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Original Article

The effects of moderate aerobic training on cardiorespiratory parameters in healthy elderly subjects

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Abstract:
The present study is aiming to demonstrate the benefits of moderate aerobic training on cardiorespiratory parameters in healthy elderly subjects.
Material and methods:
We studied 29 healthy elderly subjects. They were divided into two groups: training group (6 men and 8 women) aged 67.14±9.6 years (mean±SD) and control group (5 men and 10 women) aged 68.32±8.2 years.
Subjects in the experimental group attended 45-min sessions of moderate aerobic exercise three times a week for 6 months. The control group did not receive any training.
All subjects underwent assessments for heart rate and arterial blood pressure. The 6-minute walking test was performed before and after the training program. Oxygen saturation (SpO2) and the rate of perceived dyspnea (modified Borg Scale) were recorded before and after completion of the walking test.
Results: At the end of the observed period we obtained a significant reduction of heart rate, systolic and diastolic blood pressure in the training group (p<0,05). Contrary, in control subjects cardiac parameters increased considerably (p<0,05). The 6 minute walking test was found similar in both groups and no difference was observed after the exercising program (p>0,05). Pre- and post-test SpO2 was not significantly different between the two groups (p>0,05). We didn't recorded significant dyspnea responses during and at the end of the 6 minute walking test (p>0,05).
Conclusions: Moderate aerobic training is beneficial in improving cardiovascular parameters and can prevent the development of cardiovascular diseases in healthy elderly subjects.
Healthy older individuals showed no breathlessness or oxygen desaturation during moderate exercises improving their aerobic endurance.
Key Words: aerobic physical training, blood pressure, heart rate, dyspneea, Borg scale

Introduction

The ageing process of the Romanian population started 4-5 decades later than in the other European countries. In the last six decades, Romania's population aging increased; the number of the elderly persons doubled (14.5% in 2004 compared with the conventional threshold of 7%) (Fercală E., 2009).

According to "An Ageing World 2008"published by the U.S. National Institute of Health, the world's older population will grow by an average of 870000 people each month during the year. They estimate that in fewer than 10 years, people aged 65 and over will outnumber children less than 5 years (Kinsella K., Wan H., 2009).

Influence of aging on health and quality of life exceeds any effects of known disease thus old age is considered to be the main risk factor for many diseases. Ageing induces different involutive processes that occur in most physiological systems, even in the absence of serious diseases.

Regular exercise provides multiple benefits in older adults, including improvements in muscle strength and in the capacity of the muscles to use oxygen. In addition, physical training contributes to the decreased risk for coronary diseases and to improvements in lipids and glucose metabolism (Nied R.J. et al., 2002).

Aerobic training has significant effects on stroke volume, maximal cardiac output and on maximal arteriovenous oxygen difference (Ogawa T. et al., 1992). Trained older persons are capable to maintain a submaximal effort with less cardiovascular involvement and muscular fatigue than sedentary subjects (Coggan A.R. et al., 1993; Soto P.F. et al., 2008).

Regular exercise has been shown to decrease mortality and age-related morbidity in older adults (Nied R.J. et al., 2002).

The present study is aiming to demonstrate the benefits of moderate physical training on cardiorespiratory parameters in healthy elderly subjects.

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Material & methods

We studied 29 healthy elderly subjects. Participants were categorized on the basis of age, sex and training status into the following two groups: training group (6 men and 8 women) aged 67.14±9.6 years (mean±SD) and control group (5 men and 10 women) aged 68.32±8.2 years.

The training group attended 45-min sessions three times a week for 6 months. Training sessions consisted of moderate aerobic exercise on a treadmill, stationary bicycle or a walking. The intensity was maintained at 60–85% of the individual maximum heart rate calculated by using the formula 220-age.

Each training session was monitored and recorded by using a Polar RS800 heart rate monitor in order to adjust the intensity and duration of the exercise program. Cool down for 5-10 minutes was peformed by each subject at the ending of the program. The control group did not receive any training.

