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Artigo

# AQUATIC EXERCISE REDUCES CARDIOVASCULAR RISK IN POSTMENOPAUSAL WOMEN WITH TYPE 2 DIABETES MELLITUS

# EXERCÍCIO AQUÁTICO REDUZ RISCO CARDIOVASCULAR EM MULHERES NA PÓS-MENOPAUSA COM DIABETES MELLITUS TIPO 2

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**ABSTRACT** - The aim of the study was to analyze the effect of an aquatic exercise program on risk factors for cardiovascular disease in postmenopausal women with type 2 diabetes. A randomized clinical trial was done in 25 women aged between 51 to 83 years, divided into exercise group submitted for 12 weeks to two weekly sessions of 50 minutes each, and control group (n = 12) without physical exercise. There was a decrease in fasting glycemia, total cholesterol, triglycerides, waist circumference, body mass index and fat percentage in the exercise group, but without significant effect on blood pressure and heart rate at rest. In the control group there was a significant increase in fasting glycemia and waist circumference. Twelve weeks of two weekly sessions of

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aquatic exercise of moderate to vigorous, can contribute significantly to the reduction of cardiovascular risk factors in postmenopausal women with type 2 diabetes mellitus.

**Keywords:** Type 2 diabetes; Cardiovascular disease; Fasting glycose; Hyperglycemia; Lifestyle modification.

**RESUMO** - O objetivo do estudo foi analisar o efeito de um programa de exercícios aquáticos sobre fatores de risco para doenças cardiovasculares em mulheres na pós-menopausa com diabetes tipo 2. Foi realizado um ensaio clínico randomizado em 25 mulheres com idades entre 51 a 83 anos, divididas em grupo de exercícios submetidos por 12 semanas a duas sessões semanais de 50 minutos cada, e grupo controle (n = 12) sem exercício físico. Houve diminuição da glicemia de jejum, colesterol total, triglicerídeos, circunferência da cintura, índice de massa corporal e percentual de gordura no grupo de exercício, mas sem efeito significativo sobre a pressão arterial e freqüência cardíaca em repouso. No grupo controle, houve um aumento significativo na glicemia de jejum e na circunferência de cintura. Doze semanas de duas sessões semanais de exercício aquático de intensidade moderado reduzem os fatores de risco cardiovascular em mulheres na pós-menopausa com diabetes mellitus tipo 2.

**Palavras-chave:** Diabetes tipo 2; Doença cardiovascular; Glicemia de jejum; Hiperglicemia; modificação do estilo de vida.

## INTRODUCTION

Physical exercise represents a great therapeutic strategy which is highly value in the treatment of patients with type 2 diabetes mellitus (T2DM), since it is capable of acting simultaneously on different cardiovascular risk factor as well as in reducing symptoms of pain and improvement of the functional capacity (COLBERG et al., 2016). This feature of the exercise becomes important because almost 60% of middle-aged adults and seniors with T2DM have at least one chronic disease associated and up to 40% have four or more (HUANG, 2016).

However the process of aging and T2DM, as well as sarcopenia(BIANCHI; VOLPATO, 2016) and osteoarthritis (COURTIES; SELLAM, 2016) often present in postmenopausal women with type 2 diabetes, contribute to the reduction of strength and function physical, thus compromising their ability to perform physical exercises, especially those performed on land. On the other hand, aquatic exercise represents an important option for people with restrictions and limitations for physical exercises (BOCALINI et al., 2010).

The possible advantage of the physical exercise in water is related to reduced joint overload due to the thrust that enables practices in higher intensities and with less risk of injury (CUGUSI et al., 2015). Moreover, the hydrostatic pressure produced in the water immersion can contribute to the reduction of peripheral resistance, improves venous return and increased dieresis (IGARASHI; NOGAMI, 2018). However, scientific evidence that aquatic exercise contributes significantly in reducing cardiovascular risk factors in postmenopausal women with type 2 diabetes are still limited (REES; JOHNSON; BOULÉ, 2017).

It is known that prolonged hyperglycemia is an independent risk factor for coronary artery disease (CAD), stroke (or cerebral vascular accident) and peripheral artery disease since it induces a large number of cellular changes in vascular tissue that accelerate the atherosclerotic process (MÁRK; DANI, 2016). Moreover, patients with T2DM often have diabetic dyslipidemia, which is represented by quantitative and qualitative abnormalities of lipoproteins that contribute to the development of vascular complications (FILIPPATOS et al., 2017) and hypertension (SOLINI et al., 2014). After 40 years, T2DM is most prevalent in women because of hormonal changes (KARVONEN-GUTIERREZ; PARK; KIM, 2016).

