studies to identify other factors that support control of the GDM.

Finally, it is important to consider the economical and social influence (Wilson C, 2003). Pregnant women usually modify their food intake according to the influence of their nutritional orientation . The full costs to achieve a behavioral change and the policies are complex and difficult to estimate. The efforts to reduce the increment of diabetes mellitus type 2, is screening pregnant women. In sum, the benefits will be for the fetus growth and health for both

6. Acknowledgment

Teacher Gabriela Ramirez-Tavares and Joseph Gerald Phillips for their contributions to this English version. Medical and Nutrition Department, Health and Science Division , Campus Leon, University of Guanajuato.

7. References

- Alwan, N; Tuffnell, DJ; West J. (2009). Tratamiento para la diabetes gestacional: (Revision Cochrane traducida). En: *Biblioteca Cochrane Plus*; Num 3. Oxford: Update Software Ltd. Available in: <http://www.update-software.com>; <http://www.biblioteca-cochrane.com/BCPGetDocument.asp?SessionID=%201659402&DocumentID=CD003395#CD003395-fig-00120>
- American diabetes association. (2003). Position statement: Gestational diabetes mellitus. *Diabetes Care*; 26(suppl 1): S103-S5. ISSN: 0149-5992
- American Diabetes Association. (2004). Gestational diabetes mellitus (Position Statement). *Diabetes Care*; 27(Suppl. 1): S88- S90. ISSN: 0149-5992
- American Diabetes Association. (2007). Standards of medical care in diabetes 2007. *Diabetes care*; 30: suppl 1: S4-S41. ISSN: 0149-5992
- American Diabetes Association. (2010). Standards of Medical Care in Diabetes—2010. *Diabetes care*;33 (suppl 1): 11s-61s. ISSN: 0149-5992
- Arora, SK & Mcfarlane, SI (2005). The case for low carbohydrate diets in diabetes management. *Nutr Metab*; 2:16. ISSN: 1743-7075
- Artal, R. & Toole, M.O . (2003). Guidelines of the American College of Obstetricians and Gynecologists for exercise during pregnancy and the postpartum period. *Br J Sports Med* ;37:6-12. ISSN: 1473-0480
- Atkinson, F; Foster-Powell, K; Brand-Miller, JC. (2008). International Tables of Glycemic Index and Glycemic Load Values: 2008. *Diabetes Care*; 31:2281–2283. ISSN: 0149-5992
- Avila, A; Shamah, T; Chávez, A. (1995). Encuesta urbana de alimentación y nutrición en la zona metropolitana de la ciudad de México. (Urban food and nutrition survey in the metropolitan area of Mexico City.) México City. *Instituto Nacional de la Nutrición*.
- Briefel, RR; Wilson, A; Gleason PM. (2009). Consumption of Low-Nutrient, Energy-Dense Foods and Beverages at School, Home, and Other Locations among School Lunch Participants and Nonparticipants. *J Am Diet Assoc*; 109:S79-S90. ISSN: 0002-8223
- Centers for Disease Control and Prevention*. National Center for Health Statistics. National Health and Nutrition Examination Survey. Available from: http://www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm. Accessed November, 2010.
- Goldhaber-Fiebert, JD; Goldhaber-Fiebert, SN; Tristán, ML; Nathan DM.(2003). Randomized controlled community-based nutrition and exercise intervention improves glycemia and cardiovascular risk factors in type 2 diabetic patients in rural Costa Rica. *Diabetes Care*; 26: 24– 29. ISSN: 0149-5992

