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Benefits and Physiological Effects Provided by Physical Exercises of Endurance and/or Counter-Strength in Individuals with Diabetes Mellitus

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Abstract: *Diabetes mellitus is an endocrine disease characterized by elevated levels of blood glucose (hyperglycemia) continuous or intermittent. Is a serious public health problem, it has reached large proportions, both in terms of numbers people affected, such as premature mortality and disability. The physical activity has been indicated for the control/treatment off people with DM. The aim of this study was to assess the benefits and physiological effects brought by exercise, endurance and/or resistance in subjects with diabetes mellitus. For this literature, review was performed on a database with SCIELO and PUBMED articles published between 2009-2016, in Portuguese, English and Spanish. Into the study 16 articles and 3 supplemental sources. As result, there was a decrease in total cholesterol, LDL, HDL, lower blood glucose after the exercises, reduced fasting glucose, glycated hemoglobin and an improvement in vascular function. So exercise endurance and resistance proved effective in controlling variables that aggravate diabetes mellitus.*

Keywords: *Diabetes mellitus; physical exercise; treatment.*

I. Introduction

The world is an irreversible demographic transformation process. In Brazil, until the 40s, the demographic pattern had remained stable, however, from the turn of the century, advances in medicine, chemical-pharmaceutical industry and care with health promotion promoted an increased expectation life, so the elderly population could double by 2050 [1, 2]. This has brought about a change of the population epidemiological, before the main responsible for the deaths were the contagious diseases, today the main responsible are the chronic-degenerative diseases such as diabetes, cancer, respiratory diseases and cardiovascular diseases [3]. According to the UN (United Nations Organization), 350 million people in the world suffer from diabetes mellitus (DM). In 2012, the DM was directly responsible for the death of 1.5 million people, being that 80% of these people are situated in the less developed countries and their majority is of middle class and/or low [1, 2, 3]. The DM is a chronic disease that occurs when the pancreatic beta cells (cells of the pancreas responsible for the production of insulin) does not produce insulin for the body, or when the organism is not able to use effectively the insulin produced, resulting consequences for the individual. The DM, as well as any non-transmissible chronic disease, constitutes a serious public health problem, its prevalence has been reaching large proportions, both in terms of numbers of people affected, as premature mortality, functional incapacity. Despite being long lasting, require continuous monitoring, continuous interventions and require a great demand for materials. The treatment of DM is very complex and involves changes in lifestyle of patients, requiring care glucose monitoring, regular physical activity, medication administration (oral hypoglycemic and / or insulin) and the adoption of healthy diet to maintain stabilized blood sugar levels and thus prevent chronic complications [4].The practice of physical activity has been indicated for the treatment of individuals with DM, because exercise has benefits, such as metabolic responses to reduce blood glucose levels, decreased blood pressure, improved vascular function [5]. However, the objective of this study was to verify the benefits and physiological effects provided by physical exercises of endurance and/or against resistance, in individuals with Diabetes Mellitus through a bibliographic review.

II. Results and Discussion

1. Description Of Diabetes Mellitus

The DM is constituted as metabolic disorder characterized by high levels of blood glycemia (hyperglycemia) continuous or intermittent, this is due to the fact of a lower insulin sensitivity in their tissues and/or by reduced insulin secretion by the pancreas. The same is classified into DM: type 1 or insulin dependent (DM1) and type 2 or non-insulin dependent (DM2); gestational; and secondary to other pathologies [6]. Nevertheless, this pathology can be classified into four clinical classes: Diabetes Mellitus Type 1 (DM1); Diabetes Mellitus Type 2 (DM2); Gestational Diabetes mellitus (GDM) and; Diabetes Mellitus by other specific causes.

1.1 Diabetes Mellitus Type 1

Type 1 DM is a multifactorial autoimmune disease, determined by the interaction of genetic and environmental factors. It is characterized by chronic hyperglycemia and micro vascular complications, this pathological condition, neurological damage is extensive in the diabetic patient, widely the peripheral nervous system in their sensormotor and autonomous components, because the effect of insulin is to promote glucose transport into the inside of almost all cells, where the glucose will provide power to the proper functioning of the body, as diabetes is an inability of transport of glucose into the cell is not provided enough energy for a good functioning. In this type of DM there is a progressive loss of β cells (responsible for insulin secretion) due to the destruction of these by T cells or T lymphocytes (responsible for defending the body against unknown agents), resulting in the disruption of insulin production and consequent severe metabolic imbalance, being necessary to the exogenous administration of the hormone [7, 8]. The DM1 can occur at any age; however, in general, is diagnosed before 20 years of age and comprises about 5 to 10% of all cases of DM [8].

