






Effect of physical exercise on cardiometabolic parameters in postmenopause: an integrative review

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Abstract

Objective: To identify the evidence available in literature which relates the practice of physical exercise to improvements in the cardiovascular and metabolic parameters of postmenopausal women. **Method:** A search was performed of works published between 2008 and 2018 included in the MEDLINE, BDENF, IBCS and LILACS databases. Of the 792 studies identified, 23 met the inclusion criteria. **Results:** Following analysis, the studies were separated into three categories. In the first category it was observed that physical exercise improved lipid metabolism, reduced abdominal circumference and promoted weight loss. The second category revealed that physical exercise reduced systolic blood pressure, prevented the development of arterial hypertension and reduced the release of sympathomimetic hormones. In the third category the studies indicated that physical exercise elevated the antioxidant mediators and reversed the oxidative stress involved in the inflammatory reactions present in cardiovascular diseases. **Conclusion:** The studies confirm the beneficial effects of physical exercise on the metabolic and cardiovascular parameters of postmenopausal women.

Keywords: Menopause.
Exercise. Hypertension. Basal
Metabolism.

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INTRODUCTION

In the premenopausal period, women have a lower prevalence of cardiovascular and metabolic diseases than men of the same age. In contrast, after menopause (50-59 years of age), there is a higher prevalence of these diseases in women, indicating that the hormonal transition present in menopause is an important risk factor for female morbidity and mortality¹. Menopause is a phase of the life cycle that occurs in women at the age of 51 and is characterized by amenorrhea for at least 12 uninterrupted months². The postmenopausal period is divided into two phases: an initial phase, which occurs in the first four years after the cessation of menstruation, with women more prone to irritability and frequent mood changes, and a late phase, starting from four years after the end of menstruation³. The postmenopausal period, whether early or late, is associated with several changes in the female body, which influence the development of health problems, promoting significant losses in the functioning of the body².

These imbalances may be temporary, such as the development of coronary artery disease, the loss of collagen and joint elasticity, osteoporosis, and the reduction of the sexual and reproductive functions of women. In addition, systemic disorders such as metabolic syndrome frequently occur⁴. This syndrome is defined as a set of metabolic changes that generate successive dysfunctions in lipid and glycemic levels, promoting the development of diseases such as visceral fat deposition (central obesity), insulin resistance and dyslipidemia. Hypoestrogenism is one of the causes related to the onset of metabolic syndrome, altering endocrine metabolism, with consequences for body weight gain, selective fat deposition and changes in lipid profile⁵.

The mechanisms that promote reduced estrogen plasma levels have not yet been clearly elucidated. However, research has indicated that estrogen plays an important role in the uptake of low-density lipoprotein (LDL) cholesterol by the liver, reducing their circulating values^{5,6}. Estrogen also promotes increased lipoprotein lipase activity, an enzyme that increases fat lipolysis and contributes to reduced fat accumulation and triglyceride levels⁶. This chain of events promotes increased risks for cardiovascular

and metabolic diseases, directly affecting the quality of life of women.

From this perspective, it is vital to promote proper care for women at this stage of life, based on care plans that encourage non-pharmacological methods such as regular physical exercise. In this context, physical activity is defined as any movement of the body generated by the contraction of the skeletal muscles, which raises energy expenditure above the resting metabolic rate. In 1985, meanwhile, Caspersen defined physical exercise as a subcategory of physical activity, which is planned, structured and repetitive, and favors the maintenance or development of physical fitness⁷. In the present study, therefore, we considered physical exercise in the cardiovascular and metabolic context of postmenopausal women.

Physical exercise has a beneficial effect on women's health, and contributes to well-being and quality of life⁶. It is considered an important strategy for increasing daily energy expenditure, controlling the basal metabolic rate, contributing to the improvement of physical conditioning and the maintenance of lean mass⁸. It is therefore essential that health professionals understand the impact that physical exercise has on metabolic and cardiovascular parameters, with the aim of increasing the appreciation of this strategy and improving the quality of related activities during care.

The aim of the present review was therefore to analyze the evidence available in literature that relates the practice of physical exercise to improvements in cardiovascular and metabolic parameters in postmenopausal women.

