

Hemodynamic and metabolic adaptations after one year of physical training in men participating in the public physical exercise guidance program

Adaptações hemodinâmicas e metabólicas após um ano de treinamento físico em homens participantes do programa de orientação ao exercício físico

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ABSTRACT

Introduction: The Public Exercise Guidance Program (PROEF) facilitates adherence to physical activity. Men are less likely to seek these services, despite being more susceptible to chronic diseases. **Objective:** To evaluate the effects of PROEF interventions on hemodynamic and metabolic variables in men. **Methods:** Eight men (65.5 ± 13.3 years) were assessed before and after 1 year of adherence to PROEF. Three sessions/week were applied: walking (~30 min, 3x/week), exercises with elastic resistance for upper limbs (1x) and interval exercises with elastic resistance (1x). A paired t-test and effect size (ES) were used to compare pre- and post-effects. **Results:** There was a reduction in body mass, BMI, waist circumference, and LDL cholesterol ($P < 0.05$); and an increase in HDL ($P \leq 0.05$). SBP and DBP decreased 10.8 and 4.9 mmHg ($P > 0.05$; ES = 0.54 and 0.45). **Conclusion:** One year of intervention in PROEF improved the hemodynamic, metabolic, and anthropometric parameters of middle-aged and older men.

Keywords: men's health; blood pressure; unified health system; exercise

RESUMO

Introdução: O programa público de orientação ao exercício (PROEF) facilita a adesão à atividade física. Entretanto, os homens tendem a buscar menos esses serviços, mesmo sendo mais vulneráveis a doenças crônicas. **Objetivo:** Avaliar os efeitos das intervenções do PROEF nas variáveis hemodinâmicas e metabólicas de homens. **Métodos:** Oito homens ($65,5 \pm 13,3$ anos) foram avaliados antes e após 1 ano de adesão ao PROEF. Foram aplicadas 3 sessões/semana, de caminhada (~30 min, 3x), exercícios com resistência elástica para membros superiores (1x) e intervalado com resistência elástica (1x). Foi utilizado teste t pareado e tamanho de efeito. **Resultados:** Houve redução da massa corporal, IMC, circunferência abdominal e no colesterol LDL ($P < 0,05$); e aumento do HDL ($P \leq 0,05$). A PAS e PAD reduziu 10,8 e 4,9 mmHg ($P > 0,05$; TE = 0,54 e 0,45). **Conclusão:** Um ano de intervenção no PROEF melhorou os parâmetros hemodinâmicos, metabólicos e antropométricos de homens de meia idade e idosos.

Palavras-chave: saúde do homem; pressão arterial; sistema único de saúde; exercício físico

Introduction

A sedentary lifestyle is a public health problem that affects 31% of adults in the world, motivating the implementation of government strategies to promote physical activity (PA). Associated with population aging, this scenario demands priority actions from the Unified Health System (SUS), aiming to promote healthy aging and mitigate the risk of chronic non-communicable diseases (NCDs) [1]. The National Policy for Men's Health Care (2008) recognizes the greater vulnerability of men to NCDs and their lower demand for health services. The lower demand for men may be associated with sociocultural constructs of hegemonic masculinity, such as heteronormativity, high socioeconomic status, perception of dominance, and patriarchal models [2].

The promotion of active habits faces multifactorial barriers, including contextual variables (e.g., urban environment, public safety, pollution, infrastructure) that influence individual and collective decisions [3]. Clinical studies have shown that aerobic, strength, or combined exercise interventions in older men and women result in improved aerobic fitness and muscle strength. However, 12-week protocols were not sufficient to alter metabolic or biochemical markers, suggesting that adaptations to these parameters require more prolonged interventions [4].

In this context, strategies to expand the supply of physical activities in the SUS are essential, considering the accessibility and diversity of modalities. The use of elastic resistance as a tool for strength training is a safe and effective alternative. This simple and inexpensive tool is commonly used for physical training in the elderly population [5]. In a study involving 24 elderly women, both with and without high blood pressure, a single session of interval exercise using elastic resistance effectively reduced blood pressure and capillary glucose levels for up to one hour after the intervention [6].

