

Introduction

Diabetes Mellitus (DM) is defined as a group of metabolic disorders characterized by high blood sugar (glucose) levels. This chronic hyperglycemia results from defects in the insulin secretion by the pancreas (diabetes type I) and/or from the insufficient action of the insulin in the muscle and fatty tissue (diabetes type II). In addition, individuals with diabetes, as compared to the general population, have a 2-4 time greater risk of developing vascular disease. Diabetes has become a significant public health issue, reaching an alarming level of illness and related death independent of geographic region and ethnic background.

The etiological classification of the diabetes presents three subdivisions:

Type I (DM-1) or juvenile diabetes is an autoimmune disease that destroys the beta cells of the pancreas, thus decreasing or eliminating the capacity of that organ to produce insulin. Type I accounts for approximately 5% of all of the cases of diabetes in the world; these individuals must rely on insulin medication for survival.

Type II diabetes (DM-2) or non-insulin dependent DM (NIDDM) tends to begin in adulthood. It is characterized by the lack of sensitivity to insulin, which in turn results in larger quantities of insulin being produced. In addition, the release of insulin from the pancreas may be defective, leading to a decline in glucose control. Type II accounts for approximately 90% of the incidence of DM and is frequently considered the “disease of modernization” since it rises proportionally among populations that adopt a modern, less active, standard of living. Among the risk factors for the development of type II diabetes are advanced age, obesity, family history, improper diet and sedentary lifestyle.

5-10% of the cases of diabetes are due to other causes including the gestational diabetes (2-5%), diabetes induced by drugs or medicines, genetic syndromes, infections and other chronic diseases.

Diagnosis

The established criteria for the diagnosis of DM (American Diabetes Association Expert Committee on Diagnosis and Classification of DM) are:

- Plasma glucose at random (non-fasting) of 200 mg/dl (11.1 mmol/l) or higher
- Fasting (at least 8 hours) plasma glucose of 126 mg/dl (7.0 mmol/l) or higher
- Plasma glucose of 200 mg/dl or higher two hours following the glucose tolerance test (fasting for 8-16 hours then administration of 75 grams of glucose)

A fasting plasma glucose level of 110 mg/dl or less is considered normal; between 110-126 mg/dl it is defined as impaired fasting glucose (IFG) or “pre-diabetes.”

Effects of Exercise

The multi-faceted treatment of DM consists of education, diet, regular exercise and drugs (when necessary). There are several aspects of exercise, such as the activity type, duration and intensity, which contribute to the individual responses seen in persons with DM. These exercise parameters will alter the metabolic, cardiovascular, neural and hormonal functions of the diabetic individual, thus the program must be specific. The altered levels of insulin, glucagon (a hormone produced by the pancreas that raises the blood sugar level) and catecholamines (organic compounds that affect the sympathetic nervous system) directly influence the availability of the necessary energy fuels for muscular contractions.

The metabolic answers to exercise design depend on countless factors. The following factors are described by Tsui & Zinman (1995):

1. Intensity, duration and exercise type
2. Patient's physical condition
3. Metabolic control
4. Schedule of meals
5. Schedule, type and place of administration of the insulin or medicine

Aquatic exercise is an excellent way for people of all ages and fitness levels to exercise in an injury free environment created by the natural properties of water: buoyancy, gravity, pressure and warming/ cooling properties. Water exercise can increase flexibility, strength, heart health, coordination and overall wellbeing. For these same reasons, aquatic exercise programs are also highly recommended for individuals with DM.

SIDEBAR

Beneficial Effects of Physical Activity

Increase in insulin sensitivity
Improvement or normalization in tolerance to glucose
Decrease in hba1c
Increase in HDL levels and decrease in cholesterol and triglycerides
Decrease in body weight
Increase in physical capacity
Improvement in wellness
Improvement in the quality of life

Countless results of accumulated studies suggest that exercises can promote weight loss and maintenance when practiced together with a plan of controlled caloric consumption. Few studies exist dealing with this specific matter for individuals with type II diabetes; the majority of the available results involve the simultaneous use of diet and other behavioral interventions. Other studies suggest a disproportionate effect of exercise in the loss of intra-abdominal fat, the presence of which has been associated to several metabolic abnormalities.

Before beginning a physical activity program, the individual with DM should complete a discerning and detailed medical evaluation with his/her physician. That evaluation should aim to detect the presence of vascular complications, which may worsen with the initiation of an exercise program. Careful consideration should also focus on symptoms and signs of DM and the potential effects on the nervous system, the eyes and the kidneys. The medical evaluation will allow a prescription of individualized exercise protocols to minimize the risks for the diabetic individual.

Recommendations for Exercise

In addition to the importance of individualization, Zinman (1995) suggests the following exercise guidelines.

- Maintain strict control of the blood glucose levels, preferably before, during and after exercise
- Whenever possible, exercise should be conducted in the period post-prandial (after a meal)
- If pre-exercise blood glucose levels are above 250 mg/dl, delay the beginning of the activity
- Always use identification (in a group exercise program, know which individuals have diabetes)
- Be aware of the signs of hypoglycemia, before and after exercise
- Have easy access to easily-absorbed carbohydrates
- Hydration should occur before, during and after exercise

The standard exercise recommendations remain the same for all participants, with or without DM. In other words, the main segment of training should be preceded by a gradual warm up and should be followed by a gradual warm down phase. The warm up typically consists of 5-10 minutes of light aerobic activities (walking, cycling, etc.) – this is similar to the main segment but at a lower intensity. The objective is to prepare the musculoskeletal and cardiorespiratory systems for a progressive increase in exercise intensity. After completing the prescribed activity or main segment of training, a 5 - 10 minute warm down should be included to return the heart rate to a pre-exercise level. Water exercise programs should be designed not only to develop optimal fitness but also to enhance long-term adherence, especially for the diabetic patient.

Exercise should be an integral part of every person's life – whether or not diabetes is a current medical issue. Water exercise can be a safe, effective and enjoyable way to increase the level of physical activity for most individuals. Healthy habits increase a healthy lifespan.

SIDEBAR 2

Physical Activity Recommendations for the Diabetic Patient

- Consult a physician before beginning an exercise program.

- For individuals over 35 years of age, a stress test may be recommended.
- Monitor plasma glucose levels before and after the exercise session.
- Do not exercise if the blood glucose level is above 240 mg/dl and if the urine test indicates the presence of ketone.
- If the blood glucose is above 240 mg/dl, but ketone is not present in the urine, the following procedures can be followed: Type I: Do not perform physical activity if the glucose level is 300 mg/dl or above. Type II: Do not perform physical activity if the glucose level is 400 mg/dl or above.
- Plan the exercise session to prevent the occurrence of hypoglycemia by exercising 1 – 1.5 hours after a light meal.
- Always have some type of carbohydrate (sugar tablet, fruit juice, etc.) readily available during the exercise session.
- Consume adequate fluids before, during and after exercise.
- Wear appropriate and comfortable shoes, even when exercising in the water.

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