CIRCUIT WEIGHT TRAINING OR WALKING EXERCISE IN ELDERLY PATIENTS WITH MEDICATED DIABETES AND HYPERTENSION

Treinamento em circuito com peso ou exercício de caminhada em pacientes idosas com hipertensão ou diabetes medicadas

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ABSTRACT

BACKGROUND: There are different types of exercises, but the circuit weight training is less prescribed for the elderly in order to corroborate the control of glycaemia and hypertension. OBJECTIVE: To compare the acute and chronic effects of circuit weight training or walking exercises on capillary glucose, physical fitness, and arterial blood pressure of the elderly women. METHODS: Twelve weeks of circuit weight (n = 14) or walking (n = 9) were performed 3 times a week at the intensity of 40 to 60% heart rate, 11 to 13 in the Borg Scale. The elderly patients with medicated hypertension and diabetes (users of β-blockers, angiotensin-converting enzyme inhibitors and oral hypoglycemic) were selected. RESULTS: The capillary glucose decreased in both groups in acute and chronic effects of exercise (p ≤ 0.05). The systolic blood pressure increased in acute moment only in the circuit weight (+6 mmHg, p ≤ 0.05) without differences in the diastolic blood pressure. The right handgrip, the balance of right and left legs, the sitting and standing test were improved in walking (p ≤ 0.05), and flexibility in circuit weight (p ≤ 0.05). There was no statistically significant difference in the left handgrip, subscapularis, lumbar back, and abdominal circumference, three-meters walking under line. There was no difference in the comparison between groups. CONCLUSION: The two types of exercises improve metabolic rehabilitation. Only 12 weeks of the circuit weight training seems to be a short period to induce higher physical performance in elderly women.

KEYWORDS: aging; blood glucose; physical fitness; rehabilitation.

INTRODUÇÃO: Existem diferentes tipos de exercícios físicos, mas o de circuito com pesos é pouco prescrito para idosos, a fim de corroborar no controle da glicemia e da hipertensão. OBJETIVO: Comparar os efeitos dos exercícios em circuito com pesos ou de caminhada nas fases aguda e crônica sobre glicemia capilar, aptidão física e pressão arterial de mulheres idosas. MÉTODOS: Foram realizadas 12 semanas de exercícios em circuito com pesos (n = 14) ou caminhada (n = 9), 3 vezes por semana, em intensidade de 40 a 60% da frequência cardíaca, 11 a 13 na escala de Borg. As pacientes idosas tinham diabetes e hipertensão medicada (usuárias de substâncias β-bloqueadoras, inibidores de enzima conversora de angiotensina e hipoglicemiante oral) foram seleccionadas. RESULTADOS: A glicemia diminuiu em ambos os grupos nas fases aguda e crônica do exercício (p ≤ 0.05). No exercício de circuito com pesos, a pressão arterial sistólica aumentou apenas na fase aguda (+6 mmHg, p ≤ 0.05), sem diferenças na pressão arterial diastólica. A força de preensão da mão direita, o teste de equilíbrio das pernas direita e esquerda e no teste de sentar e levantar foram melhorados na caminhada (p ≤ 0.05), e a flexibilidade no circuito com pesos (p ≤ 0.05). Não houve diferenças estatisticamente significantes na força de preensão da mão esquerda, na subescapular, na lombar e na circunferência abdominal durante o andar sob linha de três metros. Na comparação entre o exercício de circuito com pesos ou caminhada, não houve significância estatística. CONCLUSÃO: Os dois tipos de exercícios favorecem a reabilitação metabólica. Apenas 12 semanas de exercício de circuito com pesos parece pouco tempo para induzir maior desempenho físico em idosas.

PALAVRAS-CHAVE: envelhecimento; glicose sanguínea; aptidão física; reabilitação.

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INTRODUCTION

The elderly population is increasing and it is estimated that there will be two billion people aged 60 years or older by 2050 in the world, with the majority living in developing countries. Therefore, public health intervention by qualified professionals is necessary to supply this demand, and physical exercises (PE) can be a good action strategy.

Diabetes mellitus (DM) is a chronic and degenerative metabolic disease. It presents multiple etiologies, due to genetic or environmental factors. An increase in DM prevalence may be the result from changes in dietary intake and lifestyle, whereas decreased levels are the effect of physical activity and aging population. In order to prevent injuries, glucose levels can be monitored in the elderly during training or rehabilitation sessions by means of capillary blood glucose (CBG) tests.

Thus, exercises can be used as a non-pharmacological therapy in the elderly with DM, together with changes in eating habits, hypoglycemic drugs, or insulin administration.