METHOD

An integrative literature review was conducted in six steps: 1. Creation of the guiding question: *What scientific evidence relates the practice of physical exercise to benefits for the cardiovascular system and metabolic rate of postmenopausal women?*; 2. Creation of the inclusion and exclusion criteria for scientific works and the establishment of databases; 3. Stipulation of information to be drawn from the selected studies; 4. Analysis and evaluation of articles included in the integrative review; 5. Interpretation and discussion

of results; and 6. Presentation of the review/synthesis of knowledge⁹.

The bibliographic search was conducted using the guiding question from May to June 2018 through the Virtual Health Library, with access to the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE), Latin American and Caribbean Literature in Health Sciences (or LILACS), the Spanish Bibliographic Index of Health Sciences (or IBCES) and the Specialized Bibliographic Database in the Field of Nursing (or BDENF), from terms selected in the Descriptors in Health Science (DeCS) and the Medical Subject Headings (MeSH). The strategy combined the descriptors applying the Boolean operators AND; OR: climatério/climacteric/climatério; Exercício/Exercise/Ejercicio; Metabolismo/Metabolism; Sistema Cardiovascular/Cardiovascular System.

The included studies had the following characteristics: papers published in English, Portuguese and Spanish, from 2008 to 2018; complete scientific productions that presented summaries and information about the importance of physical exercise

for the cardiovascular and metabolic parameters of postmenopausal women. Master and doctoral theses were excluded from the study.

The initial search identified a total of seven hundred and ninety-two (792) studies. After reading the titles and abstracts, twenty-seven (27) were found to be duplicates, seven hundred and six (706) did not answer the research question and one study (01) was not available in full. Thus, twenty-three (23) studies constituted the final sample of this review (Figure 1).

To validate the selection of studies for analysis, in the fourth phase of the study the articles were evaluated by two researchers using independent selection. The results of the fourth phase were compared and disagreements resolved by consensus among the reviewers. Of the seven hundred and ninety-two (792) studies evaluated at this stage, twenty-three (23) were selected by the two researchers and included. A total of fifteen (15) disagreements (11%) were identified among the reviewers and after reevaluation these articles were excluded due to not directly addressing the cardiovascular and metabolic parameters.

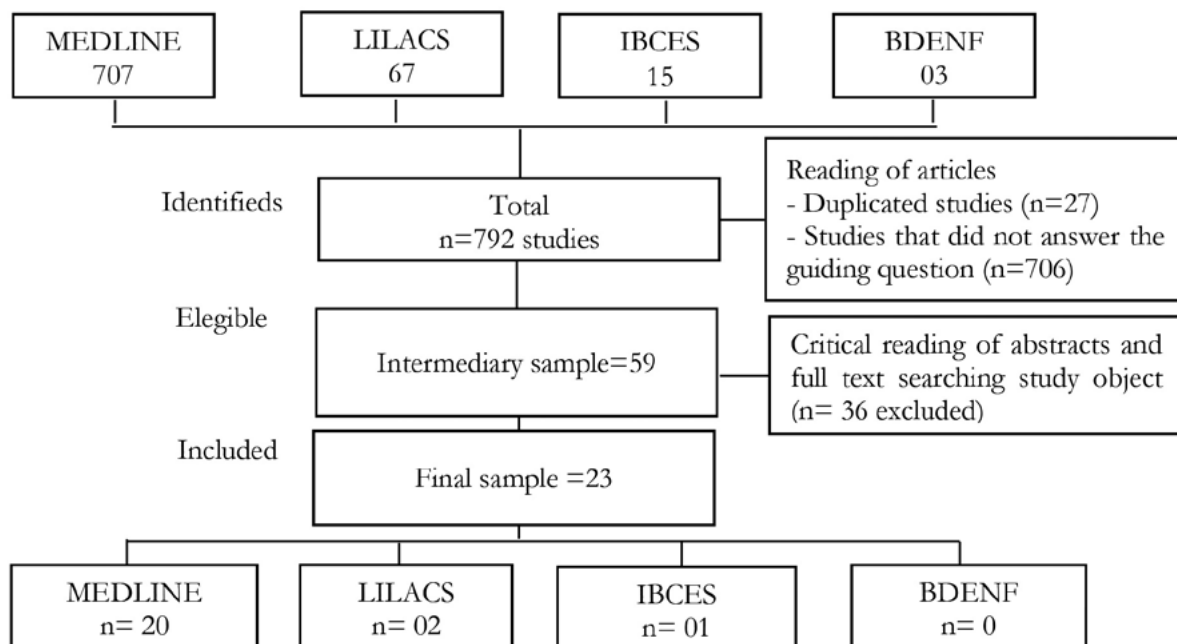


Figure 1. Study selection process flow. Belo Horizonte, Minas Gerais, 2018.