Therefore, treatment in T2DM aims to achieve and maintain optimal levels of blood glucose, lipid profile and blood pressure (BP) to prevent or delay the chronic complications of diabetes (ACSM, 2000). However 33 to 49% of patients do not meet the goals for glycemic control, blood pressure or cholesterol, only 14% to meet the goals three measurements (ADA, 2017). This way, considering that aquatic exercise can contribute to the improvement of metabolic and hemodynamic aspects, and that the exercise carried out in this environment is more favorable to the adoption of an active lifestyle for people with functional limitations, the present study, proposes to test the hypothesis that this practice, when based in the recomendations of physical exersice of T2DM pacients can contribute to the improvement of in fasting glycemia, blood pressure, cholesterol, triglycerides and body composition of postmenopausal women with T2DM.

## METHOD

## Population of Study and Casuistic

An intervention study was performed (treatment), parallel, of two-arms, open-masking and randomized controlled allocation. Figure 1 shows the folowing flow chart of the study participants. Patients were submitted to an initial evaluation about the history of disease, drug therapy, postmenopausal status and physical activity patterns. After the initial evaluation, the volunteers included in the study performed anthropometric measurements, biochemical and blood pressure, and were then randomized and allocated to exercise group (EG) and control group (CG). The allocation was made through drawing in a sealed envelope. Data collection was performed on two non-consecutive days and repeated after 12 weeks of the intervention period. The post-intervention measurements were performed seven days after the end of the intervention period. After the end of the study the patients allocated to the CG were invited to participate in aquatic exercise program on the same terms available to EG.

The project was approved by the Ethics Committee of the University of Marilia-SP (UNIMAR) (protocol n° 1441220/2016 CAAE: 53040116.2.0000.5496), and follows the criteria established by resolution of the National Health Council (CNS 466 / 12). The trial was registered with the Brazilian Registry of Clinical Trials (Rebec) (registry number: RBR-8btc25).

The sample size was initially estimated to be 10 sampling units per group calculated from the study blood glucose levels of Cugusi et al (CUGUSI et al., 2015), the type I error (α) of 1% and a power of 80%. Considering a sample loss of 30% were included 13 sampling units per group. The sample consisted of 25 women aged 51-83 years and amenorrhea for at least 12 months, diagnosed with type 2 diabetes for at least three years and sedentary (<150 minutes per exercise week moderate to strong in the last three months). They were initially included in the study all patients with T2DM and medical referral with recommendation for aquatic exercise training in the Laboratory of Physical Evaluation and Practice of Sports Unimar (LAFIPE-UNIMAR). Patients unable to enter and exit the pool independently were not included in the study. They were excluded from the study patients who did not complete the evaluation protocol and intervention, and those presented during the study of the conditions set out in the non-inclusion criteria.

## Study Variables

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The prevalence of chronic diseases in the study population was obtained by questionnaire of referred morbidities, and confirmed by clinical diagnosis in the medical this routing. It was considered as cardiovascular risk factors the variables: Body mass index (BMI), waist circumference (WC), fat percentage (% L), fasting glucose (FG), total cholesterol (TC), triglyceride (TG), systolic blood pressure (SBP) and diastolic blood pressure (DBP). The dosages of TC, TG, and FG biochemical were performed in venous blood after overnight fasting for 8 hours. The SBP, DBP and resting heart rate (HR) were measured in the supine position after twenty minutes of rest with automatic digital equipment (Omron HEM-742-INT, China).

For the analysis of body composition were taken anthropometric measurements of weight, height, skinfold thickness and waist circumference (WC) (ACSM, 2011). The WC values were used to represent the central obesity (abdominal), and to classify the risk of metabolic complications: low-risk (<80 cm); increased risk (80-88 cm); greatly increased risk (>88 cm). The BMI values representative of the overall obesity, was classified into low weight (<18.5 kg/m$^2$); eutrophic (18.5 to 24.9 kg/m$^2$); overweight (25 to 29.9 kg/m$^2$); obesity (≥30 kg/m$^2$) (ABESO, 2016). Skinfolds were measured of: triceps; suprailliac and medial thigh. The skinfold measurements were used for calculation of body density by the generalized equation for women. The body density values were converted to fat percentage for specific equation for age, race and sex (ACSM, 2011).