Systemic arterial hypertension (AH) is a chronic disease with high prevalence in the elderly population. Studies have shown that aerobic or resistance exercises are beneficial for the adult population. However, lifestyle changes are also necessary, including good nutrition, body weight control, and practice of sports and leisure time. In addition, it is important to monitor the heart rate and arterial blood pressure (ABP) during exercise sessions.

Due to greater knowledge of the aerobic exercise benefits, it is prescribed more often and is mentioned by several studies. In contrast, the demand for resistance exercises with weights has increased. These have numerous applications following the objectives for elderly with AH and DM, and it is associated with the development of physical fitness and health. Aerobic and resistance exercises with weights have presented beneficial effects in the treatment of DM in adults aged in average 52 years. However, it is unknown whether circuit weight training (CWT) for 12 weeks is able to yield similar results in the elderly.

Therefore, it is believed that the indication of both exercises is important. Several studies have demonstrated that the pre-hypertensive elderly showed improvement after six months of regular exercise. However, it is still unknown whether these improvements are related only to CWT exercises, without considering changes in the lifestyle and diet of such population.

CWT is rarely practiced due to less prescription by health professionals (physical therapists and physical educators), particularly in the elderly population. However, walking (WLK) is commonly indicated. Therefore, the aims of this study were to compare the exercises effects with CWT or WLK, the acute and chronic phases of capillary glucose, physical fitness, and ABP of the elderly medicated women.

MATERIALS AND METHODS

This is an exploratory study with an experimental exercise protocol. Exercises were conducted in two types and analyzed, i.e., in acute and chronic phases, in 23 elderly people from the Padre Firmino Duarte Social Center for Elderly People (SCE), who were taking medicine like β-blockers, angiotensin-converting enzyme (ACE) inhibitors, and oral hypoglycemic agents. In this study, the elderly subjects exhibited a high prevalence of metabolic conditions, especially AH and DM. The WLK and CWT exercises were prescribed for rehabilitation due to their low cost. The CWT used free weights as leg weights, baton of iron, and dumbbells. The proposal was to exclude weight training with bodybuilding gym equipment.

We selected elderly women with AH and DM who had been diagnosed 12 months before the study. Participants were divided into two groups according to the type of exercise: CWT (n = 14) and WLK (n = 9). All subjects signed the free informed consent, and the protocol was approved by the Research Ethics Committee of Julio Müller University Hospital (number 330/CEP-HUJM).

Inclusion and exclusion criteria

Elderly people with AH and DM, ≥ 60 years of age, with body mass index (BMI) between 25 and 35 kg/m², and attending the SCE facility were included. Carriers of acute arthritis or osteoarthritis, physical or mental disabilities, decompensated DM or AH regardless of regular medication use, cardiopathy with angina at rest, acute inflammatory diseases or major stroke sequel were excluded. Apart from the study protocol, subjects were advised not to perform any kind of exercise programs. In addition, they needed to have a minimum attendance of 75% at training sessions and to provide a medical permission to practice exercise. During the interview, the sociodemographic questionnaire and Lawton’s Instrumental Activities of Daily Living (IADL) scale were applied (0 to 9 points = dependent; 9 to 18 = partially dependent; and 18 to 27 = totally independent); physical evaluations (anthropometry and tests) were conducted before the protocol beginning, and 48 hours after the last session of training rehabilitation (12 weeks).

Anthropometry measurements

We used a metric tape (Sanny® Made in Fortal, Brazil), which was not flexible or extensible, with an accuracy of 0.1 cm, to measure circumferences of waist (WC), abdomen (AbC),
Elderly patients in physical exercise with diabetes and hypertension

and hip (HC).19 To measure body weight, a set of platform scales with a stadiometer (Filizola Electronic® Made Oswaldo Filizola, Brazil) was used, with precision of 0.1 kg and 0.5 cm. The elderly subjects were weighed with the smallest possible clothing, and their height was measured standing barefoot, with the neck, buttocks, and heels touching the stadiometer of scales.20 The weight and height measurements were used to calculate the BMI (kg/m²).21