1.2 Diabetes Mellitus Type 2

The type 2 diabetes is the most common form of the disease accounting for approximately 90% to 95% of cases. Its onset typically occurs in individuals after 40 years of age, but, nevertheless may affect younger adults, adolescents and children, being in the majority of times, obese [9]. It is associated with a resistance to the action of insulin, insulin secretion abnormal and plasma insulin levels of abnormal and high. Individuals with this type feature of fasting hyperglycemia due to high and constant program of hepatic gluconeogenesis and low capacity of abstraction and use of glucose in the skeletal muscle. In chronic hyperglycemia, individuals with type 2 diabetes have a dysfunction in the metabolism of lipids (excess circulating free fatty acids in the portal system), leading to the formation of atheroma plaques which are manifestations of atherosclerosis characterized by the focal accumulation of lipids, hydrates carbon, blood and blood products, fibrous tissue and calcium deposits in the artery intima [8].

1.3 Gestational Diabetes Mellitus

Gestational diabetes mellitus (GDM) is defined as any glucose intolerance of variable magnitude, diagnosed or first recognized during pregnancy [4]. Pregnancy is a condition that can cause hyperinsulinemia (excess circulating insulin hormone in the human body), and is characterized by the progressive increase in the need and insulin resistance. In women with partial or complete deficiency in the function of Langerhans islets, is a carbohydrate intolerance of any severity when diagnosed during pregnancy is termed Gestational Diabetes Mellitus (GDM).The impairment of the fetus of a maternal hyperglycemia that is transmitted via facilitated diffusion. After to achieve a state of hyperglycemia, there will be an exaggerated stimulation in insulin production, thus breaking, homeostasis, triggering: macrosomia (excess weight of newborns), fetuses were large for gestational age (LGA), increasing rates of cesarean section, traumas of the delivery channel and shoulder skews, hypoglycemia(decrease of normal amount of glucose in the blood), hyperbilirubinemia (excessive bilirubin is a yellowish substance found in bile), hypocalcemia(rate of calcium in blood below the considered normal) and polycythemia (blood change characterized by large increase in the quantity of circulating erythrocytes), neonatal respiratory disorders and intrauterine deaths. The presence of DMG implies a high risk for the mother and the newborn. The perinatal morbidity is increased when compared to the general population of pregnant women [8].

2. Physiological And Metabolic Changes of Diabetes Mellitus

Diabetes is a disease that affects humans since the ancient times and is responsible for the disastrous consequences of deficiency of insulin in the body [10]. The chronic hyperglycemia is characteristic of both types of diabetes (type 1 and 2) and leads to the main symptoms of the disease. Glycosuria and osmotic diuresis are caused by increases of filtered loads and excreted by the kidneys of glucose.The osmotic effect prevents the reabsorption of the liquid, appearing polyuria, resulting in dehydration and polydipsia.This chronic hyperglycemia is action and damage the system micro and macrovascular. In microvascular damage, we can

highlight the blindness, renal disease in final stage and a variety of debilitating neuropathies. In macrovascular, we mention atherosclerosis that affects the arteries that supply the heart, brain and lower limbs; causing acute myocardial infarction, stroke, and amputation of the lower extremities, respectively.One of the factors contributing to formation of atheroma due to abnormal fat metabolism, resulting in an increase in circulating free fatty acids. Diabetes develops changes in protein metabolism because of hipoinsulinismo, which leads the individual to stay in a catabolic state. This stems from a change in the balance between synthesis and protein degradation. This change in protein synthesis causes a dysfunction in tissue repair after injury and infection. Another important change in diabetes is due to increased degradation and oxidation of fat, resulting in excess ketones, causing diabetic ketoacidosis, which can lead to death in this disease [11].

The Diabetic Nephropathy (DN) is a chronic diabetic complication that effects on average 30% of people with diabetes mellitus type 1 or type 2, accounting for about half of new cases of kidney failure in people on dialysis and have been associated with significant increase in mortality, especially cardiovascular.

This DN if gives by the presence of small quantities of albumin in urine represents the initial stage of diabetic nephropathy (microalbuminuria or incipient nephropathy), already the advanced stage characterizes the clinical nephropathy (macroalbuminuria or proteinuria) and the terminal phase is the renal failure [12].