**Intervention Procedures**

The intervention period was 12 weeks with two weekly sessions lasting 50 minutes each for the exercise group (EG). The control group (CG) received guidelines for the maintenance of living habits and physical activity identified in the baseline. The training sessions were held in heated at medium temperature of 28 ° C, 1.3 m deep and in groups of up to six volunteers. The training sessions were organized in the early stages (5minutes), main phase (40 minutes) and late phase (5 minutes).

In the initial phase were performed active stretching exercises lasting 30 seconds each and dynamic exercises in sets of 10 reps for the joints, neck, shoulders, elbows, wrists, hips, knee and ankle. In the main phase were performed six pack exercises, each with five exercises combining movements of the upper limbs (MMS) and lower limbs (MMI), totaling 30 exercises. The description and the order of the exercises performed in the main phase of the study are described Olkoski et al (OLKOSKI et al., 2013). The progression of the intensity between the blocks is characterized by increased muscle volume. The target intensity was moderate to vigorous, controlled by the scale of perceived exertion between 12 to 14 points according to Borg's scale (6 to 20) (BORG, 1982). Whenever the intensity reported were less than 12 points, the patient was instructed to perform the exercises at higher speed in order to raise the intensity. The final phase lasted 5 minutes, where stretching exercises were performed similarly to the initial stage (deltoid, biceps, triceps, pectoral, dorsal, quadriceps, hamstrings and calf).

**Statistical analysis**

The variables are described as mean and standard deviation (SD) or by the distribution of the absolute frequency (*f*) and relative (%). To analyze the association was used the Fisher's exact test. The distribution normality was verified by the Shapiro-Wilk test. To analyze the effect of intervention between groups (exercise vs. control) a mixed ANOVA was built for repeated measures followed the Bonferroni post-hoc test to analyze the effect within groups. The ANOVA for effect size was determined by means of the square values ETA ($\eta 2$). The delta change ($\Delta$) ($\Delta$ = Post - Pre) between pre and post-intervention was used to quantitatively analyze the variation of the variables under study during the intervening time. Multiple linear regression was used to analyze the effect of group values at baseline covariates on and the delta change in the cardiovascular risk factors stepwise method. The $R^2$ was analyzed to check the determination of the percentage coefficient of variation explained by the model. The independent variables that showed $p>0.05$ were taken from the regression model. For all analyzes, we used the SPSS version 19.0 software for Windows, adopting a significance level of 5%.

## RESULTS

The average adherence of the GE training sessions was 65%. It was not observed significant differences between the groups for age, time of diagnosis of T2DM, morbidities and medication therapy at baseline. Considering the cardiovascular risk factors and osteoarticular disease 96% of the sample showed two or more associated morbidities (Table 1).b

The EG was observed significant reduction of FG, TG, TC, CC% fat and BMI after 12 weeks of aquatic exercise, but no significant change in SBP, DBP and HR. For variables, FG, CC and fat% was observed a great effect (η2> 0.50) and the variable CT, TG, and an average BMI effect (η2> 0.30). In the control group there was a significant increase in GL and CC after the intervention period, but without significant variations in CT values, TG, BMI, SBP, DBP, HR and fat% (Table 2).

In regression analysis, beyond the effect of group was observed a significant effect of glycemia values at baseline of over Δ fasting glucose values. The Δ cholesterol, showed a similar behavior to glycemia, with a main effect of group and discreet effect of cholesterol from baseline values. In the analysis of triglyceride Δ, beyond the significant effect of group and triglyceride levels at baseline, there was a significant effect of nutritional status (BMI categorization). For BMI Δ and % fat only the group showed significant effect. The group and the presence of dyslipidemia showed significant effect on Δ waist circumference (WC), but the presence of dyslipidemia appears to attenuate the effect of the group in reducing abdominal obesity. On the other hand patients with dyslipidemia was observed greater reductions in HR. For the Δ SBP and DBP values only their values at baseline showed a significant effect, but with a slight effect (Table 3).

***Discussion***

The results indicate that the practice of two weekly sessions of aquatic exercises for 12 weeks had significantly contributes positively to metabolic and body composition changes, and consequently to reduce the cardiovascular risk. About the body composition, BMI reductions were observed, WC and % fat in EG. The adaptations in the body composition represent reduction in cardiovascular risk because they can pass on the improvement of metabolic aspects and reduce obesity, which is considered a main risk factor for T2DM and dyslipidemia (VERMA; HUSSAIN, 2017).