In the fifth phase of the review, the studies were analyzed and the data were grouped in an organized and synthesized manner through the construction of a synoptic table, containing the following data: title, authors, year, journal, location, level of evidence, objective, methodological design and main results. Moreover, following comparison of the studies that made up the final sample of the review, the primary scientific productions were grouped into three analytical categories: “Influence of physical exercise on the metabolism of menopausal women”, “Effect of physical exercise on the prevention and control of systemic arterial hypertension” and “Physical exercise as a parameter to prevent cardiovascular risks in menopausal women”.

The quality of the scientific productions in terms of Evidence Level (EL) was analyzed in order to identify the profile of the studies on the subject, with the publications grouped as follows: Level I. Evidence

of meta-analysis of multiple randomized controlled trials; Level II. Evidence from individual studies with experimental design; Level III. Evidence from quasi-experimental studies; Level IV. Evidence from descriptive or qualitative studies; Level V. Evidence of case reports or experiences; level VI. Evidence from studies based on expert opinion⁹.

The study took into consideration the ethical aspects of research, respecting the authorship and ideas in the publications included in the review.

RESULTS

After applying the eligibility criteria, 23 articles were selected for discussion. Table 1 shows an overview of the studies analyzed by author(s)/year, level of evidence, objective, methodological design, sample and main results.

Table 1. Synoptic table of articles selected for the final sample. Belo Horizonte, (Minas Gerais), 2018.

Author(s)	Level of evidence	Objective	Methodological design	Sample	Main results
Manuzet et al. ¹⁰ 2017	I	to evaluate the effectiveness of organized exercise programs dedicated to sedentary older women.	Randomized controlled trial	Late postmenopausal women, >55 years (mean age 65 - 73 years), with no contraindications to exercise.	After two weeks of moderate intensity physical training, there was a significant improvement in metabolic (lipid) parameters and a reduction in SBP and DBP. In addition, there was a 10-year reduction in the risk of cardiovascular disease.
Mendoza et al. ¹¹ 2016	IV	Determine the benefits of exercise after menopause.	Descriptive Study	Early and late postmenopausal women, without a stipulated average age, from Spanish scientific societies related to the practice of physical exercise and menopause.	The literature demonstrates that the practice of synchronized physical exercise reduces the risk of bone fracture and acts on the cardiovascular system with reduced BP levels, as well as increased HDL levels.

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Continuation of Table 1

Gudmundsdottir et al. ¹² 2013	IV	To evaluate the association between physical activity and metabolic risk factors in premenopausal women.	Qualitative study	Two populations were selected: group 1 and 2 comprised premenopausal women with a mean age >40 years and group 3 comprised early and/or late postmenopausal women.	After 24 months of moderate intensity synchronized exercise, group 1 and 2 exhibited a weight reduction and HDL increase. Group 3 showed a reduction in weight, waist-hip ratio, triglycerides and LDL. In this context, the study demonstrated that physical exercise promotes many benefits in pre and post menopausal women.
Ohta et al. ¹³ 2012	I	To examine the effect of bench exercise on PWV and the associated contribution of insulin resistance, bioactivity and NO.	Randomized controlled trial	Late postmenopausal women, mean age 65-85 years (excluding those with cardiometabolic and orthopedic disorders). Two groups were created: 1. Bench exercise group; 2. Control group.	After 12 weeks in the bench exercise group there was an improvement in BMI, SBP, fasting glucose, LDL and NO compared to the control group.
Novais et al. ¹⁴ 2017	I	To examine the effects of aerobic exercise training on cGMP and NO levels in normotensive and treated hypertensive postmenopausal women.	Randomized controlled trial	Sedentary early and/or late menopausal women divided into two groups: 1. Normotensive women; 2. Treated hypertensive women.	After 24 sessions of aerobic exercise, group 2 showed an increase in fasting NO and an increase in cGMP concentration. In addition, both groups had reduced BP, body fat and triglycerides.
Lavoie et al. ¹⁵ 2013	IV	To determine the synergistic associations between diet quality and exercise energy expenditure on cardiometabolic factors.	Qualitative study	Women in early and/or late postmenopause, overweight or obese, aged 46-70 years, without hormone replacement therapy.	After 24 weeks of synchronized low intensity exercise there was a reduction in cholesterol and an improvement in BMI, highlighting that the association of diet and exercise promotes a better quality of life in postmenopausal women.
Hernández-Angeles et al. ¹⁶ 2016	IV	To analyze the effect of dietary counseling on the health of postmenopausal women.	Descriptive Study	Early and late postmenopausal women without a determined average age.	Study showed that regular, synchronized exercise combined with a healthy diet in postmenopausal women leads to weight reduction, visceral adipose tissue, and waist circumference.