Written informed consent for participation was obtained from each subject prior to enrolment. All subjects completed a comprehensive screening medical evaluation, including a medical history, physical examination and resting ECG.

Subjects were eligible to participate if they were healthy, sedentary and able to participate in the training; they were not currently taking any medications. The exclusion criteria's were: cardiopulmonary diseases, hypertension, diabetes treated by insulin, impaired cognitive function, neuromuscular disease, claudication, severe musculoskeletal problems affecting the lower extremity or spine.

Cardiovascular parameters comprise measuring of systolic (sTA) and diastolic arterial tension (dTA). Upon arrival, the subjects remained resting at least 5 min before starting the measurements. The values of arterial tension were obtained as average values of three consecutive measurements on left forearms. Besides arterial tension measurements, we simultaneously determined the heart rate (HR).

The 6-minute walking test was performed before and after the training programs in order to assess the individual's response to exercise.

Oxygen saturation (SpO2) was recorded before and after completion of the 6MWT using an oximeter and finger sensor. The modified Borg Scale for perceived dyspnea (BRPD) was used to grade the degree of dyspnea that the patient experiences before and after the 6MWT. On a scale ranging from 0 to 10, 0 is "no shortness of breath " and 10 represents "so much shortness of breath that you have to stop the activity". Subjects were asked to verbalize their main reason for stopping exercise (i.e., breathlessness, leg discomfort, both breathing and legs, or other), and this reason was documented.

The statistical analysis was performed by using Microsoft Office Excel 2007. The independent *t* test (two-tailed) was used to compare two means and in particular when those means come from different groups of subjects. Student's *t* test for paired data (two-tailed) was used for the comparison of the mean values in each group of patients.

A *p* value less than 0.05 was considered statistical significant.

Results

Data of subjects included in this study are shown in Table 1.

Table 1. Characteristics of subjects

	Training group	**Control group**	**p**
Male (n)	6	5	NS
Female (n)	8	10	NS
Age (years)	67.14±9.6	68.32±8.2	NS

Values are presented as mean±standard deviation

We found no significant statistical difference in the distribution of males and females between the two groups (Table 1).

Table 2. Cardiovascular parameters

	Training group	**Control group**	**p**
sTA start (mmHg)	130.4±6.7	128±11.6	NS
sTA end (mmHg)	126±4.7*	158.5±9.1*	S
dTA start (mmHg)	82.6±5	83.7±5.4	NS
dTA end (mmHg)	75.4±5.5*	90±6.6*	S
HR start	77.1±6.4	77.8±7	NS
HR end	72.1±7*	95.2±3.2*	S

Values are presented as mean±standard deviation

sTA-systolic arterial tension; dTA-diastolic arterial tension; HR-heart rate;

*p<0.05 vs. starting data

After the initial testing we didn't noticed significant differences in sTA, dTA and heart rate (HR) between the two groups. At the end of the observed period we noticed a significant reduction of sTA, dTA and HR in the training group ($p<0,05$). Contrary, in control subjects cardiac parameters increased considerably ($p<0,05$) which explains the lack of adaptation to aerobic exercises (Table 2).

The distance (in meters) covered during the 6 minute walking test (6MWD) was found to be similar in both groups and no difference was observed before and after the exercising program. Also, no difference was observed between the two groups ($p>0,05$). However, subjects in the training group achieved superior results in the final six minutes test than control group subjects, as shown in the table below (Table 3).

Table 3. The 6 minute walking test

	Training group	Control group	p
6MWD start (m)	481±55.8	442±56	NS
6MWD end (m)	504±88.5	472±46.6	NS
SpO2 start (%)	93.4±2.5	92.6±2.9	NS
SpO2 end (%)	93.9±1.8	94±2.1	NS
RPD start	0.12±0.3	0.3±0.5	NS
RPD end	0.05±0.1	05.±0.5	NS

6MWD-6 minute walk distance; SpO2- oxygen saturation; RPD- rate of perceived dyspnea
*$p<0.05$ vs. starting data

Pre- and post-test SpO2 was not significantly different in the training or control group. No difference in oxygen saturation was observed between the two groups ($p>0,05$).