Although there were significant reductions in the composition after 12 weeks of intervention with aquatic exercise, other studies did not find significant changes on body composition after 12 weeks of aquatic exercise (ARCA et al., 2014), as well as those who reported worsening anthropometric parameters even after 24 weeks of intervention with aquatic exercise (COLADO et al., 2009). While physical exercise being pointed to an important means of reducing weight and body fat, its effect is strongly dependent on the dietary pattern of the patient (CHAGAS et al., 2017). In the present study was not carried out a detailed monitoring of eating habits, but at the end of the study subjects were asked whether they had made any change in dietary habits from the beginning of the study, and none reported having significant changes.

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The most important adaptation observed in EG was on metabolic aspects, especially in reducing FG, whose findings are of great clinical relevance because the glycemic levels not only decreased, but changed their rating category, according to the diagnostic criteria, from diabetes to impaired glucose tolerance (ADA, 2017). This effect has a strong impact on the pathophysiology and complications caused by T2DM, for the reduction of blood glycemia is associated with less activation of polyol pathway, by the advanced glycation end products (AGEs), pathway protein kinase C (PKC) and pathway hexossamina, which are directly related to damage to the target tissue, particularly on the renal system and the renin-angiotensin system, which are related to the control of blood pressure (HELEN VLASSARA, 2015).

Additionally it was also possible to see significant reductions in cholesterol and triglyceride concentration, which also reflect significant reduction in the risk of cardiovascular disease. This is due to the relative high levels of cholesterol and triglycerides are in the atherosclerotic process (FILIPPATOS et al., 2017; MÁRK; DANI, 2016). Although the mechanisms underlying the effect of exercise on the lipid profile are not fully known, exercise appears to increase the ability of skeletal muscle to use lipids, during and after exercise, thus reducing their plasma levels (MANN; BEEDIE; JIMENEZ, 2014). Furthermore, the reduction in lipid concentrations could improve glucose uptake by muscle and liver tissue, decrease with lipotoxicity, reflecting in a better metabolic control and reduce cardiovascular risks in patients with T2DM.

In relation to hemodynamic aspects intervention with aquatic exercise had no significant effect. The main factor that may have influenced in the absence of effect of aquatic exercise on the SBP, DBP and HR, with regard to the values observed at baseline were within normal limits (MALACHIAS et al., 2016). Despite this, the water swimming exercise or other forms of aquatic exercise shown to have a beneficial effect on reduction blood pressure and HR, especially in hypertensive population, which in turn are related to cardiovascular risk reduction (IGARASHI; NOGAMI, 2018).

Among the studies that performed interventions with aquatic exercise for 12 weeks, but with three weekly sessions in patients with T2DM (CUGUSI et al., 2015; DELEVATTI et al., 2016; FILHO et al., 2012; SUNTRALUCK; TANAKA; SUKSOM, 2017), it is possible to observe its effect on glycemic control, but also on the lipid profile and blood pressure appears to be partly dependent on the values observed at baseline. In the present study regression analysis indicated that higher values at baseline to FG, TC, TG, SBP and DBP are significantly associated with greater reductions of these variables after the intervention period.

Thus, when the baseline values show up near normal limits even further intervention time can not produce a significant reduction in these parameters (COLADO et al., 2009). On the other hand, in situations in which baseline values are shown high, mainly glycemia, it is possible to observe significant decreases even after shorter periods of intervention (ÅSA et al., 2012). Although the baseline values represent an important influence on the effects of physical exercise, the results of this study, as other (REES; JOHNSON; BOULÉ, 2017), indicate that 12-week aquatic exercise with moderate to vigorous have important effect on metabolic control in patients with T2DM, even when performed in just two weekly sessions.

It is noteworthy that significant effects on body composition, GL, TC and TG were observed even with a low adhesion in the training sessions (65%). Among the factors that justify the low adherence of the EG aquatic exercise program, there are the absences for attendance at medical consultations and assistance in family care. Although the low adherence represents a limitation of the study this reflects a clinical reality by considering the population of postmenopausal women with T2DM. In this way, increases in the number of weekly sessions, the intervention time and intensity of exercise may represent an alternative to compensate for the low frequency of attendance observed in this population.

Although this study has not done glycated hemoglobin measurements, insulin and other indicators that allow a better understanding of the physiological mechanisms involved in the metabolism of glucose and the effect of physical exercise on the pathophysiology of diabetes, interventions with aquatic exercise in postmenopausal women T2DM are still limited, and the results presented here reinforce the contribution of aquatic exercise on metabolic aspects and body composition of the population studied.