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Continuation of Table 1

Soto et al. ¹⁷ 2016	I	To evaluate the influence of a physical exercise program on cardiovascular risk and quality of menopausal women.	Randomized controlled trial	Early and/or late postmenopausal women, aged 50-60 years, overweight and/or obese.	After three months of moderate intensity physical exercise and change in eating habits, there was a reduction in weight, BMI, fasting blood pressure and blood glucose and lipid profile.
Lesser et al. ¹⁸ 2016	I	To assess changes in cardiometabolic risk factors in postmenopausal women in South Asia.	Randomized controlled trial	Early and/or late postmenopausal women, with an average of 50-60 years and overweight.	After 12 weeks of aerobic exercise there was a significant improvement in glucose and insulin levels in the body. In addition, there was a reduction in insulin resistance, which was identified by calculating the HOMA-IR index.
Zheng et al. ¹⁹ 2014	I	To investigate the estimated total energy consumption and biomarkers associated with cardiovascular risks in menopausal women.	Randomized controlled trial	Late postmenopausal women, mean age 50-79 years.	After five years of follow-up of women with moderate intensity exercise, there was a significant reduction in the risk of several cardiovascular diseases. In addition, diet and exercise promotes a better quality of life for postmenopausal women.
Son et al. ²⁰ 2007	I	To examine the impact of combined resistance and physical training on blood pressure in menopausal women with hypertension.	Randomized controlled trial	Late postmenopausal women with an average age of 75 years and hypertensive divided in: 1. Control and 2. Moderate physical exercise.	After 12 weeks of moderate exercise the group 2 showed an improvement in functional capacity and body composition compared to the control group.
Casas et al. ²¹ 2012	IV	To examine the individual and combined associations of leisure-time physical activity and sleep with cardiovascular risk factors in postmenopausal women.	Qualitative study	Late postmenopausal women with a mean age between 62 and 63 years old, normotensive and non-diabetic, divided into two groups: 1. Active women with a low-fat diet and good sleep quality (>7 hours); 2. Active women with poor sleep quality (<7hours).	After 48 months of moderate intensity exercise of up to 150 minutes/week, group 1 presented lower total body fat, triglycerides and fasting glucose than group 2.

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Continuation of Table 1

Yoshizawa et al. ²² 2009	I	To determine the effects of ingestion of lactic tripeptides and regular aerobic exercise on arterial compliance in postmenopausal women.	Randomized controlled trial	Early and late postmenopausal women aged 50-65 years were randomly divided into: group 1. Aerobic exercise with lactic tripeptide ingestion; and group 2. Women using placebo.	Eight weeks of regular aerobic exercise showed that there were no differences in baseline arterial compliance in group 1 compared with group 2. However, in group 1 there was a reduction in blood pressure and plasma angiotensin II concentrations.
Rodrigo et al. ²³ 2015	I	To analyze the influence of a strength exercise program on cardiovascular risk factors in postmenopausal women.	Randomized controlled trial	Late postmenopausal women (45-69 year old) at cardiovascular risk. Group 1. Using resistance exercises and group 2. Control.	After six months of resistance exercise in group 1, there was a reduction in blood pressure, as well as an improvement in arterial compliance and angiotensin II plasma concentrations when compared to group 2.
Lima et al. ²⁴ 2011	I	To evaluate the effect of an aerobic exercise program on blood pressure control in postmenopausal hypertensive women.	Randomized controlled trial	Late and early menopausal women without estimated average age.	After 12 weeks of aerobic exercise practice, there was a significant reduction in resting blood pressure from 30mmHg, in addition to the improvement in functional capacity of women undergoing the study.
Merino et al. ²⁵ 2013	I	Study the impact of a lower than recommended level of exercise on vascular function and in postmenopausal women.	Randomized controlled trial	Early and late postmenopausal women without an estimated average age, overweight and / or obesity.	After four months of low intensity exercise for 1 hour and twice a week there was an improvement in several parameters associated with cardiovascular health reducing the risk of cardiovascular disease, in addition to the increase in antioxidant enzymes.
Heeren et al. ²⁶ 2008	IV	Emphasize physical training as an important approach in reducing cardiovascular diseases in women after menopause.	Descriptive Study	Early and late postmenopausal women with no stipulated average age.	Adopting an active lifestyle with exercise and healthy eating habits promotes numerous benefits in reducing cardiovascular risks such as lowering blood pressure, lowering LDL levels and increasing HDL, as well as reducing body weight.