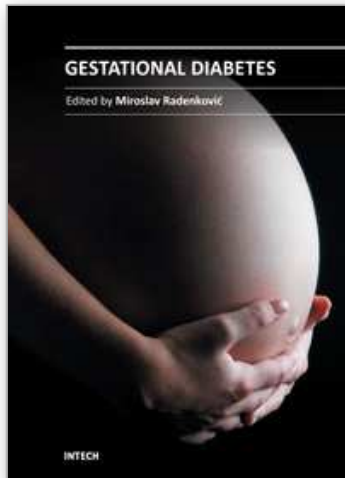
- Fall C. (2009). Maternal nutrition: effects on health in the next generation. *Indian J Med Res*;130(5):593-9. ISSN: 0971-5916
- Food and Nutrition Board (FNB). 2005. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients). This report may be accessed via www.nap.edu and is available in: http://books.nap.edu/openbook.php?record_id=10490&page=275
- Foster, GD; Wyatt, HR; Hill, JO; McGuckin, BG; Brill, C; Mohammed, BS; Szapary, PO; Rader DJ; et al. (2003). A randomized trial of a low-carbohydrate diet for obesity. *N Engl J Med*; 348(21):2082-2090. ISSN 1533-4406.
- Franz, M; Bantle, JP; Beebe, CA; Brunzell, JD; Chiasson, JL; Garg, A; Holzmeister, LA; Hoogwerf, B; Mayer-Davis, E; Mooradian, AD; Purnell, JQ; Wheeler, M. (2002). Evidence based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications. *Diabetes Care*; 25:148-98. ISSN: 0149-5992
- Franz M.(2003). The glycemic index: not the most effective nutrition therapy intervention. *Diabetes Care* 26:2466-2468. ISSN: 0149-5992
- Foster-Powell, K; Holt, SH; Brand-Miller, JC. (2002). International table of glycemic index and glycemic load values: 2002. *Am J Clin Nutr*; 76:5-56. ISSN: 1938-3207
- Fraser, RB; Ford, FA; Lawrence, GF. (1998).Insulin sensitivity in third trimester of pregnancy. A randomized study of dietary effects. *Br J Obstet Gynaecol*; 95: 223-9. ISSN 0306-5456
- Hardie DG. (2004). AMP-activated protein kinase: a key system mediating metabolic responses to exercise. *Med Sci Sports Exerc*; 36:28-34. ISSN 1530-0315
- Institución Nacional de Salud Pública, Secretaría de Salud, Instituto Nacional de Estadística, Geografía e Informática. (2006). Encuesta Nacional de Salud y Nutrición.
- International Association of Diabetes and Pregnancy Study Groups Consensus Panel.(2010). International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. *Diabetes Care*;33:676-82. ISSN: 0149-5992
- Jenkins, DJA; Wolever, TMS; Jenkins, AL; Josse, RG; Wong, GS. (1984).The glycaemic response to carbohydrate foods. *Lancet*; 2:388-91. ISSN 0140-6736
- Jovanovic, L. (2000).Medical nutritional therapy in pregnant women with pregestational diabetes mellitus. *J Matern Fetal Neonatal Med*; 9: 21-8 . ISSN: 1476-7058
- Kant, AK. (2000). Consumption of energy-dense, nutrient-poor foods by adult Americans: nutritional and health implications. The third National Health and Nutrition Examination survey, 1988-1994. *Am J Clin Nutr*; 72:929-936. ISSN: 1938-3207
- Kim, C; Newton, KM; Knopp, RH. (2002). Gestational diabetes and the incidence of type 2 diabetes: a systematic review. *Diabetes Care*; 25: 1862- 1868. ISSN: 0149-5992
- Ludwig, DS; Peterson, KE; Gortmaker, SL. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet* ; 357(9255):505-508. ISSN 0140-6736
- Nielsen, S & Popkin, B. (2003). Patterns and Trends in Food Portion Sizes, 1977-1998. *JAMA* ;289(4):450-453. ISSN: 00987484