The aquatic exercise performed for 12 weeks in moderate to vigorous reduces positively the glycemia, total cholesterol, triglyceride and body composition in postmenopausal women with type 2 diabetes, which is a significant reduction of cardiovascular risk in this population, even when done in just two wekkly sessions and with low adherence. The results also indicate that the size of the effect of aquatic exercise on metabolic and blood pressure variables is dependent on the values observed at baseline. In this way, it is expected that the effects of broader range aquatic exercise are observed in patients with higher values at baseline. In addition, it can be observed that the absence of physical exercise can affect worsening of

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glycemic control and abdominal fat accumulation in postmenopausal women with T2DM.

***Conflict of interest***

The authors declare there is no conflict of interest.

## REFERENCES

ABESO. **Diretrizes Brasileiras de obesidade 4ª edição**. 4. ed.2016.

ACSM. Exercise and Type 2 Diabetes. **Medicine & Science in Sports & Exercise**, v. 32, n. 7, p. 1345–1360, 2000.

ACSM. **ACSM's manual for evaluation of physical fitness and health**. Rio de Janeiro:2011.

ADA. American Diab Et Es Association. Standards of Medical Care in Diabetes 2017. v. 40, n. January, 2017.

ARCA, E. A. et al. Aquatic exercise is as effective as dry land training to blood pressure reduction in postmenopausal hypertensive women. **Physiotherapy Research International**, v. 19, n. 2, p. 93–98, 2014.

ÅSA, C. et al. Aquatic exercise is effective in improving exercise performance in patients with heart failure and type 2 diabetes mellitus. **Evidence-based Complementary and Alternative Medicine**, v. 2012, 2012.

BIANCHI, L.; VOLPATO, S. Muscle dysfunction in type 2 diabetes: a major threat to patient's mobility and independence. **Acta Diabetologica**, v. 53, n. 6, p. 879–889, 2016.

BOCALINI, D. S. et al. Repercussions of training and detraining by water-based exercise on functional fitness and quality of life: a short-term follow-up in healthy older women. **Clinics**, v. 65, n. 12, p. 1305–1309, 2010.

BORG, G. **Psychophysical basis of percieved exhertion.pdf**, 1982.

CHAGAS, E. F. B. et al. Effect of Moderate-Intensity Exercise on Inflammatory

Markers Among Postmenopausal Women. **Journal of Physical Activity and Health**, v. 14, n. 6, p. 479–485, jun. 2017.

COLADO, J. C. et al. Effects of aquatic resistance training on health and fitness in postmenopausal women. **European Journal of Applied Physiology**, v. 106, n. 1, p. 113–122, 10 maio 2009.

COLBERG, S. R. et al. Physical activity/exercise and diabetes: A position statement of the American Diabetes Association. **Diabetes Care**, v. 39, n. 11, p. 2065–2079, 2016.
COURTIES, A.; SELLAM, J. Osteoarthritis and type 2 diabetes mellitus: What are the links? **Diabetes Research and Clinical Practice**, v. 122, p. 198–206, 2016.

CUGUSI, L. et al. Effects of an Aquatic-Based Exercise Program to Improve Cardiometabolic Profile, Quality of Life, and Physical Activity Levels in Men With Type 2 Diabetes Mellitus. **PM and R**, v. 7, n. 2, p. 141–148, 2015.

DELEVATTI, R. S. et al. Glucose control can be similarly improved after aquatic or dry-land aerobic training in patients with type 2 diabetes: A randomized clinical trial. **Journal of Science and Medicine in Sport**, v. 19, n. 8, p. 688–693, ago. 2016.

FILHO, A. D. DOS R. et al. Efeito de 12 semanas de hidroginástica sobre a glicemia capilar em portadores de diabetes mellitus tipo II. **Revista Brasileira de Atividade Física e Saúde**, v. 17, n. 4, p. 252–257, 2012.

FILIPPATOS, T. et al. Pathophysiology of Diabetic Dyslipidaemia. **Current Vascular Pharmacology**, v. 15, n. 6, p. 1–10, 2017.

HELEN VLASSARA, AND J. U. Advanced Glycation End Products (AGE) and Diabetes: Cause, Effect, or Both? **Current Diabetes Reports**, v. 14, n. 1, p. 1–17, 2015.