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Continuation of Table 1

Puga et al. ²⁷ 2016	I	To examine the effects of acute aerobic exercise-associated with administration of L-arginine on blood pressure in normotensive postmenopausal women.	Randomized controlled trial	Early and late postmenopausal women (average 57 years) and normotensive. There were two groups: 1. L-arginine + aerobic exercise; and 2. Control.	After the four experimental sessions it was possible to show that the group submitted to the use of L-arginine in line with aerobic exercise showed a reduction in the diastolic blood pressure levels through the reduction of sympathetic activity, release of vasodilator substances and among others, in relation to group control.
Figueroa et al. ²⁸ 2015	I	To investigate the effects of full body vibration training on ankle SBP in postmenopausal women.	Randomized controlled trial	Women in early postmenopausal, non-stipulated middle age, prehypertensive, hypertensive, overweight or obese. They were divided into two groups: 1. Body vibration training exercises; and 2. Control group.	After three weeks, group 1 showed a reduction in systolic blood pressure of the ankle compared to the group that underwent normal exercise only.
Arca et al. ²⁹ 2014	I	To compare the effect of aquatic exercise versus land-based training in menopausal hypertensive women.	Randomized controlled trial	Early and/or late postmenopausal women with no stipulated middle age and hypertension. They were separated into three groups: 1. Water exercises; 2. Exercises on land; 3. Control	After 12 weeks of exercise it was found that groups 1 and 2 had no differences in baseline blood pressure. Regarding SBP, there was a statistically significant reduction \pm 18 mmHg in the aquatic exercise group and \pm 10 mmHg in the land group.
Swift et al. ³⁰ 2012	I	To determine the effect of different intensities of aerobic exercise training on blood pressure in obese postmenopausal women.	Randomized controlled trial	Early and/or late postmenopausal women, with no stipulated average age, separated into: 1. Exercise group; and 2. Control.	After six months of moderate intensity exercise, it was found that group 1 had a reduction in diastolic blood pressure and body weight in comparison with group 2.

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Continuação do Quadro 1

Thomopoulos et al. ³¹ 2013	IV	To analyze the role of exercise in the vascular system in menopausal women.	Qualitative study	Early and/or late postmenopausal women with no stipulated average age.	After three months of aerobic exercise it was shown that aerobic exercise has favorable effects on carotid artery compliance in postmenopausal women, in addition to reducing blood pressure levels, decreasing cardiovascular risks and promoting a better quality of life.
Rossi et al. ³² 2013	I	To verify the effects of 16 weeks of aerobic and resistance combined training on cardiac autonomic modulation in menopausal women.	Randomized controlled trial	Early and/or late postmenopausal women with no stipulated average age. Divided into two groups: 1. Training group; and 2. Control group	After 16 weeks of aerobic and combined resistance training, group 1 showed an increase in parasympathetic system and reduction in sympathetic system compared to group 2. Training promoted benefits for autonomic modulation in women undergoing exercise.

cGMP: cyclic Guanosine Monophosphate; HDL: High Density Lipoproteins; BMI: body mass index; LDL: Low Density Lipoproteins; NO: Nitric Oxide; BP: blood pressure; DBP: diastolic blood pressure; SBP: systolic blood pressure; PWV: Pulse wave velocity.