The Diabetic Neuropathy is a chronic complication that affects 30 to 50% of patients with DM, defined by cause neurological damage, more specifically the nervous system of these patients, in the majority of cases are manifested as sensory-motor distal polyneuropathy symmetric. This diabetic polyneuropathy is associated to the impairment of the quality of life of patients with DM, directly related to clinical (framework of chronic pain, risks of amputations, etc) presented by these patients [13].

3. Effect Of Physical Exercise

The exercise should be prescribed as a non-pharmacological treatment for people with diabetes and include both exercises against-resistance as elements of aerobic exercise training [14]. Physical exercise is, nowadays, an effective method in the prevention and treatment of diabetes and the WHO (2011) recommends the practice of at least 30 minutes of physical activity, all days.In particular contributing to the weight loss, improving metabolic control, lipid profile, blood pressure levels and glycemic control of individuals, as well as the prevention or reduction of cardiovascular complications, for the physical and psychological well-being [15].

The regular practice of physical exercises for diabetic patients results in several important metabolic changes such as the reduction of glycemia after performing the exercise, reduction of fasting glucose levels of glycated hemoglobin (HbA1c), as well as vascular function improvement [16] . Galvin et al., 2014 affirms that for the diabetic individual training of energy is extremely important since the mobilization of glucose in the blood is used for formation of energy, thus during and after the exercise blood glucose levels will be relatively more Netherlands, may even reach normal levels. This reduction is due to the fact of physical exercise to use as the main energy substrate the hepatic and muscular glycogen, blood glucose and free fatty acids, depending on the duration and intensity of the activity [17].

3.1 In Glycemic Control

The aerobic and resistance exercises help in preventing, combating and treatment of diabetes and act by reducing the levels of blood glucose levels by increasing the consumption of glucose by skeletal muscles, as well as increases the sensitivity to insulin [18].Resistance exercise has been more appropriate to promote greater mobilization of GLUT4 and improve the increased blood flow mediated by nitric oxide in skeletal muscle, contributing to weight loss and improved systemic insulin sensitivity [19]. Moreover, it has proven to be of great help in the control and maintenance of blood sugar levels and other organ dysfunction that may occur due to the DM [20]. Galvin et al., 2014 explain that insulin acts in metabolic control, specifically carbohydrate metabolism. When sugar levels are elevated in the bloodstream the pancreas secrets the insulin, this in turn has the function of facilitating the entry of glucose for use in the cell, this process is given by facilitated diffusion (transport occurs in favor of concentration gradient, assuming means more concentrated for the means less concentrated). Also verified that the entry of glucose in skeletal muscle cells and is facilitated by carriers (GLUT). The GLUT-4 is responsible for facilitating the entry of glucose into the cell at high levels of blood glucose or high concentration of circulating insulin, as GLUT moves to the cell surface via a separate drive mechanism through the action of insulin to optimize glucose uptake. Once inside the cell that glucose is the source of energy needed to carry out the proposed activities [17].

3.2 Possible Mechanism

The muscle contraction produces substances called chemokine's, which belong to the group of interleukins, known for its effects on the immune system [21]. Increased production of chemokine's antagonizes the action of proinflammatory cytokines, producing anti-inflammatory effect, and normal muscle contraction provides protection for diseases such as cardiovascular, diabetes, obesity, hypertension, autoimmune diseases

and some cancers, as the intestines and breasts [22].During moderate exercise the hepatic glucose production is directly linked to raising blood glucose by skeletal muscles. The aerobic exercise induces increased secretion of the hormone glucagon (produced by pancreatic α cells), this in turn stimulates glycogenolysis and gluconeogenesis. However, for this process took place correctly it is necessary that occur a decrease in insulin during exercise [9]. In DM, the resistive exercise (ER) to start the muscle contraction causes the mobilization of glycogen storage to meet the new energy needs, increasing the uptake of glucose rolling stock, which implies in the improvement of transport of glucose, resulting in reduction of hyperglycemia [20]. When conducted with regularity, exercise also induces the increases the sensitivity of insulin receptors and the number of glucose transporters insulin-dependent (GLUT4), with increased glucose uptake and efficiency in the selection and use of energy sources to activate mitochondrial enzyme.

A large part of the withdrawal of blood glucose by the skeletal muscles that gives by tracks AMPK dependent and insulin dependent, in two there is an adjustment of the phosphorylation of Akt Substrate (AS160), promoting the translocation of GLUT4 to the cellular membrane for glucose uptake (Figure 1). The exercise of endurance or against resistance generates an increase of GLUT4 in muscle. Another important factor is the increase in insulin sensitivity in DM2 physically active, which occurs due to the increase in muscle mass, increased blood flow and by higher uptake and use of glucose by skeletal muscle [9].

