

Aerobic Capacity of Elderly Women Engaged in Controlled Physical Activity

by

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The objective of this study was to evaluate the aerobic capacity of elderly participants in the family health program at Health Municipal Secretary, who were submitted to a regular program of physical exercise. This experimental study had a sample size of 98 hypertensive elderly women. The sample was divided randomly into an experimental group (EG; $n=58$, age: 67 ± 6 years) and a control group (CG; $n=40$; age: 70 ± 6 years). Aerobic capacity was evaluated by a six-minute walking test (WT6). The intervention program was conducted three times a week (Monday, Wednesday and Friday), between 17:00 and 17:45 hours, with an intensity that varied from 55% to 75% of the theoretical maximum heart rate. Student's paired *t*-tests or Wilcoxon tests were utilised in the intra-group analysis (for homogenous or heterogeneous distributions of the data, respectively). An ANOVA two-way parametric test was used to evaluate the inter-group data followed by the Scheffe post hoc test. A value of $p<0.05$ was adopted for statistical significance. The results revealed an increase in distance travelled in the EG in the post-test relative to the pre-test ($\Delta= 70.58$ m; $p<0.0001$) and relative to the CG post-test ($\Delta= 116.58$ m; $p<0.0001$). Furthermore, the CG travelled less distance in the post-test than in the pre-test ($\Delta= -0.78$ m; $p=0.003$). Therefore, we infer that a walking regimen of controlled intensity improves the distance travelled by elderly women in the WT6 by increasing their aerobic capacity.

Key words: physical exercise, aerobic capacity, six-minute walking test (WT6), elderly women

Introduction

Present-day society is characterised by mechanisation and computerisation trends that reduce the need for physical activity, particularly at work. In recent years, we observed an increase in sedentarism, and the social group that is most affected by this is the elderly (Cader et al., 2006).

In addition to the functional changes that occur in the cardiovascular and respiratory systems due to

aging, a decrease in aerobic capacity also occurs (Guenard and Marthan, 1996). Accordingly, a physiological parameter was established to determine the aerobic capacity of an individual, which is oxygen consumption - VO_2 (Mynarski et al., 2009). There are various factors that promote the decline of VO_2 in individuals of advanced age; this decline occurs even more rapidly (nearly doubling) in sedentary individuals than in life-long physically active individuals (Matsudo et al., 2000).

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The literature refers to using the walking test as a primary component in evaluating aerobic capacity in diverse clinical situations. The walking test is a quick, easily administrable, low-cost and low-impact exam that can be conducted at any time of the day (Perecin et al., 2003).

Despite the advantages of physical activity, a large segment of the population is inactive or exercise at insufficient levels to obtain satisfactory health results (Fechio and Malerbi, 2004). While the elderly clearly benefit from physical activity, the greatest benefits occur when the activities are scheduled and occur at moderate to intense levels (Kłapcińska et al., 2008). While physical activity aims at maintaining and recuperating health, socialisation and leisure, physical exercise is a planned and structured repetitive activity that aims to maintain and improve one or more components of the physical form (Pieron, 2003).

In this context, programs to promote physical activity in the community have recently risen in popularity. The Family Health Program (PSF) is a reorientation of the care model strategy that employs multi-professional teams in basic health units. These teams are responsible for monitoring a defined number of families that are located in a specific geographical area. The teams seek to promote good health, prevention, recuperation and rehabilitation from illness and frequent injuries; basically seeking to improve or maintain the overall health of a specific community (Guimarães et al., 2008).

The objective of this study was to use the WT6 test to evaluate the aerobic capacity of elderly PSF participants who were submitted to a regular program of physical exercise and presents the hypothesis that there will be improvement in aerobic conditioning and functional capacity in elderly hypertensive women accompanied by The Family Health Program.

Materials and methods

Methodology

Sample

This research is characterised as experimental in that the sample was composed of hypertensive elderly women who were registered with the PSF (n=360) in the city of Juazeiro do Norte in the southern region of Ceará.

As inclusion criteria, individuals had to be registered at PSF site 22 or 44 in the city of Juazeiro do

Norte, and over 60 years of age, hypertensive, and not practicing any regular physical activity. These were the clinical conditions required to participate in the study.