MEDLINE provided the most publications (90%), followed by LILACS (6%) and IBCES (4%). There was a predominance of the English language (87%, used in 19 publications), followed by two articles published in Portuguese and two in Spanish. Regarding the types of studies included, level of evidence I prevailed in 80% of the selected sample (19 randomized controlled clinical trials), followed by level IV in 20% (two literature review studies and five qualitative studies).

According to the results of this study, a mechanism that highlights the protective effect of continuous or intermittent regular exercise on the cardiovascular system provides beneficial changes, reducing cardiovascular risks and promoting a higher quality of life.

In menopause, there is a reduction in ovarian hormone production, which is related to the onset and aggravation of cardiovascular and metabolic diseases. Physical exercise inhibits the occurrence

of such diseases by promoting weight loss, blood pressure control and anti-inflammatory and anti-oxidative effects.

DISCUSSION

According to the analysis of the studies, physical exercise influences cardiovascular and metabolic parameters in a complex manner, allowing the creation of three thematic categories, namely: “The influence of physical exercise on the metabolism of postmenopausal women”, “The effect of physical exercise on the prevention and control of systemic arterial hypertension” and “Physical exercise as a strategy for the prevention of cardiovascular risks in postmenopausal women”. The largest number of studies were in the category “The effect of physical exercise on the prevention and control of systemic arterial hypertension” (37%) and “Physical exercise as a strategy for the prevention of cardiovascular risks in postmenopausal women” (37%) followed by the

category “The influence of physical exercise on the metabolism of postmenopausal women” (26%). The categories are presented below with their respective analysis and discussion.

The influence of physical exercise on the metabolism of postmenopausal women

This category consists of seven publications¹⁰⁻¹⁶ that address the effects of exercise on the metabolism of menopausal women. The authors mainly focused on the endocrine metabolism and the normalization of the body's hormones in order to improve the well-being of women under these conditions. Of the articles analyzed, four¹⁰⁻¹³ addressed the contributions of physical exercise to the lipid metabolism, the reduction of waist circumference and weight loss. One study¹¹ demonstrated that regular exercise training over a three-month period resulted in a significant improvement in metabolic parameters, with a significant increase in HDL level, a significant reduction in LDL level, improved physical fitness and heart rate and diastolic blood pressure normalization, reducing cardiovascular risks over ten years when analyzed by the Framingham scale^{10,11}.

In addition, the studies^{14,15} highlighted that performing exercise as a non-pharmacological intervention is a valuable therapeutic resource in postmenopausal women, acting positively in reducing visceral adipose tissue, waist circumference and BMI. It also promotes greater respiratory capacity, ensuring greater functional capacity and quality of life among these women. Somatic symptoms such as pain, weakness, fatigue and nausea were also less severe in this population, which reinforces the positive role of exercise in the climacteric and menopause periods¹⁶.

Postmenopausal women who practice exercise and a nutritious diet were cited in two studies^{15,16}, reiterating that a nutrient-rich diet in association with exercise has a positive effect on modulating and reducing systemic inflammation, preventing the development and progression of atherosclerosis, as well as reducing the hepatic cholesterol content, providing positive regulation of the LDL receptor and increasing LDL cholesterol clearance¹⁶. One study¹⁴

emphasized that the combination of the daily intake of soy isoflavones (Mediterranean diet) and exercise reduces insulin resistance in postmenopausal women more effectively than each of these separate factors.

In this context, it is clear that lifestyle modification is more effective when there is association combination of diet and exercise, bringing improvements to the health of menopausal women. The same was true for improving the metabolism and quality of life in terms of women's general clinical condition and mental health.

The effect of physical exercise on the prevention and control of systemic arterial hypertension

This category includes eight scientific productions¹⁷⁻²⁴ that related the practice of physical exercise to the management of the prevention and control of systemic arterial hypertension in postmenopausal women. Two scientific productions^{17,18} identified that the performance of exercise programs by menopausal women significantly reduced systolic blood pressure, although changes in diastolic blood pressure were not observed. Such effects are associated with a reduction in adrenaline and norepinephrine secretion levels at rest and during effort, in addition to lower sympathetic tone activity¹⁷.