HUANG, E. S. Management of diabetes mellitus in older people with comorbidities. **BMJ (Online)**, v. 353, n. May 2005, p. 1–11, 2016.

IGARASHI, Y.; NOGAMI, Y. The effect of regular aquatic exercise on blood pressure: A meta-analysis of randomized controlled trials. **European Journal of Preventive**

**Cardiology**, v. 25, n. 2, p. 190–199, 2018.

KARVONEN-GUTIERREZ, C. A.; PARK, S. K.; KIM, C. Diabetes and Menopause. **Current Diabetes Reports**, v. 16, n. 4, p. 1–8, 2016.

MALACHIAS, M. et al. Capítulo 2 - Diagnóstico e Classificação. **Arquivos Brasileiros de Cardiologia**, v. 107, n. 3, 2016.

MANN, S.; BEEDIE, C.; JIMENEZ, A. Differential effects of aerobic exercise, resistance training and combined exercise modalities on cholesterol and the lipid profile: review, synthesis and recommendations. **Sports Medicine**, v. 44, n. 2, p. 211–221, 2014.

MÁRK, L.; DANI, G. Diabeteses dyslipidaemia és atherosclerosis. **Orvosi Hetilap**, v. 157, n. 19, p. 746–752, 2016.

OLKOSKI, M. M. et al. Metodologia para o planejamento de aulas de hidroginastica. **Motricidade**, v. 9, n. 3, p. 36–43, 2013.

REES, J. L.; JOHNSON, S. T.; BOULÉ, N. G. Aquatic exercise for adults with type 2 diabetes: a meta-analysis. **Acta Diabetologica**, v. 54, n. 10, p. 895–904, 2017.

SOLINI, A. et al. Resistant hypertension in patients with type 2 diabetes: Clinical correlates and association with complications. **Journal of Hypertension**, v. 32, n. 12, p. 2401–2410, 2014.

SUNTRALUCK, S.; TANAKA, H.; SUKSOM, D. The relative efficacy of land-based and water-based exercise training on macro-and microvascular functions in older patients with type 2 diabetes. **Journal of Aging and Physical Activity**, v. 25, n. 3, p. 446–452, 2017.

VERMA, S.; HUSSAIN, M. E. Obesity and diabetes: An update. **Diabetes and Metabolic Syndrome: Clinical Research and Reviews**, v. 11, n. 1, p. 73–79, 2017.

ANEXOS

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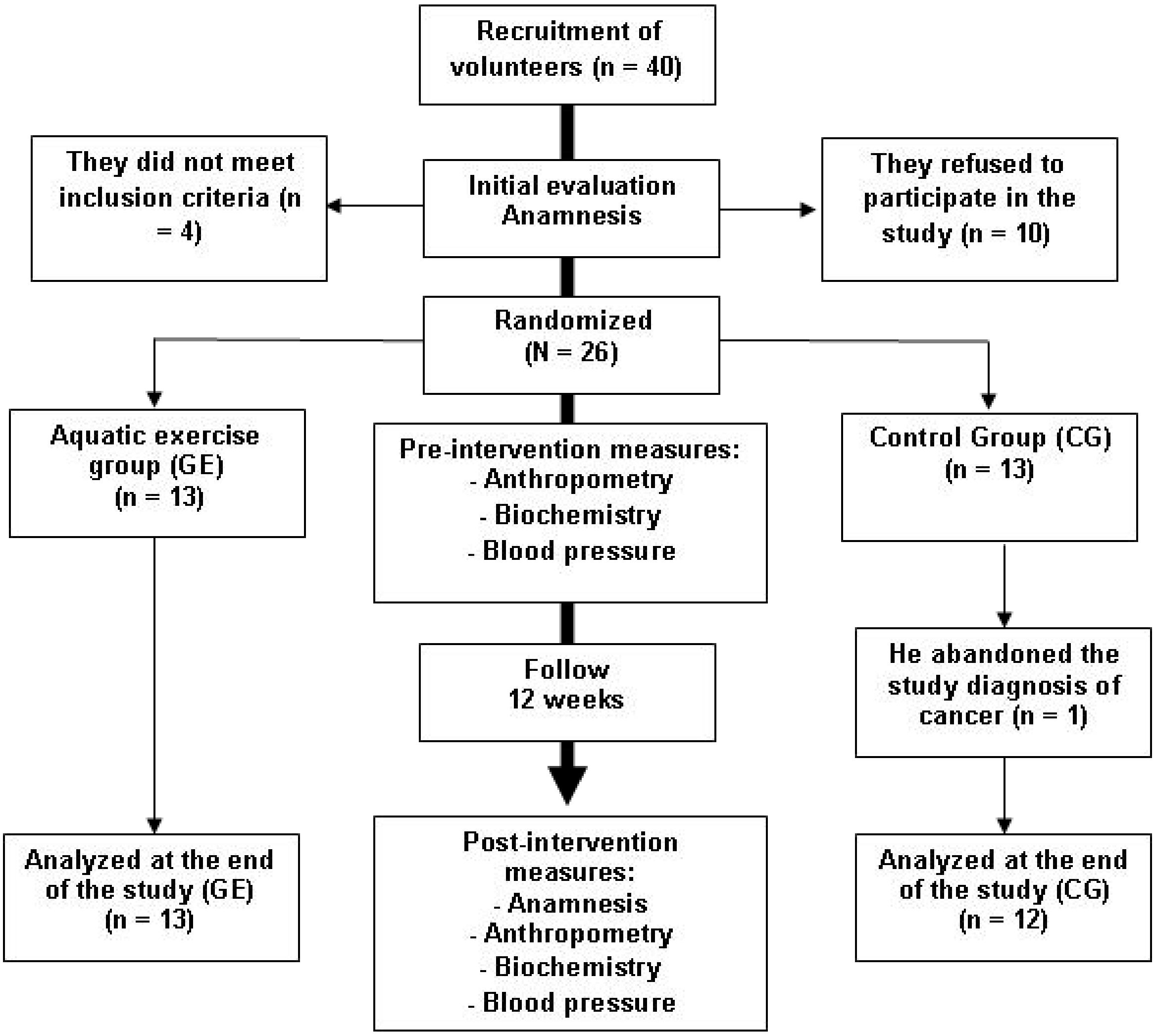