Physical tests

Romberg’s test,22 which consists of walking a three-meter long line with eyes open (up to two attempts allowed), was performed. The number of times a person sits down and stands up23 in 30 seconds (complete movement and sitting with lumbar back up and standing with knees extended) in a 43-cm tall chair, which was leaning against the wall and had a straight back without arms, was calculated. In order to calculate flexibility, we used Wells’s test,20 which involved the elderly subject sitting on an exercise mat for two seconds, maintaining the maximum trunk flexion (the mean of three attempts was calculated). In addition, we calculated the one-legged stance balance,24 with eyes opened and arms along the body and without resting hands until balance loss or till maximum time of 60 seconds (with calculated mean of the best result in two attempts). The strength of the hand and subscapularis (range of 0 to 100 kg) and lower limb (0 to 170 kg) was measured using dynamometry (Kratos®). These strength tests were conducted for six seconds, with an interval rest of one minute (the mean of three attempts was calculated).20

Glycemic test and measurement of arterial blood pressure

The maintenance of eating habits without dietary modifications was recommended to the elderly people, who were asked to arrive 15 minutes earlier in order to rest both for evaluations as well as for doing PE. Blood was aseptically collected from a finger sterilized with cotton dipped in alcohol using a lancet. The glycaemia concentration was determined by reagent strips in a portable glucometer (ONE TOUCH® Advantage-plus, made Life Scan, Inc., USA), before and after the PE session. Then, SBP and DBP were measured with a sphygmomanometer (Solidor® Made São Paulo, Brazil) and a stethoscope (Rapport® Made Wenzhou Instruments Co Ltda, China) from the brachial artery of the right arm, in the sitting position (the mean of two measurements was considered).

The data of pre- and post-PE session denominated acute effect were measured with the elderly sitting in a room in CWT or on chairs placed beside the WLK track immediately after complete training. The chronic effect data were collected following the training session after the adaptation period and after 12 weeks of PE. The measurement and assessment were similar to the chronic phase 48 hours after the last training session and prior to the re-evaluation of physical tests.

Physical rehabilitation protocol

The use of a shirt customized for the study, of shorts or sweatpants, and tennis shoes with caps or hats was recommended for WLK. After resting, rate monitors (Polar® Made Proximus Tecnologia, Rio de Janeiro, Brazil) were placed for monitoring the ABP and heart rate during the PE.

CWT was composed of 11 seasons, with exercises for each muscle group, 15 minutes of warm-up and stretching and 45 minutes with weights: 40” weight duration, interspersed by 30” change over interval. On average, three rounds of a 15-minute circuit each was the minimum performed, with one-hour duration of PE, totaling 36 sessions over 12 weeks. The initial weight used was a load of 20% of the lowest measured handgrip dynamometry value (5 kg/f), which corresponded to 1 kg (Chart 1).

WLK was performed on an appropriate track attached to the center, with 10 minutes of warming, 40 minutes of WLK, and 10 minutes of final stretching.

The CWT was done in a covered space with six windows and ceiling fans in a room of approximately 80 m². Exercises VIII–IX–X (Figure 1) performed lying on the mattress presented no changes during the interval. The CWT sequence included an initial warm-up in various positions and stretching for different muscle groups at the end of the training, which were conducted in the standing, sitting, or lying position (Figure 1).

Statistical analysis

The sample distribution was determined by Shapiro-Wilk’s test followed by descriptive statistics to calculate
the mean and standard deviation of the analyzed variables. In order to verify the influence of acute and chronic phases, the exercise on glycaemia values, before and after intervention of WLK and CWT, the paired Student’s $t$-test was applied. In the comparison between WLK and CWT groups, the unpaired Student’s $t$-test was used with independent samples, significance of $p \leq 0.05$ and 95% confidence interval (CI).

**RESULTS**

This study found a 62% prevalence of AH and 21% of DM among the elderly subjects admitted to the SCE. 17% ($n = 23$) elderly people with AH and DM were selected for exercise protocols.

With regard to the IADL, the mean was 25 ($\pm 2$) in the elderly people, and this score classified them at the level of total independence. The mean waist to hip ratio (WHR) was $0.87 \pm 0.05$ and the abdominal circumference was $96.27 \pm 8.8$ cm, which may indicate risk factors for metabolic diseases (Table 1).

The results show that the pre- and post-interventions in acute and chronic phases on glycaemia levels were significant improved ($p \leq 0.05$) with either WLK or CWT interventions. On the other hand, the acute effect of CWT increases the SBP ($p \leq 0.05$), with a non-significant reduction observed with WLK. No chronic effect from either CWT or WLK was observed on SBP.

There were improvements in both hand strength ($p \leq 0.05$) and in the 30-second sitting and standing test ($p \leq 0.05$), as well as in the right and left-legged stance test ($p \leq 0.05$) with WLK (but not CWT) training. In the CWT trained group, there was improvement in flexibility ($p \leq 0.05$) measured using Wells's test of bench. No other variables assessed

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**Figure 1** Site plan of circuit weight training performed in the social center for elderly with the respective sequence of exercises for different muscle groups.