Despite these advances, there is a lack of studies that have investigated chronic metabolic and hemodynamic adaptations in older men participating in the Physical Exercise Guidance Program (PROEF). Octogenarians exhibited hemodynamic and autonomic responses comparable to those of young adults following an exercise session, including post-exercise hypotension, which positively contributes to blood pressure control [7]. Furthermore, lifestyle modifications in obese older adults have been shown to reduce cardiovascular risk, total cholesterol, and triglyceride levels in obese older men. However, none of these investigations were carried out within a public health framework [8]. Therefore, the present study aims to assess the effects of a supervised physical exercise program on anthropometric, hemodynamic, and metabolic adaptations in middle-aged and older men. We hypothesize that performing the intervention three times per week will result in significant improvements in the analyzed parameters, thereby supporting its effectiveness as a non-pharmacological strategy for the prevention and management of non-communicable diseases in this population.

Methods

This descriptive, pre-experimental, longitudinal study was conducted within the Brazilian Unified Health System (SUS). Eight men (age: 65.5 ± 13.3 years; range: 45–85 years; body mass: 81.0 ± 10.5 kg; height: 1.69 ± 0.04 m) enrolled in PROEF: a program affiliated with the Municipal Health Department (SESA) of Serra, Espírito Santo were recruited through voluntary and convenience sampling. All participants were SUS users diagnosed with systemic arterial hypertension, diabetes mellitus, and/or dyslipidemia, under pharmacological treatment, and had engaged in supervised exercise for at least one year.

Anthropometric (scale and tape measure), hemodynamic (OMRON HEM-7200), and biochemical variables (blood samples collected at the Regional Health Unit of Serra Dourada, Serra/ES) were assessed pre- and post-intervention (Figure 1). Measurements were performed in the morning, within the same month, and by the same evaluator to ensure consistency.

Inclusion criteria: male sex and participation in PROEF for at least 1 year. Exclusion criteria: musculoskeletal limitations, decompensated cardiometabolic diseases, cognitive impairment, ventricular arrhythmias, or diagnosed atrial fibrillation.

All procedures complied with the Brazilian National Health Council Resolution No. 466/2012 and were approved by the Ethics Committee of the Federal University of Espírito Santo (CAAE: 78240124.9.0000.5542).

Anthropometry

Body mass and height were measured using a digital anthropometric scale with a one-millimeter precision stadiometer (Welmy, W200, Brazil) and with a maximum capacity of 201 kg and sensitivity of 50 grams. The Body Mass Index (BMI) was calculated. Anthropometric measurements were performed by the same experienced evaluator using a 2 m perimetric measuring tape of flexible steel with mm resolution (Sanny SN4010, SP).

Resting blood pressure

Heart rate and blood pressure were measured with an oscillometric device (OMRON HEM7200) following the protocols guided by the Brazilian Guidelines for Blood Pressure Measurements in and out of the Office 2023, before and after the training program [9].

Biochemical profile

Blood samples were collected by venipuncture in a closed vacuum system. The samples were collected by a nursing technician at the Regional Health Unit of Serra Dourada – Serra/ES and analyzed by the laboratory linked to the municipality.