**Figure 1**: Flowchart tracking of volunteers.

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Table 1: Frequency relative distribution (%) of the presence of cardiovascular risk factors and diseases ostearticulares groups control and exercise.

| | Control (n = 12) | Exercise (n = 13) | |
|---|---|---|---|
| | % | % | p-value |
| **Number of Risk Factors** | | | |
| One | 8.3 | 0.0 | 0.640 |
| Two | 33.3 | 38.5 | |
| Three | 41.7 | 38.5 | |
| Four | 16.7 | 23.1 | |
| **Musculoskeletal diseases** | 66.7 | 61.5 | 0.794 |

Note: p-value for distribution of relative frequency (%) for Fisher's Exact test.

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Table 2: Mean and standard deviation (SD) of cardiovascular risk factors for the control and intervention in pre and post-intervention.

| | Control (n = 12) | | Exercise (n = 13) | | The new | | | |
|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Time | Group | Interaction | |
| Variables | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | p-value | p-value | p-value | η2 |
| FG (mg / dL) | 158.6 ± 39 | 182.5 ± 44 † | 135.5 ± 32 | 112.0 ± 15 † | 0.973 | 0.002 ** | 0.0001 * | 0.566 |
| TC (mg / dL) | 212.1 ± 46 | 223.8 ± 42 | 239.2 ± 35 | 186.1 ± 28 † | 0.018 *** | 0.696 | 0.001 * | 0.442 |
| TG (mg / dL) | 202.4 ± 80 | 209.4 ± 71 | 190.3 ± 83 | 140.5 ± 61 † | 0.025 *** | 0.18 | 0.004 * | 0.318 |
| BMI (kg / m) | 29.9 ± 7.9 | 30.1 ± 8.0 | 31.0 ± 6.1 | 30.4 ± 3.9 † | 0.025 *** | 0.784 | 0.0001 * | 0.439 |
| WC (cm) | 88.0 ± 29 | 89.7 ± 30 † | 99.6 ± 9.1 | 96.4 ± 8.1 † | 0.071 | 0.303 | 0.0001 * | 0.621 |
| %Fat | 33.1 ± 4.4 | 34.1 ± 4.5 | 33.2 ± 5.7 | 31.4 ± 6.2 | 0.160 | 0.555 | 0.0001 * | 0.523 |
| SBP (mmHg) | 121.5 ± 13 | 123.5 ± 12 | 128.6 ± 22 | 130.8 ± 17 | 0.494 | 0.255 | 0.968 | 0.001 |
| DBP (mmHg) | 77.0 ± 14 | 73.3 ± 8.9 | 80.4 ± 8.6 | 75.3 ± 7.6 | 0.087 | 0.407 | 0.766 | 0.004 |
| HR (bpm) | 71.9 ± 10.7 | 71.8 ± 10.2 | 67.0 ± 11.1 | 68.6 ± 11.9 | 0.510 | 0.362 | 0.449 | 0.025 |