CWT: circuit weight training.
herein changed acutely or after 12 weeks of rehabilitation with CWT or WLK training (Table 2).

DISCUSSION

There was a statistically significant reduction in glycaemia levels with both exercise protocols. The result of physical performance was better in WLK training, probably because this group presented poorer initial performance than the CWT group. In addition, elderly people with AH and DM who used drugs for a longer period had a worse health associated with aging, phase of the rehabilitation, and/or recovery, which generally took longer for improved fitness physical.

Similarly to the results observed in this study, other authors also reported improvements in both acute and chronic effects of exercise on blood glucose levels. In a study, authors also found significant improvements in glycaemia levels after PE, with non-CWT. These studies differ from the present study because they used gym equipment and people were younger. In the present study, participants aged 60 years or more and worked out using free-weight device or equipment, such as barbells, leg weights, batons, and iron bars. However, the progressive load increase was limited during training since we do not have equipment with adjustable loads.

Table 1 Characteristics of the elderly selected for intervention.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intervention subsample (n = 23)</th>
<th>n (%)</th>
<th>Mean (± SD)</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>23 (100)</td>
<td>68.00 (5.3)</td>
<td>65.7 – 70.3</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>23 (100)</td>
<td>63.12 (8.10)</td>
<td>59.62 – 66.62</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td>23 (100)</td>
<td>1.50 (0.05)</td>
<td>1.48 – 1.52</td>
<td></td>
</tr>
<tr>
<td>IADL (0 to 27 points)</td>
<td>23 (100)</td>
<td>25.33 (2.4)</td>
<td>24.38 – 26.48</td>
<td></td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>23 (100)</td>
<td>27.86 (2.9)</td>
<td>26.6 – 29.12</td>
<td></td>
</tr>
<tr>
<td>WHR (W/H cm)</td>
<td>23 (100)</td>
<td>0.87 (0.05)</td>
<td>0.85 – 0.89</td>
<td></td>
</tr>
<tr>
<td>Abdominal circumference (cm)</td>
<td>23 (100)</td>
<td>96.27 (8.8)</td>
<td>92.3 – 100.1</td>
<td></td>
</tr>
</tbody>
</table>

In a study performed with middle-aged obese women, Fett et al. noted significant improvements in the physical performance and biochemical markers after eight weeks of CWT together with lectures and nutritionist interventions. In the present study, there were no guidelines as well as nutritional recommendations; this fact, at least in part, may have influenced the adhesion to the program.

Improvements in physical fitness were not seen in all variables in this study. Other researchers reported positive changes. Nevertheless, in another investigation, it was applied a combined exercise circuit session that attenuated stress blood pressure reactivity in healthy adults. Another hypothesis may be the constant necessity to monitor the correct use of antihypertensive drugs, which was reported by caregivers who observed failures in the administration of these drugs.

The elevation of ABP in the CWT training in acute effect of exercise on SBP and DBP can be explained by an increased release of catecholamines, with subsequent higher cardiac output at the end of the training session. However, in the cumulative effect of exercise, blood pressure levels reduced but they did not present statistical significance. Even though, in another study, the authors mention the absence of dietary monitoring, amount of salt intake, regular practice of PE, difficulties in changing habits and lifestyle, and the need of a multidisciplinary team in centers for the elderly. But there was no guidance or prescribed diets in the present study. This could be an important reason for no observed difference. In addition, in another study, the patients were under medication and in these conditions, they presented normal blood pressure. It is relevant to point out that our subjects were under treatment (antihypertensive and hypoglycemic drugs) and this condition normalizes the blood pressure and glycemcic levels.

The meta-analysis performed by Peterson et al. reported that trained elderly people (three times per week; 17.6 to 24 weeks of training) aging 50 to 92 years showed improvements of 40 to 85% in relation to muscle strength tests and 70% in the one-repetition maximum test. After 12 weeks of training, the present study showed that the intensity chosen by us caused good adherence and no painful relapses; however, it was not progressive enough for statistical significance in the CWT group. It increased muscle strength in the WLK group, which was explained by the admission of more sedentary elderly people performing this PE protocol.