We didn't recorded significant dyspnea responses during and at the end of the 6 minute walking test ($p>0,05$). Furthermore, all subjects answered that they could perform all daily activities with less energy.

Discussion

The capacity of aerobic effort depends on the quantity of oxygen the muscles can collect, transport and use for performing exercises. The limiting factor of the aerobic effort does not depend on the volume of oxygen collected and transported to the mitochondria but in the capacity of the muscles to use as much oxygen as possible at this tissue level.

Previous studies demonstrated that physical training contributes to a decrease in blood pressure and heart rate, but there were contradictions in terms of intensity and frequency of exercises. According to Pescatello et al. the exercise intensity of 60% - 85% of the individual maximum heart rate is more effective in decreasing BP compared to higher intensities (Pescatello L.S. et al, 2004; Kokkinos P.F. et al., 2009).

Similar to other findings (Kokkinos P.F. et al., 2009; Matsusaki M. et al., 1992), in our study the training group attended 45-min sessions of continuous aerobic exercise and the intensity was maintained at 60–85% of the individual maximum heart rate.

Exercise training improves skeletal muscle work capacity, reduces resistance and increases the peripheral circulation. It has been reported that physical exercises of the lower extremities can decrease systolic and diastolic blood pressure without any intervention of weight loss or diet intake. Moreover, these results of exercise training are not affected by the type of aerobic training because several studies used home training programs and found comparable reductions in blood pressure to those in which subjects trained under staff supervision (Ilic T. et al., 2007).

In our study we found a decreased systolic and diastolic blood pressure in the training group, because of reduced peripheral resistance which have occurred after exercises (Table 2).

Heart rate was lower in moderate aerobic training group compared to the starting values, but in the control group, a significant increase of heart rate was registered after 6 months of follow up (Table 2). These results are similar with other studies (Chaudhary S. et al., 2010; Ilic T. et al., 2007).

The 'six minute walking test' is a simple and low-cost test that requires submaximal levels of physical exertion and reflects the ability to perform walking under conditions similar to those experienced in daily life. This test may be used clinically to measure the impact of multiple comorbidities, including cardiovascular disease, lung disease, arthritis, diabetes, cognitive dysfunction and depression, on exercise capacity and endurance in older adults. Demographic, anthropometric, clinical, and physiological characteristics can affect the test performance in healthy elderly subjects (Enright P.L. et al., 2003; Camarri B. et al., 2006).

The 6-minute walk distance was found to be similar in both groups and no difference was observed before and after the exercising program. We noticed that our subjects maintained good oxygen saturation and experienced very slight shortness of breath. The parameters (SpO2, rate of perceived dyspnea) recorded during and at the end of the 6MWT were not significantly different (Table 3).

Moreover, Ofir D. et al. suggested that more than 30% of the elderly experience breathlessness during activities of daily living. The relative unresponsiveness of the lung to exercise training is due to the fact that respiratory system may limit performance only in certain exercise situation and this is evident in highly-trained endurance athletes. Arterial oxygen content is maintained relatively constant during heavy exercise in most individuals, which suggest that the lung, airways and respiratory muscles are "overbuilt" with respect requirements for gas transport (Maughan R.J., 2008).

Conclusions

Moderate aerobic training is beneficial in improving cardiovascular parameters and can prevent the development of cardiovascular diseases in healthy elderly subjects. Healthy older individuals showed no breathlessness or oxygen desaturation during moderate exercises improving their aerobic endurance.

Finally, I conclude that moderate physical training should become a way of life even in healthy elderly subjects.

Conflicts of interest - There is no conflict of interest.

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