3.3 In Lipid Profile

Among the effects caused DM, in acute effects are the hiper and hypoglycemia; already the chronic effects may be cardiac diseases, vascular diseases, retinopathy, nephropathy and neuropathy [23]. There are variables that are commonly found in diabetic as concentrations of elevated LDL and HDL reduced [24].The disease, in relation to the muscles and tissues is characterized by the decrease of the ability of insulin to stimulate the use of glucose by muscle and adipose tissue, harming the suppression of lipolysis mediated by this hormone [25].The reduction in weight and reduction of cardiovascular risks is often associated with improvement of cholesterol levels (Estridge and Reynolds, 2011). The physical training, together with a diet may reduce the adiposity and control the levels of cholesterol [26].

The physical exercise has been shown to increase the antioxidant defenses, reduce oxidative stress, as well as improve the lipid profile, generate an arterial hypotension (acute and chronic) and possibly reduce the renal lesions [27].

3.4 In Renal Function

The chronic kidney disease (CKD) has been considered a public health problem in which the higher prevalence occurs in individuals with diagnosis of diabetes mellitus (DM) and Systemic Arterial Hypertension (SAH) [28]. The DRC limits the functional capacity, bringing cardiovascular complications, endocrine-metabolic changes, osteomyoarticular between other that compromise the quality of life [29]. Roso et al (2011) says that patients with chronic kidney disease (CKD) have lower tolerance to exercise, even for activities of daily life, when compared with healthy individuals or with renal disease of lesser severity [30]. Besides that, the physical activity may contribute significantly to the improvement of the DRC; however, there is no evidence on the more appropriate parameters such as intensity, frequency and duration of exercise [31].

4. Exercises For Diabetes Prescription

The main function of physical exercise for the daily of the individual with diabetes are the beneficial effects for its prevention and treatment. The exercise must have a primary function in risk groups as obese and relatives of diabetic patients. The continuities of these morbidities entail several diseases that are triggered by multifactor authentication may be aggravated, where not being treated with urgency bring damage to health. "(...) the physical exercise acts directly on the insulin resistance, in addition to increasing the capillarization in skeletal muscle cells [26]."We know that diabetic patients have lower muscle strength, less flexibility and less aerobic condition than people who have the same sex and age. Diabetic patients that have better aerobic condition and that are physically active present a better prognosis than those who do physical exercise [32].

4.1 Pre-Exercise Evaluation

As well as those that do not have this diabetes, individuals who seek start any program of exercises must pass a medical assessment careful. The assessment should not be the standard group of diabetic patients, because for each level of physical exercise and public there are differences. This evaluation should contain an electrocardiogram and ergometric test before starting the practice, preferably at a time close to that same held the activity, without suspend the use of the medication. It is essential to evaluate possible arterial complications, renal, besides the retinopathy and autonomic neuropathy [8, 33]. For those diabetic patients who already under exercise, a periodic medical evaluation is fundamental. The patient who presents the framework of diabetes and that please start exercises of moderate to high intensity, the stress test is indicated for those who present the

conditions in the following table [32]. The initial evaluation of DM should be judicious. Must be subjected to an electrocardiogram and ergometric test before starting, preferably at a time close to that same held the activity, with medication use (if make use). To evaluate the presence of peripheral arterial disease, retinopathy, renal disease and autonomic neuropathy. The following criteria shall be used for the implementation of the Exercise Test [8, 33]:

- Age > 40 years (with or without FRs CV);
- Age > 30 years (DM1 or DM2 + 10 years):
  - HA;
  - Smoker;
  - Dyslipidemia;
  - Retinopathy;
  - Nephropathy, including microalbumiúria;
- Age Any (suspicion of CVD, CVD, of):
  - Autonomic neuropathy;
  - Advanced nephropathy with renal insufficiency.

4.2 Exercise Types

Aerobic exercises, flexibility, resistance exercises/muscle strengthening, these exercises help in the improvement of the valences of individual, delaying the physical factors that in the course of the disorder (diabetes) usually happens, mainly in individuals not active [32].

4.3 Frequency Of Exercise And Exercise Duration

For the diabetics to recommendation of daily aerobic activity, or at least every 2 days, is reinforced to the benefits on the glucose metabolism are achieved. The most current recommendation for diabetics is 150 minutes of moderate intensity exercises a week or 75 minutes of high-intensity exercise per week or a combination of both [32].

4.4 Exercise Prescription

The exercise should be prescribed always respecting the special features of the disease. Playful activities, sports, recreation and laboratory can be made but must be attentive limitations and possible aggravations caused by complications that diabetes could exercise. The ACSM explains that this practice of exercises must be associated to the increase of the levels of daily physical activity, so as to control the glycemic levels and obtain benefits to health [33].

4.5 Strength Exercise Prescription

According to the guidelines of the Sociedade Brasileira de Diabetes [4], for resistance exercises are necessary 2 to 3 times per week the practice of exercises, including large muscle groups, progressing to 2 to 3 series of 8 to 10 repetitions with weight that does not support more than these repetitions. The exercise against resistance may be an alternative for diabetic patients with microvascular complications in the lower limbs (peripheral neuropathy, diabetic foot) that disables or impeding the completion of exercise with joint impact [32].Already to the prescription, strength training includes a series of 8 to 10 types of exercise with 8 to 12 repetitions [34]. To ACSM, 2010, it is recommended to perform the strength training twice a week, with at least 48 hours of interval between sessions with load between 40%-60% of 1RM. A series of exercises for the main muscle groups with 10 to 15 repetitions [33]. The effects of training in the skeletal musculature may be seen with increased strength and physical resistance, thus representing a significant contribution in diabetes control, as well as an improvement in working capacity [32].

4.6 Exercise Intensity

For diabetic individuals who wish to participate in activities of mild intensity/low as walk, for example, can be performed without the request of effort test if the walk does not exceed the intensity of daily activities. The majority of international guidelines prevents the request of stress tests in individuals with low risk [35].
The ideal is that the prescription admire exercises of moderate and high intensity, which must follow the descriptions in the following table:

	PERCENTAGE VO_2 MAX	PERCENTAGE FC MAX
Moderate	40-60	50-70
Vigorous	> 60	> 70

VO_2 max= maximum O_2 consumption; FCmax= maximum heart rate during exercise testing or calculated by the formula: 220 - age.

The highest intensity exercises have greater impact on the increase of aerobic condition and in the reduction of glycated hemoglobin than the increase of the weekly volume of exercise in diabetic patients. This occurs depending on the state of the patient, whether or not it is active and also the state of the patient with diabetes. However, for sedentary diabetic individuals, without any physical activity level, more intense exercises are difficult to achieve. Thus, it is recommended moderate activity and it is considered the possibility of increasing the intensity for additional benefit in glycemic control. ARRANTES; SANTOS; NAVARRO; (2009) carried out a case study in a patient with diabetes type 1 to check the influence of an exercise program combined (aerobic and of force) in glycemia, the results showed that a reduction of glycemia and the application of exogenous insulin, but had no significant improvement in a chronic way in glycated hemoglobin [36].

5. Recommendation And Prescription Exercises For Diabetes Type 1

Usually present in children and young people, there is a standard protocol, which exercise to do specifically with people with DM1, but the following table shows the factors that influence the response to exercise thus assisting in the prescription: Exercise: intensity, duration and type; Performance level; Hours and content of the last meal; Specific factors of the individual; Hours of the last dose of insulin; Type insulin; Metabolic control; Presence of complications; Phase of the women's menstrual cycle [32]

The greatest risk in practice exercise in diabetes is hypoglycemia that may occur during, immediately after or hours after the end of activity, is more common in diabetic dependent on insulin and those who use insulin-secreting substances. The glucose monitoring is the basis for the adaptation of treatment to exercise and should be conducted before, during (when the exercise duration> 45 minutes) and after him, especially in insulin-dependent [32].

6. Recommendation And Exercise Prescription For Diabetes Type 2

The recommended exercises are those of aerobic characteristic such as walking, swimming, running, cycling, etc., involving large muscle mass, often three to four times weekly and lasting 20 to 60 minutes and should not exceed the amount of 85% VO2max, can this level of control is also made based on the PSE (Subjective Perception of Effort). This type of exercise is more recommended due to the group of individuals that diabetes type 2 acts, if obese. All obese do not have diabetes, much less type 2, but is the public reached [32].

7. Contraindications For The Practice Of Physical Exercises For Diabetics.

A study conducted by Lara (2009) with a sedentary person and diabetic who performed the exercise of force and walk, generated reduction in blood glucose, but this decrease was more pronounced in the exercise of walking (fell by 55% after two hours) when compared to the exercise of force (fell in 28% after two hours). High-intensity physical exercise is not recommended for result a state of hyperglycemia, because the mechanisms mediated by insulin are not present. This occurs depending on the state of the patient, whether or not it is active and the state of the patient with diabetes. Soon, the refitting of carbohydrates extra or reduction in the dose of insulin can result in the exacerbation of hyperglycemia post-exercise and not a reduction required for individuals with DM 1. This is because individuals with DM1 have the regulatory mechanisms of glycemia independent of insulin are preserved. Soon, is the release of catecholamine that will control the hepatic glucose production [32].The current recommendations of the American Diabetes Association (ADA) focus on not the glycemic level, but the presence of ketosis and absence of insulin use for 12 to 48 hours. In this case, the exercises, mainly the forceful, may worsen the hyperglycemia and ketosis. However, provided that the patient is clinically well, with normal diuresis and with negative plasma ketones is not necessary to postpone the reasoned exercise only in hyperglycemia [32].

7.1 Special Note To Exercise For Diabetic Patients With:

7.1.1retinopathy

Is the term used for the lesion in the small blood vessels, which nourish the retina and may lead to partial or total loss of vision. Activities that increase dramatically blood pressure should be avoided and more frequent ophthalmic revaluations, every 4-6 months, carried out [32].

7.1.2 Peripheral Neuropathy

It is a damage in the peripheral nervous system, often affecting the ends of longer nerves, as in the legs and arms, but can also occur in the thorax, face and genital regions. Depending on the degree of peripheral neuropathy, is advised indicate activities that do not overload the lower limbs [32].

7.1.3 Autonomic Neuropathy

A condition has as cause damage in nerves that help control of components. Must be recommended heating and prolonged downturn, avoid sudden postural changes, greater attention to hydration and adverse weather conditions and avoid to work out after meals and at night or in places with low visibility [32].

7.1.4 Microalbuminuria And Nephropathy

The microalbuminuria may be defined as a persistent elevation of albumin in urine. In the case of nephropathy, is a change in the blood vessels of the kidneys, which leads to loss of protein through the urine. Studies in animals have shown that exercises of greater intensity in diabetics reduced the renal excretion of protein by better glycemic control and blood pressure [32].

7.1.5 Peripheral Vascular Disease

Occurs in virtue of narrowing or obstruction of arterial blood vessels, responsible for bringing the blood to nourish the ends as arms and legs, being more common in the lower limbs involvement than in higher [32].

7.1.6 Coronary Artery Disease

It is characterized by the obstruction of the blood vessels that irrigate the heart. According to the Brazilian Society of Diabetes guidelines 2014 and 2015, follows some special recommendations for the practice of physical exercise for the patient with diabetes, which are [32]:

- Look for if exercise daily, preferably at the same time.
- Earn 150 minutes of exercise of moderate intensity or 75 minutes of high-intensity exercise, or a combination of the two.
- Look for carrying out exercises of greater intensity at least 1-2 times a week, preferably with some degree of supervision.
- Browse to perform exercises of greater intensity at least 1-2 times a week, preferably with some degree of supervision.
- Flexibility exercises/stretching must be performed daily.
- Inform professionals that are supervising/guiding and their partners of physical exercise on their clinical condition.
- If you make use of insulin, do not inject close to areas of large muscle groups that will be used during the financial year (e.g., do not inject insulin in thigh if you want to ride).
- Reduce in 30% to 50% the dose of regular insulin or rapid absorption when used 1 to 3 h before the exercise.
- Heaters and back to calm are important, especially in patients who have already diabetic dysautonomia.
- Appreciates the occurrence of abnormal signs and symptoms during physical exercise.
- Avoid exercises in which the intensity and duration are previously difficult to predict or, still, in radical sports (greater release of epinephrine, with greater risk of hypoglycemia, and consequent prejudice the cognitive ability and potential risk of life).

III. Conclusion

Based on the presented literature review, we can conclude that DM causes a series of metabolic changes, affecting different systems, especially vascular resulting in chronic complications that can lead to the death of the individual.Soon the regular practice of physical exercises for patients with DM was effective in optimizing the lipid profile, increasing HDL and lowering LDL cholesterol and in some studies, blood glucose. a combination of exercises and suggested (endurance exercises and counter-resistance) with proper intensity to the practitioner, moderate or high for providing independent effects, and complement each other in promoting metabolic benefits to the individual.

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