In the re-test of hand and lumbar dynamometry, although the same technique was used in both tests, the elderly were probably not interested in using too much force. This hypothesis is reinforced by their opinion when they performed it first time (mainly pain back). Therefore, in the elderly, other types of test
may be more appropriate to measure muscle strength. Although circuit training was created in 1953 in England by Morgan and Adamson, studies with the elderly are rarely found in the literature; therefore, this prejudices the comparison with other studies. The limiting factors of this study were the lack of a control group, thus there was not a record of the eating habits and diet, and no quantification of the use of salt or the frequency and timing of continuous use of medication, not applying maximum overload tests for specific muscle groups and no individualized programs.

Table 2  Acute and chronic phase exercise on physical performance in circuit weight training and walking in the elderly group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>CWT (n = 14)</th>
<th>WLK (n = 09)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td></td>
<td>Acute</td>
<td>Chronic</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>64.12 (8.4)</td>
<td>64.45 (9.6)</td>
</tr>
<tr>
<td>IADL (points)</td>
<td>25.42 (2.7)</td>
<td>26.0 (1.7)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.81 (2.3)</td>
<td>27.9 (2.7)</td>
</tr>
<tr>
<td>Glycaemia (acute) in mg/dL</td>
<td>102.92 (11.8)</td>
<td>91.54 (11.7)*</td>
</tr>
<tr>
<td>Glycaemia (chronic) in mg/dL</td>
<td>91.70 (11.70)</td>
<td>84.21 (10.24)*</td>
</tr>
<tr>
<td>SBP (acute) in mmHg</td>
<td>121.43 (11.67)</td>
<td>127.0 (11.38)*</td>
</tr>
<tr>
<td>SBP (chronic) in mmHg</td>
<td>127.14 (11.3)</td>
<td>130.0 (13.5)</td>
</tr>
<tr>
<td>DBP (acute) in mmHg</td>
<td>77.85 (5.78)</td>
<td>77.14 (6.11)</td>
</tr>
<tr>
<td>DBP (chronic) in mmHg</td>
<td>77.85 (5.78)</td>
<td>77.14 (6.11)</td>
</tr>
<tr>
<td>Hand grip right (kg/f)</td>
<td>22.16 (4.1)</td>
<td>22.36 (4.49)</td>
</tr>
<tr>
<td>Hand grip left (kg/f)</td>
<td>19.28 (4.1)</td>
<td>19.80 (4.80)</td>
</tr>
<tr>
<td>Subscapularis (kg/f)</td>
<td>12.10 (3.9)</td>
<td>10.76 (2.9)</td>
</tr>
<tr>
<td>Lumbar dynamometry (kg/f)</td>
<td>49.2 (15)</td>
<td>50.92 (12)</td>
</tr>
<tr>
<td>Abdominal circumference (cm)</td>
<td>97.87 (8.12)</td>
<td>98.2 (8.8)</td>
</tr>
<tr>
<td>Walking three-meters line (m/s)</td>
<td>20.17 (19.71)</td>
<td>20.03 (6.8)</td>
</tr>
<tr>
<td>Flexibility (cm)</td>
<td>28.23 (11.9)</td>
<td>31.8 (11.8)*</td>
</tr>
<tr>
<td>RLB (s)</td>
<td>32.14 (23.65)</td>
<td>34.29 (19.9)</td>
</tr>
<tr>
<td>LLB (s)</td>
<td>28.8 (19.4)</td>
<td>34.06 (17.4)</td>
</tr>
<tr>
<td>SS (times)</td>
<td>10.7 (2.01)</td>
<td>12.2 (3.17)</td>
</tr>
</tbody>
</table>

WLK: walking; CWT: circuit weight training; Acute: immediate effect of exercise; Chronic: cumulative effect of exercise; SBP: systolic blood pressure; DBP: diastolic blood pressure; SD: standard deviation; BMI: body mass index; RLB and LLB: right and left-legged balance (s = seconds up to a maximum of 60 s); SS: sit and stand; IADL: Lawton’s Instrumental Activities of Daily Living (0 to 9 points = dependent, 9 to 18 points = partially dependent, and 18 to 27 points = totally independent). Sample distribution measured through the Shapiro-Wilk test, *paired Student’s t-test with significance of p ≤ 0.05; †unpaired Student’s t-test independent samples without statistical significance between the exercise groups with 95% confidence interval.

CONCLUSION

These two ways of intervention contributed to reductions of glycaemia levels and probably to the improved metabolic glucose uptake. This proposed rehabilitation is characterized as of low cost if compared to traditional health clubs and can be perfectly adapted to elderly community centers. Although there was good adherence, in more than 12 weeks of sessions, progression of load and association with changes in lifestyle are necessary to obtain significant responses from PE.
CONFLICT OF INTERESTS

Th e authors report no confl ict of interests.

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