Elderly women who had any type of acute or chronic infirmity that could compromise or become an impeding factor in the execution of the WT6 and the proposed physical exercise routine were excluded from participation. Elderly women with uncontrolled hypertension, heart disease, or any musculoskeletal condition that could inhibit the execution of exercise (such as osteoarthritis, a recent fracture, a recent surgery, tendinitis, neurological problems or morbid obesity) were excluded from the sample, as were those who used drugs that caused attention disorders.

After the inclusion and exclusion criteria were met, the sample was composed of 98 elderly women who were divided randomly into two groups: an experimental group (EG; n=58, age: 67±6 years) and a control group (CG; n=40; age: 70±6 years).

The study followed the guidelines determined by the Helsinki Declaration (WMO, 2008) for human subject research. It was approved by the Research Ethics Committee of the Castelo Branco University on July 19, 2008, under protocol number 0042/2008.

All voluntary informed consent form before the beginning of the research, which provided instructions about the activities involved in the study and highlighting the health risks and the option to unconditionally quit the program at any time.

Procedures

For the physical evaluation, the participants were asked to wear bathing suits (swimsuit and trunks) to obtain body measurements such as height and body mass index (BMI). The record-keeping for all participants was conducted with systematic monitoring throughout the 16-week physical and clinical evaluation period.

The first data collection occurred during the first week of April, and the second collection occurred during the first week of August of the same year, always in the morning.

To evaluate body mass, an INMETRO certified (precision of 100 g) Filizola scale was used. Height was measured using an INMETRO certified stadiometer (precision of 1 mm) (Marfell-Jones et al., 2006).

The intervention program was conducted three times a week (Monday, Wednesday, Friday) be-

tween 17:00 and 17:45 hours, with an intensity that varied from 55% to 75% of the theoretical maximum heart rate (MHR), which was obtained by the equation: $MHR = 222 - \text{age}$. The MHR was controlled by manually measuring the heart rate (HR) in the carotid for six seconds and then multiplying by 10 (ACSM, 2003). This HR was measured by the participants themselves, after having been informed and trained to do so correctly.

All participants had their HRs measured by one of the monitors at least once a session, soon after they measured it themselves, to confirm the value identified by the elderly woman. The moment of HR measurement varied and was performed at the command of the instructor in charge or requested by the closest monitor.

The sessions were conducted in the following manner:

- Warm-up: 5 to 10 minutes of articular exercises of the upper body, neck, trunk and lower body.
- Routine: 20 to 30 minutes of walking in the Natural method.
- Cool-down: 3 to 5 minutes of seated and/or lying down stretching of the neck, upper body, trunk and lower body, using the "alternate by segment" method. The intervention activity was conducted in a controlled environment as to the surface (flat and not slippery) and accuracy in reading the travelled distances (unofficial racetrack – 260 meters). The training was controlled by time restriction and was in compliance with the American College Sports Medicine guidelines (2003) and with the 5th Brazilian Arterial Hypertension Guideline (2007), which recommends a maximal fre-

quency of training of three times a week for a duration of 20 to 30 minutes, as an adequate routine for achieving significant physiological changes in this age group.

To assess aerobic resistance, the WT6 was conducted according to Rikli and Jones's protocol (2001). The elderly women were instructed to travel the greatest possible distance of the known route for six minutes at a walking pace determined by each individual--they could not run.

Statistical Treatment

Descriptive statistics such as average, standard error, median, standard deviation and absolute delta (Δ) were used. The sample normality was evaluated by the Shapiro-Wilk test for the CG and by the Kolmogorov Smirnov for the EG. For the intra-group variance response analysis, a paired Student's t-test or the Wilcoxon test was used when appropriate (for homogeneous or heterogeneous data distributions, respectively). For the inter-group assessment, the two-way ANOVA parametric test was used according to the Scheffe post hoc test. We adopted a level of $p < 0.05$ for statistical significance. To evaluate the results, Excel and Statistical Package for Social Science ® Ver. 14.0 (SPSS) software were utilised.

Results

For a better description of the sample characteristics, we evaluated the subjects' anthropometric measurements (Table 1).