- Marvan, L; Pérez, AB; Palacios, B. (2008). Mexican Food System Equivalents. Third edition. Fomento de Nutrición y Salud; México D.F. ISBN: 978-970-94523-1-0
- Major, CA; Henry, JM; De Veciana, M; Morgan, MA. (1998). The effects of carbohydrate restriction in patients with diet-controlled gestacional diabetes. *Obstet and Gynecol*; 91: 600-3. ISSN: 0029-7844
- McLeroy, KR; Bibeau, D; Steckler, A; Glanz, K. (1998). An Ecological Perspective for Health Promotion Programs. *Health Educ Q* ; 15(4):351-378. ISSN: 0195-8402
- Medical nutrition therapy: nutrition practice guidelines for gestational diabetes.(2001). *Am Dietetic assoc.* ISSN, 0002-8223
- Monroy-Torres, R; Reeves-Aguirre, CC; Naves-Sánchez, J; Macias, AE. (2008). Influencia de una dieta individualizada de bajo en índice glucémico en el control de la diabetes mellitus gestacional. *Rev Ginecol obstetr Mex*; (76)12:722-729. ISSN 1561-3062
- Monroy-Torres, R; Velásquez, A; Ortiz, A. (2010). Programa oportunidades sobre la seguridad alimentaria y nutricional en Atarjea: desde la percepción de sus participantes. *Avances en seguridad alimentaria y nutricional*; 1(1): 63-73 ISSN: 1659-326X.
- Moses, R; Luebcke, M; Davis, W; Coleman, K; Tapsell,L; Petocz, P; Brand-Miller. (2006), "Effect of a low glycemic index diet during pregnancy on obstetric outcome". *Am J Clin Nutr*; 84, 807-812. ISSN: 1938-3207
- Pastor, JG; Warshaw, H; Daly, A; Franz, M; Kulkarni, K. (2002). The evidence for the effectiveness of medical nutrition therapy in diabetes management. *Diabetes care*; 25: 608-13 . ISSN: 0149-5992
- Qiu, C; Frederick, IO; Zhang, C; Sorensen, TK; Enquobahrie, DA; Williams, MA. (2011). Risk of gestational diabetes mellitus in relation to maternal egg and cholesterol intake. *Am J Epidemiol* ;173(6):649-58 ISSN 1476-6256
- Ramírez, JA; García, M; Cervantes, R; Mata, N; Zárate, F; Mason, T; Villarreal, A. (2005).Transición alimentaria en México. *An Pediatr* ;58(6):568-73. ISSN: 1695-4033
- Romieu, I; Hernandez-Avila, M; Rivera, JA; Ruel, MT; Parra, S. (1997).Dietary studies in countries experiencing a health transition:Mexico and Central America. *Am J Clin Nutr*; 65(suppl): 1159s-65s. ISSN: 1938-3207
- Sheard, N.F.; Clark, N.G.; Brand-Miller, J.C.; Franz, M.J.; Pi-Sunyer, F.X.; Mayer-Davis, E.; Kulkarni, K.; Geil, P. (2004). Dietary carbohydrate (amount and type) in the prevention and management of diabetes: a statement by the american diabetes association. *Diabetes Care* ;27(9):2266-71. ISSN: 0149-5992
- Schulze, MB & Hu, FB. (2005). Primary prevention of diabetes: what can be done and how much can be prevented? *Annu Rev Public Health*; 26:445-467. ISSN: 0163-7525
- Smith, C.S. & Van Andel, R. (2001). Pregnancy and North American lifestyles: exercise, work, and diet in pregnancy. *Clin Fam Pract* ;3:167-181. ISNN: 00943509
- Standards of Medical Care in Diabetes – 2008. (2008). *Diabetes Care* ; 31: (Suppl 1): S12- S54. ISSN: 0149-5992

Wilson, C; Brown, T; Acton, K; Gilliland, S. (2003). Effects of clinical nutrition education and educator discipline on glycemic control outcomes in the Indian Health Service. *Diabetes Care*; 26:S23-S30. ISSN: 0149-5992

IntechOpen

IntechOpen



Gestational Diabetes

Edited by Prof. Miroslav Radenkovic

ISBN 978-953-307-581-5

Hard cover, 382 pages

Publisher InTech

Published online 02, November, 2011

Published in print edition November, 2011

Gestational diabetes mellitus is defined as hyperglycemia with onset or first recognition during pregnancy. The incidence of gestational diabetes is still increasing and this pathological condition has strong association with adverse pregnancy outcomes. Since gestational diabetes can have long-term pathological consequences for both mother and the child, it is important that it is promptly recognized and adequately managed. Treatment of gestational diabetes is aimed to maintain euglycemia and it should involve regular glucose monitoring, dietary modifications, life style changes, appropriate physical activity, and when necessary, pharmacotherapy. Adequate glycemic control throughout the pregnancy can notably reduce the occurrence of specific adverse perinatal and maternal outcomes. In a long-term prospect, in order to prevent development of diabetes later in life, as well to avoid associated complications, an adequate education on lifestyle modifications should start in pregnancy and continue postpartum.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Rebeca Monroy-Torres and Jaime Naves-Sanchez (2011). The Influence of Diet to Control the Metabolism in Gestational Diabetes Mellitus, *Gestational Diabetes*, Prof. Miroslav Radenkovic (Ed.), ISBN: 978-953-307-581-5, InTech, Available from: <http://www.intechopen.com/books/gestational-diabetes/the-influence-of-diet-to-control-the-metabolism-in-gestational-diabetes-mellitus>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2011 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the [Creative Commons Attribution 3.0 License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen