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REVIEW ARTICLE

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## BENEFITS OF PHYSICAL EXERCISE ON TYPE 2 DIABETES MELLITUS: A REVIEW STUDY

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### ABSTRACT

Due to the advancement of science and technology, through studies, man can diagnose and prevent various diseases, and because of this it is possible to increase life expectancy. Physical exercise has been increasingly recognized as an alternative form, a non-pharmacological treatment of diseases. Diabetes Mellitus has been presented as one of the factors that most trigger deaths, among other symptoms that completely change the lives of its patients. This work is a literature review that aims to identify in the literature produced scientific studies that point out the effects of aerobic physical exercise in people with Type 2 Diabetes Mellitus that have been published in the last ten years in the Scielo database. The search resulted in studies that met the inclusion criteria and that allowed an analysis about the proposed theme. Through this survey, it was possible to verify several benefits, among them reduction of blood glucose. Thus, aerobic physical exercise has positive effects on the lives of type 2 diabetic patients, and it is recognized that there is a need to develop further research that may advance this theme.

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## INTRODUCTION

According to the World Health Organization (WHO) 1.5 million deaths worldwide were attributed to Diabetes in 2015. 9% of diabetics are adults and 90% have Type 2 disease. Type 2 Diabetes Mellitus is characterized by the inability of muscle cells to respond adequately to insulin, i.e. insulin resistance, as well as inadequate secretion of insulin by the pancreas. It belongs to the group of diseases with cardiovascular risk factors, called Metabolic Syndrome, which is related to fat accumulation, alteration of glycemic homeostasis, and hypertension. The I Brazilian Guideline for Diagnosis and Treatment of Metabolic Syndrome (2002) recommends that the adoption of life styles with a view to maintaining health, which would be: adequate diet, and regular exercise, by the population, is fundamental for the prevention of metabolic syndrome (primary prevention). This will consequently result in the control or reduction of body weight, which will culminate, among others, in the efficiency of the metabolic structure. Physical exercise is any organized and engendered physical activity that generates work, i.e., acute responses from the body, which causes morphological and functional

adaptations. Anaerobic exercise, which consists of successive movements, where large muscle groups are required, for 10 minutes minimally (McARDLLE, 2001) has been widely used to evaluate people with Type 2 Diabetes Mellitus, especially in Brazil. Therefore, it is necessary to identify the production of scientific knowledge regarding the benefits of aerobic exercise in the treatment of people with Type 2 Diabetes Mellitus, seeking to understand the best approaches to Type 2 Diabetes Mellitus from the Physical Education professional, and in the social field by transmitting these in-depth knowledge on the subject to Diabetics, helping in the treatment for better control of blood glucose levels and insulin resistance.

## MATERIALS AND METHODS

**Type of study:** The present study is an exploratory, bibliographic and review research. Exploratory research aims to approach the problem in order to explain it or build hypotheses. The bibliographical research was developed based on material that had been prepared to analyze the various positions on the chosen theme.

Table 1. Initial presentation of studies found in the scielo database

ARTICLE TITLE	YEAR	AUTHORS	OBJECTIVE	CONCLUSION
"Effect of combined and aerobic training on glycemic control in type 2 diabetes"	2012	MORO, Antônio Renato Pereira; IOP, Rodrigo da Rosa; SILVA, Franciele Cascaes, FILHO, Paulo José Barbosa Gutierrez	Compare the effect of two training modalities, The combined (aerobic and resistance) and aerobic, in glycemic control in type 2 diabetes.	Both the combined training and the aerobic showed a positive behavior in glycemic control. And specifically in aerobic exercise there was an effectiveness with respect to plasma glucose.
"Effect of Aerobic Training on Homocysteine Levels in Type 2 Diabetic Individuals".	2015	SILVA, Alexandre de Souza; LACERDA, Fábio Vieira; MOTA, Marta Paula Gonçalves.	Analyse the effects of aerobic training on plasma homocysteine levels and cardiovascular risk factors in type 2 diabetic individuals.	Significant changes in the cardiovascular capacity of type 2 diabetic patients, improving their body composition, lipid profile and glycemic index.
"Effect of Physical Exercise Frequency on Glycemic Control and Body Composition of Type 2 Diabetics".	2009	VANCEA, Denise Maria Martins; VANCEA, José Nelson; PIRES, Maria Izabel Fernandes; REIS, Marco Antônio; MOURA, Rafael Brandão; DIB, Sergio Atala.	Compare the influence of guided and structured physical exercise programs (PEOE) three and five times a week, in the period of 20 weeks, on the glycemic control and body composition of type 2 diabetics (DM2).	Reduction in BMI and body fat percentage from the 8th week of exercise, reduction in abdominal circumference, average capillary glycemia and fasting and postprandial glycemia.
"Acute Effect of Aerobic Exercise on Glycemia in Diabetics 2 on medication."	2015	BARRILE, Silvia Regina; CONEGLIAN, Camila Borin; GIMENES, Camila; CONTI, Marta Helena Souza de; ARCA, Eduardo Aguilar; JUNIOR, Geraldo Rosa; MARTINELLI Bruno.	Check the acute effect of exercise on capillary blood glucose in diabetic individuals who use insulin or oral antidiabetics.	Exercise has hypoglycemic action in non-diabetic people, however the glycemic reduction in diabetic individuals was not so evident.
"Reduction of Blood Pressure, BMI and Glucose after Aerobic Training in Older Women with Type 2 Diabetes".	2010	MONTEIRO, Luciana Zaranza; FIANI, Cássio Ricardo Vaz; FREITAS, Maria Cristina Foss; ZANETTI, Maria Lúcia, FOSS Milton César.	Check the effects of 13 weeks of aerobic training on blood pressure, body mass index and blood glucose in elderly women with type 2 diabetes.	Thirteen weeks of aerobic training was sufficient to promote significant reductions in diastolic blood pressure and glycemia, so this type of exercise reduces risk factors for cardiovascular and metabolic diseases.
"Effect of high-intensity exercise on endothelial function of patients with DM2".	2016	SILVA, Carlos Alberto da; VASCONCELOS, Francisco Sergio Lopes; SERAFIM, Marcus; BOTURA, Edson; SILVA, Roberta Cristina da Rocha; PACHECO, Christina; MARQUES, Fernando Antonio Oliveira; MELO, Sebastião Lopes; CARL J. CASPERSEN and JANET E. FULTON.	Identify the effect of high-intensity physical exercise using the clinical technique ultrasound, in the evaluation of endothelial function of patients with metabolic syndrome or diabetes mellitus type two	High intensity aerobic training improved the endothelium in a way dependent on the vasodilator response, verified by ultrasound, in patients with metabolic syndrome and type 2 diabetes.
"Epidemiology of Walking and Type 2 Diabetes".	2008	CARL J. CASPERSEN and JANET E. FULTON.	Analyze the limited epidemiological data of walking and diabetes incidence (two studies) and walking and mortality among diabetic people (three studies).	Reductions in mortality and coronary heart disease by up to 76%, and a reduction in the incidence between approximately 20% and 40% for diabetes.

**Data Collection:** A review of scientific articles addressing the benefits of aerobic exercise in Type 2 Diabetes Mellitus was conducted. Thus, a bibliographic survey of the articles available in the English and Portuguese languages of the SCIELO database was carried out, with a ten-year time cut in the period between January 2007 and May 2017, and the following descriptors were used for research guidance: *Type 2 Diabetes Mellitus*, *Physical Exercise and Diabetes*, *Aerobic Exercise and Diabetes*. The initial search using the descriptors resulted in 163 (one hundred and sixty-three) articles found in the Scielo database. After filtering done with the reading of the titles, 147 (one hundred and forty-seven) articles were discarded because they did not fit the criteria previously defined, or because they were not in accordance with the theme proposed in this study, only 16 articles remained. Through the full reading, only 07 (seven) articles were selected because they met the criteria and were suitable for analysis of the subject studied. The articles found and selected were published between 2008 and 2016 in the database.

**Data Analysis:** The analytical treatment given to the materials found was qualitative. Denzin et al (2006) affirm that in qualitative research there is the study of the use and collection of empirical materials, where there is the interpretation of these materials by the researcher, always aiming at a better understanding of the subject. The method chosen for

the analysis was proposed by Bardin (2000), where it is divided into three phases: pre-analysis, exploration of results and interpretation.

## RESULTS

In view of the knowledge presented by the studies, through a careful analysis of the articles found in the *SCIELO database*, which addressed the topic directly or indirectly on the benefits of aerobic exercise in the treatment of type 2 diabetes mellitus. Sixteen (16) publications were selected, but only seven (07) met the inclusion criteria for the analysis in this study. From the selected articles, it was possible to construct a summary table according to descriptive variables and categorization by approximating the data by reading them (Table 1). In the study conducted by Moro et al. (2012), 24 (twenty-four) diabetic participants of both genders were chosen. They were 60 years old on average. And they were divided into two groups, where one performed combined exercises (resistance and aerobic) and aerobic exercises. Both were evaluated at the beginning and at the end of the research (clinical anamnesis and biochemical variables), for the trainings occurred twice a week, in a total of 20 (twenty) weeks. The data were expressed as mean and standard deviation. Silva, Lacerda and Mota (2015) selected 15 women with type 2 diabetes, with an

average age of 60 to 70 years, and were submitted to a test to evaluate the maximum consumption of oxygen ( $VO_2\max$ ), according to Bruce's protocol, they also evaluated blood pressure, anthropometrics, homocysteine concentration, total cholesterol and glycemia, before and after the aerobic training that lasted 16 weeks. During the weeks, two non-consecutive sessions were performed, each lasting 75 minutes, with intensity between 60% and 70% of maximum heart rate. Vancea et al. (2009) in their research selected 40 (forty) people with type 2 diabetes, whose inclusion criteria were: clinical diagnosis less than 10 (ten) years, age between 45 and 65 years, BMI (body mass index) of 25-30  $kg/m^2$ , and among others, absence of chronic clinical complications of Diabetes that could impair or be impaired by physical exercise. The patients were divided into three groups: GC - who received orientation for spontaneous exercise practice, G3 - who participated in three aerobic exercise sessions per week, and G5 - five sessions during 20 weeks. Groups G3 and G5 were submitted to a program of aerobic physical exercises (trekking), and the intensity was 60% to 70% of maximum heart rate. Capillary blood glucose, basal heart rate, abdominal circumference, BMI and fat percentage were evaluated before and after the exercise program. In turn, Barrile et al. (2015), conducted a study in which 23 individuals of both sexes, with an average age of 60 years, type 2 diabetics using oral hypoglycemic agents (G1), non- diabetics (G2), and type 2 diabetics using insulin (G3 - control group), underwent clinical, biochemical, pressure, anthropometric evaluations, and an aerobic exercise session with an intensity of 60% to 70% of maximum heart rate, which consisted of a 40-minute walk. Blood glucose was measured at eight times during the session. In the research developed by Monteiro et al. (2010), eleven diabetic women with a mean of 60 (sixty) years of age, performed aerobic training in 13 weeks (G2), while the control group (G1), composed of eleven elderly women of the same age did not perform exercises.

Group 2 underwent hiking three times a week. Blood pressure, blood glucose, and  $VO_2\max$  were evaluated initial and final after 13 weeks. Silva et al. (2016) studied 31 patients with type 2 diabetes or metabolic syndrome, of both sexes and aged between 40 and 60 years, randomly distributed in three groups. The aerobic exercise training took place four times a week in 40-minute sessions. Before and after six weeks, they were submitted to strength tests and high-resolution ultrasound of the brachial artery to study endothelial function. The review study by Caspersen and Fulton (2008), sought to identify in the literature, characteristics of the populations studied regarding the incidence of diabetes, mortality, cardiovascular events among diabetic people, relative risks, risk and covariable reductions, as well as results that are related to physical exercise and diabetes, which corresponded to 2 to 3 hours of walking per week.

## DISCUSSION

In the study by Moro et al. (2012), the group that performed aerobic exercise for twenty weeks showed in the final evaluation results a positive behavior in glycemic control, compared to the results of the initial evaluation. And it was concluded that regular physical exercise can cause changes in the whole metabolism, and as a consequence an improvement in glucose homeostasis. The American Diabetes Association (2016) states that regular exercise, within the recommended intensities, results in a 10% to 20% decrease in glycosylated

hemoglobin. Silva, Lacerda and Mota (2015) analyzed the effects on aerobic training on plasma homocysteine levels and other cardiovascular risk factors in people with type 2 diabetes, and observed, from this study, that pertinent changes occurred in the overall cardiovascular capacity of individuals who participated in the research, which consequently improved their body composition, lipid profile and glycemic index. Vancea et al. (2009) in their research, sought to compare the influence of structured and guided physical exercise programs three and five times a week, over a period of 20 weeks, on the glycemic control and body composition of type 2 diabetics, and concluded that there was a significant reduction in abdominal circumference, BMI and body fat, mean capillary glycemia and fasting and postprandial glycemia. In turn, Barrile et al. (2015), verified the acute effect of aerobic exercise on capillary blood glucose in diabetic individuals who use insulin or oral antidiabetics. At the end of the study, they concluded that the glycemic reduction was not very evident, which occurred only in the control group. Thus, it was clarified that generalized physical exercise, on a regular and long-term basis, is an alternative adjunct in the decrease of glycemia. In this study only one aerobic exercise session was performed. Cambri et al. (2007) recorded that it would take three or more than 12 weeks to produce significant results. In the research developed by Monteiro et al. (2010), in thirteen weeks of aerobic training was enough to promote significant reductions in blood pressure and blood glucose. Both groups of diabetic elderly women have obtained improvements in metabolic control, among other effects, and this further reinforces the idea that exercise should be encouraged from childhood onwards, since the benefits are not only evident in the early stages of life, but mainly in old age. Silva et al. (2016) studied patients with type 2 diabetes or metabolic syndrome, and were able to conclude that high intensity aerobic training improved the endothelium in a way dependent on the vasodilator response, this by means of ultrasound. This means that if we verify the functioning of the endothelium, in the direction of peripheral conduction of the arteries, which directly affects the coronary circulation, it will be possible to identify possible cardiovascular events.

In the review study by Caspersen and Fulton (2008), they identified a very close relationship between the practice of moderate and intense aerobic exercise (walking, specifically) to significant reductions in mortality risks of certain groups with type 2 diabetes, through epidemiological research with covariants of age, muscle mass index, sedentariness and practice of vigorous physical activities. Thus, it became evident that the exercise corresponding to two to three hours per week of walking, contribute to reducing the risk of mortality of type 2 diabetics. After describing and explaining in detail all the researches found, used as a bibliographic reference in this present study, it was possible to see that all the articles analyzed, in consensus, point out that physical exercise brings positive benefits for people with type 2 diabetes. The data brought by the authors are of great importance to think about the performance of the Physical Education teacher in the quality of life, not only of type 2 diabetics, but in the life of the total formal human being. According to Gallo (1995) physical exercise, regardless of type, is a means of prevention, delay or reversal of pathologies.

Therefore, it is clear that regular physical exercise is not only effective as a non-pharmacological treatment, but also to promote health, prevention and long-term quality of life. This

bibliographic research becomes relevant since it shows the limitations of the articles published on the subject, as well as the need for more research that may occur in the necessary time, so that the effects are more evident, since the organism has a certain time for responses and adaptations to the stimuli given. On the other hand, none of the studies has pointed out negative effects and, therefore, it is recorded the need to indicate to this public the practice of aerobic exercise systemized and guided, since benefits such as decreased blood glucose, blood pressure, among others that were evidenced in this research. In addition, this study points out options and possibilities for the development of physical education research, based on the discussions about the limitations that have been pointed out about the protocols of the interventions as well as the importance of developing studies that allow a more comprehensive understanding of the effects of physical exercise in people with diabetes. In view of the above, this research presents itself as another data that will serve as a basis for new studies on Diabetes Mellitus in the academic world in general.

### Conclusion

Studies have shown that the practice of aerobic exercise is effective in the treatment of Type 2 Diabetes Mellitus, since it reduces blood glucose, improvement in the transport of oxygen through the bloodstream, improvement in vascular function and in the response of systolic blood pressure, cardiovascular capacity, body composition and lipid profile. The effects presented are, according to the studies, the result of a regular practice with moderate intensity, and that, therefore, it is of extreme importance to have a physical education teacher follow up, for prescription and monitoring during the activities.

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