The maintenance of sympathetic tone depends on the activity of the sympathetic premotor neurons, located bilaterally in the rostroventrolateral portions of the bulb that controls the sympathetic cardiovascular sites, such as the heart, blood vessels and adrenals. During physical exercise, sodium tubular reabsorption occurs, leading to lower sympathetic tone activity and, consequently, a reduction in blood pressure^{17,18}.

Other studies^{19,20} emphasized that combined physical training (aerobic and anaerobic) promotes a reduction in mean arterial pressure and arterial stiffness, in addition to increasing nitrate levels in postmenopausal women with stage 1 hypertension and improving functional capacity and strength, with no adverse effects on BP. In addition, research has identified that combined exercise reduces systolic

and diastolic blood pressure by 9 to 12 mmHg respectively, demonstrating that physical exercise effectively controls BP²⁰. Aerobic exercises play relevant roles in the control and prevention of hypertension^{22,23} reducing blood pressure levels in postmenopausal women, as well as improving the functional capacity of hypertensive women. It is also noteworthy that these changes occurred regardless of the change in body fat percentage, measured by the abdominal circumference and BMI indicators^{23,24}.

Aerobic exercise is an effective alternative therapy for the treatment and control of a moderate blood pressure level. Exercises such as cycling, swimming, going up and down stairs, treadmills and light running promote satisfactory results in lowering blood pressure⁸. The mechanisms involved in reducing blood pressure through aerobic exercise are the reduction of sympathetic tone, increasing the sensitivity of the vascular β -2 adrenoreceptors, reducing the sensitivity of α adrenoreceptors, reducing the renin and aldosterone concentration levels, and increasing the release of natriuretic peptides by cardiac tissue⁸.

Vasoactive substances present in the circulation or excreted from the endothelial cells participate in the regulation of blood pressure by controlling vascular tone, modulating peripheral vascular resistance and cellular remodeling^{8,22}. Another beneficial effect of regular exercise on blood pressure control is that exercise stimulates NO secretion from the endothelial cells, causing vasodilation and controlling blood pressure in the short and medium term. NO promotes vascular smooth muscle relaxation, reducing vascular tone and blood pressure values²².

Casas et al.²¹ analyzed the effect of physical activity combined with diet and sleep quality in postmenopausal women. They used a moderate intensity exercise program for 150 minutes a week (not synchronized) in association with a low-fat diet and sleep quality over seven hours. The study found that women who are active in terms of physical activity, with good diet and good sleep quality, had lower total fat. However, there was no difference in terms of general biochemical characteristics and cholesterol level. It is noteworthy that the work of Casas et al. was the only study in our sample which

was not specifically about physical exercise. We used the term exercise in our search, and yet the study appeared, probably as it used exercise programs for menopausal women in its routines, but not systematized exercise.

From this perspective, it can be affirmed that regular exercise has beneficial effects for menopausal women, reducing blood pressure levels in hypertensive women and preventing its occurrence in normotensive women, contributing to an active and healthy aging, encouraging the well-being of women in this condition.

Physical exercise as a strategy for the prevention of cardiovascular risks in postmenopausal women

This category consisted of eight studies²⁵⁻³² with results related to the cardiovascular benefits if regular exercise in menopausal women. Three studies²⁵⁻²⁷ demonstrated that exercise in postmenopausal women results in the elevation of antioxidant system, measured by the enzymes superoxide dismutase and glutathione peroxidase. These enzymes are primordial in the oxidative stress process and necessary for the maintenance of life, since they prevent and control the excessive production of free radicals involved in the reactions that trigger the incidence of oxidative damage²⁶. The studies stated that physical exercise reduces the levels of factors that initiate the process and progress of atherosclerosis, playing an important role in improving endothelial function²⁵.

It should be highlighted that the performance of physical presented numerous benefits, such as the reduced incidence and risk of strokes. Exercise reduces blood pressure levels and heart rate and improves the sensitivity of arterial pressoreceptors due to increased oxidative enzyme activity and reduced oxidative stress²⁶. In addition, reinforcing the importance of physical exercise as a cardioprotective agent, studies observed²⁶⁻²⁸ that postmenopausal women who exercise have greater arterial pressoreceptor sensitivity and lower heart rate variability when compared to sedentary menopausal women. These parameters are considered relevant for the occurrence of mortality from cardiovascular diseases²⁹.