Note: * p≤0,05 significant effect on interaction time vs. group; ** p≤0,05 significant effect for differences between groups; *** p≤0,05 significant effect of time. † p≤0,05 significant differences within the group compared to pre-intervention time by the Post-Hoc test Bonferroni. η2 eta squared (effect size).
FG fasting glucose; TC total cholesterol; TG triglycerides; BMI body mass index; WC Waist circumference; DBP diastolic blood pressure; SBP systolic blood pressure; HR heart rate.

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Table 3: Linear regression analysis to determine the effect of covariates and the group on the delta variation (Δ) of cardiovascular risk factors.

| Dependent variable | Independent variables | Regression Coefficient | | | | Model | |
|---|---|---|---|---|---|---|---|
| | | | CI95% | | | | |
| | | B | Lower | Upper | p-value | R2 | p-value |
| Δ Glycemia (mg / dL) | Constant | 66.215 | 26.79 | 105.6 | 0.002 | 0.808 | 0.0001 ** |
| | Group | -53.55 | -70.8 | -36.25 | 0.0001 | | |
| | Pre Glucose (mg / dL) | -0.267 | -0.5 | -0.03 | 0.029 | | |
| Δ Cholesterol (mg / dL) | Constant | 135.55 | 57.6 | 213.5 | 0.002 * | 0.793 | 0.0001 ** |
| | Group | -48.92 | -78.1 | -19.8 | 0.002 * | | |
| | Pre Cholesterol (mg / dL) | -0.584 | -0.9 | -0.2 | 0.003 * | | |
| Δ triglyceride (mg / dl) | Constant | 149.5 | 61.9 | 237.2 | 0.002 * | 0.802 | 0.0001 ** |
| | Group | -52.5 | -81.8 | -23.2 | 0.001 * | | |
| | Pre Triglycerides (mg / dL) | -0.4 | -0.6 | -0.2 | 0.001 * | | |
| | Nutritional status | -20.7 | -41 | -0.3 | 0.047 * | | |
| Δ BMI (kg / m2) | Constant | 0.2 | -0.1 | 0.4 | 0.243 | 0.428 | 0.001 ** |
| | Group | -0.7 | -1.1 | -0.4 | 0.001 * | | |
| Δ WC (cm) | Constant | .5494 | -0.63 | 1,725 | 0,343 | 0.869 | 0.0001 ** |
| | Group | -4.735 | -6.07 | -3.394 | 0.0001 * | | |
| | Dyslipidemia | 22.346 | 0.894 | 3,575 | 0.002 * | | |
| Δ% Fat (%) | Constant | .9917 | 0.146 | 1,837 | 0.024 * | 0.718 | 0.0001 ** |
| | Group | -2.807 | -3.98 | -1.634 | 0.0001 * | | |
| Δ SBP (mmHg) | Constant | 57.7 | 23.3 | 92.1 | 0.002 * | 0.576 | 0.003 ** |
| | Pre SBP (mmHg) | -0.444 | -0.71 | -0.17 | 0.003 * | | |
| Δ DBP (mmHg) | Constant | 58.2 | 34.9 | 81.5 | 0.001 * | 0.761 | 0.0001 ** |
| | PAD pre (mmHg) | -0.795 | -1.08 | -0.50 | 0.001 * | | |
| Δ HR (bpm) | Constant | 3.03 | 0.14 | 5.92 | 0.041 * | 0.191 | 0.029 ** |
| | Dyslipidemia | -4.70 | -8.87 | -0.53 | 0.029 * | | |

Note: B regression coefficient; CI confidence interval for the regression coefficient; * p≤0,05 significant effect of the independent variable regression coefficient; ** p≤0,05 significant effect of the delta model to predict changes in the dependent variable; R2 proportion of variation of the dependent variable explained by the independent variables. WC Waist circumference; Dyslipidemia (0 = absent, 1 = present); Nutritional status (1 = low weight ;2 = eutrophic; 3 = overweight; 4= obese); HR heart rate; Group

(0 = Control / = 1 Exercise); BMI body mass index; SBP systolic blood pressure; DBP diastolic blood pressure.