In Table 1, we observed that the EG experienced a small reduction of their lean mass (-1.51%) and of their BMI (-2.81%). The CG showed a slight increase in their body mass (+0.25%) and BMI (+0.25%). In

Table 1

			<i>Researching of the antropometric variables of the sample</i>				
			Average	Standard-error	Median	Standard deviation	Shapiro Wilk p-result
Body composition	EG	pre-test	62,40	1,29	61,40	9,79	0,200
		Post-test	61,46	1,38	60,05	10,48	
	CG	pre-test	60,54	1,70	62,05	10,74	0,116
		post-test	60,69	1,70	62,15	10,74	
Stature	EG	pre-test	1,50	0,01	1,51	0,06	0,028
		pos-test	1,50	0,01	1,51	0,06	
	CG	pre-test	1,48	0,01	1,49	0,06	0,194
		post-test	1,48	0,01	1,49	0,06	
BCI	EG	pre-test	27,61	0,47	27,13	3,59	0,200
		post-test	26,83	0,70	27,06	5,31	
	CG	pre-test	27,63	0,75	27,98	4,77	0,045
		post-test	27,69	0,76	28,13	4,78	

BCI: body composition index; EG: experimental group; CG: control group

the data distribution, we observed that the size variables in the EG and BMI in the CG were not normally distributed.

In evaluating the normality of the WT6 results, the EG presented a heterogeneous data distribution ($p=0.048$). Figure 1 indicates the distance travelled by each group in the WT6. The EG showed an increase in the distance travelled in the post-test, relative to the pre-test ($\Delta= 70.58$ m; $p<0.0001$), and relative to the CG post-test (116.58 m; $p<0.0001$). However, the CG experienced a reduction in distance travelled in the post-test relative to the pre-test ($\Delta= -0.78$ m; $p=0.003$).

Discussion

The WT6 can be considered a constant load because the imposed load (the individual body mass) and the walking speed did not vary throughout the test. The elderly can easily tolerate a constant load (Araújo et al., 2006). During the sub-maximum test, the oxygen transportation components properly cover the requirements imposed by cellular metabolism, and therefore the need for oxygen and carbon dioxide exchange between the mitochondria and the atmosphere is met at an intrinsic muscle level. On the other hand, the mitochondrial oxidative capacity does not reach its maximum limits, and in these conditions, symptoms like dyspnea and muscle fatigue are tolerable. As such, submaximal tests are the most suitable for evaluating physical capacity in a safe and comfortable manner in the elderly (Roca et al., 2001) and cardiac patients. According to Fiorina et al. (2007), the walking test is a more natural way of testing than cycling or treadmills, because it better reflects daily life activities. Its advantages over the other stress tests are its simplicity, safety, low cost,

high degree of acceptance by managers, ease of administration and widespread use.

Solway et al. (2001), in a qualitative systematic review of walking tests that are used in the fields of cardiac and pulmonary diseases, recognised WT6's advantage over the other walking tests. Cardiovascular diseases present significant morbidity/mortality in the elderly population. In the United States of America (USA), elderly people are responsible for 65% of the hospitalisations due to cardiac illnesses and around 85% of the deaths due to acute myocardial infarction (Nicolau et al., 2007). Until the age of 65, coronary heart disease is much more prevalent in men. From the age of 80, its prevalence is equal in both women and men (Steg et al., 2002). A study of autopsies in a clinic with patients of 90 years or older revealed that 70% of them had one or more occlusions of coronary vessels (Zaslavsky and Gus, 2002).

Research by Gremeaux et al. (2008) found significant correlations that are relevant to this study between the following variables: (a) VO_2 max and the WT6 distance; (b) VO_2 max and the execution time of a 200-m fast walking test (200mFWT) and (c) the time of the 200mFWT and distance in the WT6. Although the correlations between these parameters do not necessarily imply causality, they do suggest possible directions for rehabilitation strategies. A training program that is designed to improve VO_2 max in this population, for example, could result in an increase in the distance travelled in the WT6 and a decrease in the time needed to complete the 200mFWT. Other studies have noted similar correlations between VO_2 max and the WT6 (Cahalin et al., 1996; Zugck et al., 2000). Therefore, all the studies that follow, even though they directly measured VO_2 max to evaluate aerobic capacity and did not use the WT6, are useful for discussion.