Regarding arterial compliance, studies²⁹⁻³¹ showed that exercise improves this factor, reducing cardiovascular risk and blood pressure. One study³² showed that the presence of polymorphism for the -786T>C position of the endothelial nitric oxide synthesis gene does not affect the basal levels of nitric oxide; however, when physical exercise is performed, nitric oxide concentration is reduced for women, with this polymorphism found in both normotensive and hypertensive women. Polymorphism is directly associated with cardiovascular diseases such as acute myocardial infarction and coronary artery disease.

Importantly, there are numerous benefits of exercise for reducing cardiovascular risk, especially for decreasing proinflammatory marker levels, increasing insulin sensitivity, and improving cardiopulmonary capacity²⁵⁻²⁹. Nitric oxide has appeared in several studies as a factor with an important role in the cardiovascular system, acting as a vasodilator. When regular exercise is performed, there is an increase in NO production by endothelial cells through shear stress, promoting vasodilating and antithrombotic effects⁸.

In addition, it is noteworthy that synchronized physical exercise, as well as providing improvements in the cardiovascular system, contributes to metabolic improvement and the prevention of health problems. Studies^{33,34} have shown that resistance exercise reduces total cholesterol levels, increases muscle strength, and significantly reduces interleukin-6, leptin and resistin serum concentration levels with minor effects on interleukin-15. These rates, when elevated at menopause, can promote chronic inflammation and may trigger the development and progression of conditions such as neurodegeneration, osteoporosis and atherosclerosis, directly affecting quality of life³⁴. Resistance exercises have effects on the balance of proinflammatory gene transcription in skeletal muscle, stabilizing proinflammatory cytokine levels in muscle.

Thus, the anti-inflammatory benefits of resistance training are derived from an adaptation of transient changes in the number of proinflammatory mediators³⁴. It is also noteworthy that aerobic exercise practiced by menopausal women reduces oxidative stress^{34,35} and insulin resistance, and it is likely that this change is related to changes in autonomic

nervous system function³⁵. Another important aspect is that aerobic exercises promote the prevention of fibrolytic function decline, responsible for the lysis of intravascular and intracardiac clots, preventing thrombus or embolisms^{35,36}.

In contrast, a single study³³ revealed that moderate exercise for postmenopausal women for 12 months worsened the vasomotor symptoms, although paradoxically fewer memory problems were reported. These authors explained that the occurrence of these symptoms is associated with a decrease in BMI, which leads to a reduction in the peripheral conversion of androgens from adrenal to estrone, aggravating vasomotor symptoms. However, they observed beneficial effects in other evaluated parameters, such as physical and psychosocial measures.

Blumenthal et al.³⁷ also observed a significant hypotensive effect on blood pressure with SBP decreases of 7.4 mmHg and DBP 5.6 mmHg after aerobic training over a period of twenty-six weeks^{37,38}. In addition, three forms of non-pharmacological control are essential for the treatment of hypertension, such as: decreased body weight, synchronized physical exercise and reduced sodium intake³⁸. Thus, performing regular physical exercises with frequency and intensity control is efficient in reducing blood pressure, as well as playing an important role in the cardiometabolic system³⁸.

The protective effect of regular, continuous or intermittent exercise on the cardiovascular system promotes beneficial changes by reducing cardiovascular risks, improving metabolic parameters, reducing the incidence of pathologies and promoting the maintenance of quality of life and well-being in postmenopausal women, as at this stage they exhibit anthropometric and biochemical changes.

The interpretation of the present study should consider that the available works on this theme has limitations, as, in general, they are not sufficiently clear about the postmenopausal period or the exercise program performed by women, factors that would influence the results. Still, the results of this study raise important discussions about the effects of physical exercise for postmenopausal women, supporting this practice as a strategy to promote quality of life.

CONCLUSION

The practice of physical exercise in postmenopausal women brings benefits and prevents health problems, especially cardiovascular and metabolic diseases. Analysis of the works included in this study showed that physical exercise can promote the health benefits for postmenopausal women by improving the plasma lipid profile, controlling blood pressure and risk

factors for heart disease. Other important effects are the psychological improvement and fitness acquired through this non-pharmacological strategy. Thus, it is essential that health professionals include the practice of physical exercise in their care strategies, promoting well being and preventing health problems for women.

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