Exercise protocols

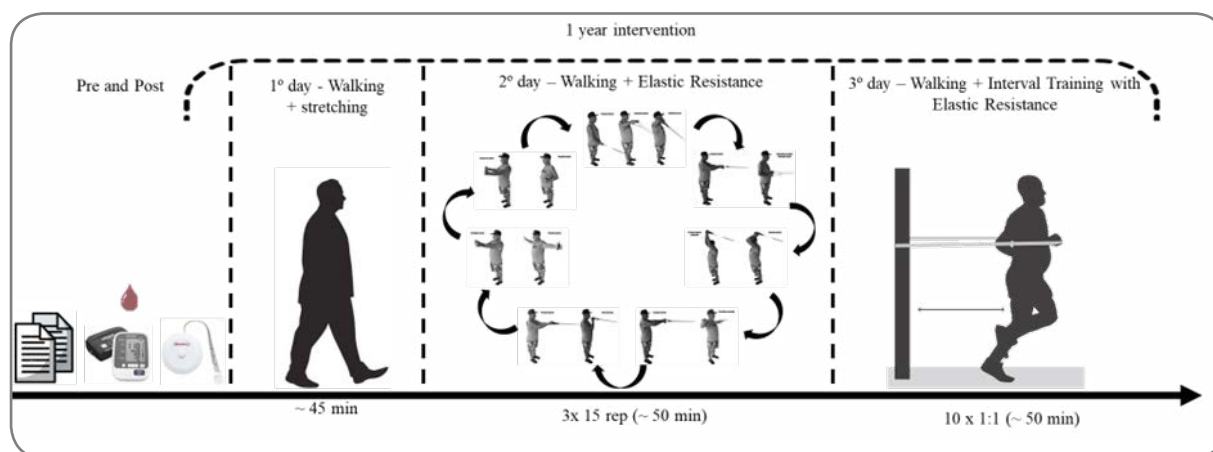
Physical exercise sessions were conducted three times per week (Monday, Wednesday, and Friday) at the Serra Dourada III Community Center, Serra/ES, from 6:30 to 7:30 a.m., as outlined in Figure 1.

Monday: Walking around the neighborhood square followed by 15 minutes of active static stretching, with a total session duration of approximately 45 minutes.

Wednesday: A 20-minute walk followed by upper limb exercises using elastic tube resistance (LEMGRUBER, n°204). The exercises were: standing shoulder flexion, standing shoulder extension, horizontal shoulder adduction with semi-extended elbow, horizontal shoulder abduction with semi-flexed elbow, overhead elbow extension, and elbow flexion with the shoulder flexed. Exercises were performed in 3 sets of 15 repetitions, with 30–45 seconds of rest between sets and exercises, for a total session duration of approximately 50 minutes.

Friday: Walking combined with interval exercises using elastic resistance bands, lasting approximately 50 minutes.

Intensity control: For walking sessions (Monday) and upper limb resistance training (Wednesday), participants received subjective cues: “If you can complete a sentence without pausing for breath, increase your walking pace” (Monday) and “If it feels too easy, increase the elastic tube stretching” (Wednesday). On Fridays, the Borg CR0–10 scale was introduced during the first five sessions to monitor the intensity of interval resistance exercises, which consisted of walking or running back and forth while holding an elastic tube at waist height. Further methodological details can be found in Gasparini-Neto *et al.* [6].



Source: Author

Figure 1 - Research design

Data analysis and statistical procedures

After verifying normality using the Shapiro–Wilk test (GraphPad Prism v.9.3.0), paired t-tests were applied to compare means. The typical error (TE) of the anthropometric variables was calculated using the formula: $SD/\sqrt{n}$, where SD is the standard deviation and n is the sample size. Effect size (ES- Cohen's d) was deter-

mined and classified according to the following arbitrary scale: null (0–0.19), small (0.20–0.49), moderate (0.50–0.79), and large (≥ 0.80). An alpha error <5% was adopted.

Results

Table 1 - Anthropometric, hemodynamic, and metabolic data before and after 1 year of supervised physical training (n = 8)

	Pre	Post	P	Diff.	ES	TE
Body mass (kg)	81±10	77±11	0.04*	-3	0.36 ^P	2.5
BMI	28±3	27±4	0.04*	-1	0.41 ^P	0.9
Waist Circumference (cm)	99±12	96±12	0.04*	-3	0.19 ^P	1.4
SBP (mmHg)	145±26	134±15	0.15	-11	0.54 ^M	-
DBP (mmHg)	83±14	78±9	0.15	-5	0.45 ^P	-
HR (bpm)	73±8	70±11	0.45	-3	0.30 ^P	-
Total Cholesterol (mg/dL)	244±68	170±45	0.10	-74	1.37^G	-
LDL (mg/dL)	127±28	98±23	0.05*	-29	1.20^G	-
HDL (mg/dL)	48±20	53±19	0.05*	5	0.30 ^P	-
Triglycerides (mg/dL)	332±394	97±30	0.15	-234	0.89 ^G	-
Glucose (mg/dL)	118±38	101±19	0.12	-17	0.58 ^M	-
HbA1C (%)	7±2	6±1	0.27	-1	0.71 ^M	-
EMG (mg/dL)	150±54	124±17	0.35	-27	0.70 ^M	-
TGO (mg/dL)	27±12	22±8	0.19	-5	0.53 ^M	-
TGP (mg/dL)	26±7	23±8	0.46	-3	0.32 ^M	-

Body Mass Index (BMI), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Heart Rate (HR), Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), Glycated Hemoglobin (HbA1C), Estimated Mean Blood Glucose (EMG), Glutamic-Oxaloacetic Transaminase (TGO), Glutamic-Pyruvic Transaminase (TGP). * ($P \leq 0.05$); Diff. (Post-Pre Difference); ES (Effect Size). ^{N, S, M, L} – Effects: null, small, moderate and large; TE (Typical Error).

Discussion

Our main findings indicate that one year of supervised physical exercise produced clinically meaningful improvements in hemodynamic and metabolic variables among male participants of PROEF, with effect sizes ranging from small to large. These results align with the findings of Ambrosim *et al.* [10], who reported that participants in a public exercise guidance program presented lower and normalized levels of total cholesterol, HDL, LDL, triglycerides, and blood glucose compared with non-participants. In our study, LDL levels decreased and HDL levels increased, while total cholesterol demonstrated a large-effect reduction, reaching normal ranges. Furthermore, normalization of LDL and HDL values suggests a reduced risk of mortality from cardiovascular diseases.

The risk of mortality can rise by up to 68% in patients with severe hypertriglyceridemia (> 500 mg/dL) [11]; however, our results showed triglyceride levels within

normal ranges after one year of intervention. Additionally, clinically relevant reductions in both systolic and diastolic blood pressure were observed. Evidence indicates that a 2 mmHg decrease in diastolic pressure reduces the risk of systemic arterial hypertension by 17%, coronary artery disease by 6%, and stroke by 15% [12,13]. Moreover, reductions greater than 3 mmHg in SBP and DBP are associated with a 14% lower risk of death from myocardial infarction and a 9% reduction in mortality from coronary heart disease [14]. Although the effect sizes for blood pressure reductions in our study were small to moderate, the observed decreases exceeded both the two mmHg and three mmHg thresholds, suggesting clinical relevance.

Despite these promising outcomes, several limitations must be acknowledged. The sample was selected for convenience from physical evaluations and re-evaluations conducted between 2023 and 2024 at a single PROEF site, with all data collected by the same evaluator at the Serra Dourada III Community Center, Serra/ES - a venue provided in partnership with the local government for physical activity programs. Although this context lends potential ecological validity, the absence of a priori sample size calculation, the convenience sampling approach, and the lack of a control group may have influenced the results. Nonetheless, the findings provide valuable insights into cardiometabolic parameters and associated risk factors, supporting the potential effectiveness of PROEF in improving the physical and metabolic health of middle-aged and older men.

These results can serve as a basis for future interventions with more robust experimental designs, such as longitudinal randomized clinical trials, ideally conducted in partnership with federal and state public higher education institutions—particularly in the fields of Physical Education and Public Health. Such initiatives could facilitate the expansion of physical activity and exercise programs for the general population, with special emphasis on men's health.

Conclusion

One year of supervised physical exercise within the PROEF program produced clinically relevant improvements in hemodynamic and metabolic parameters among middle-aged and older men.

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Conflicts of interest

The authors declare no conflicts of interest.

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Author contributions

Conception and design of the research: Gasparine Neto VH, Carletti L; Data collection: Gasparine Neto VH, Santos Junior CR; Analysis and interpretation of data: Gasparine Neto VH, Alves SP, Nunes LB, Neves LNS, Duarte LF, Leite RD, Carletti L; Statistical analysis: Gasparine Neto VH, Carletti L, Neves LNS; Writing of the manuscript: Gasparine Neto VH, Santos Junior CR, Alves SP, Nunes LB, Duarte LF, Leite RD, Carletti L; Critical review of the manuscript for important intellectual content: Santos Junior CR, Leite RD, Carletti L

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