To assess the VO_2 increase in response to exercise in octogenarians, Ehsani et al. (2003) randomised their control group ($n=24$; age= 84 ± 4 years) and their experimental group ($n=22$; age= 83 ± 4 years). Participants were submitted to a training program for six months that was composed of physical exercise, strengthening and walking with an intensity of 78% of the MHR. In addition to other cardiovascular changes, the researchers observed a 12% increase in VO_2 max in the experimental group (1.60 ± 3.38 to 1.83 ± 3.21) with $p<0.0001$ and a slight decrease in the control group (1.09 ± 0.29 to 1.05 ± 0.33 l/min). These findings are consistent with our results, demon-

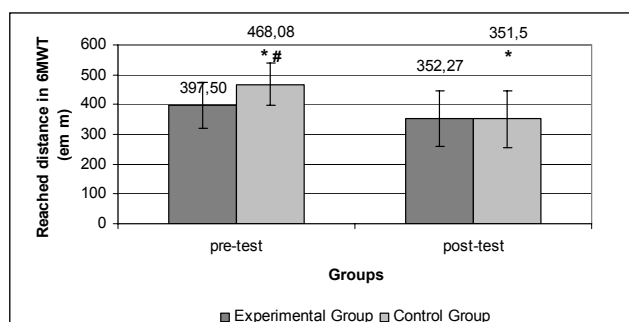


Figure 1

Comparison of the reached distance in six minute walking test (6MWT).

6MWT: six minute walking test. * $p<0.05$; pre-test vs post-test# $p<0.05$; post-test EG vs post-test CG

strating an increase in the distance travelled in the EG in the post-test and a reduction of distance in the CG, which reflect an increase and decrease in VO_2 max, respectively.

Through endurance training at 85% of the MHR, the results of Evans et al. (2005) corroborate our findings. In a sample of ten elderly people (age=80±3 years) subjected to 12 months of exercise, the study revealed an increase of VO_2 max of 15% ($p<0.0001$), a significant improvement in the lipid profile (LDL: -10%, $p=0.003$; total cholesterol: -8%, $p=0.002$) and lean mass reduction of 1.8 Kg ($p=0.003$). Although these parameters were not the focus of this study, the EG also showed a reduction in body mass and BMI. In both the Ehsani et al. (2003) and the Evans et al. (2005) studies, the increases in aerobic capacity (14% and 15%, respectively) were lower than the findings in our study (17.75% in the EG). However, these results are justified by the age factor (Weiss et al., 2006). A similar improvement (only in VO_2 max) was found in the Soto et al. study (2008) of elderly people (age=69±5 years) who had undergone endurance training for 11 months.

The training protocol used in this investigation consisted of walking between 55% and 75% of the MHR, which achieved a significant improvement ($\Delta=70.58$ m) in the WT6, despite not using strength training. These findings are supported by those pre-

sented in the work of Haykowski et al. (2005), which documented that aerobic work (1.59±0.26 to 1.73±0.22 l/min), strength training (1.48±0.23 to 1.70±0.26 l/min), and the combination of these two routines (1.47±0.47 to 1.74±0.41 l/min) all caused an increase in the VO_2 max.

In the same way that controlled training improves aerobic capacity, the lack of training reduces this capacity, according to the data in Figure 1. These findings are similar to those in the studies of Carvalho et al. (2008) and Toraman (2005). After conducting a study with elderly people between the ages of 60-86 who participated in a training program for nine weeks, Toraman (2005) observed a significant increase ($p<0.05$) in the distance travelled in the WT6 in the post-test. This improvement, relative to the results from the pre-test, remained after a short period of inactivity (six weeks of inactivity; $p<0.013$), but there was a reduction after a long period of inactivity (52 weeks; $p<0.013$). These findings corroborate the data from Graph 1, which revealed an increase in the distance travelled in the EG and a reduction in the CG that did not participate in training, and was only susceptible to the effects of senescence.

Given the above, we infer from the increase in the distance travelled in the WT6 that a walking program of controlled intensity improves the aerobic capacity of elderly women.

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