



TWELVE WEEKS OF AEROBIC TRAINING TO INCREASE VO₂max IN SEDENTARY YOUNG MALES

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Abstract

Study purpose. The aim of this study was to verify the effect of three sessions of aerobic training, for a period of 12 weeks, on VO₂max and on the distance covered during the test.

Materials and Methods. Fifteen sedentary males were recruited in this study. VO₂max was investigated using Cooper test. Aerobic intervention lasted for 12 weeks. The exercise the subjects were performing for the first 6 weeks was supervised aerobic training, 3 times per week at 60-75% of heart rate max (HRmax) (The first two weeks at 60-65% HRmax, third and fourth week at 65-70% HRmax, fifth and sixth week at 70-75% HRmax). Afterwards, the subjects continued supervised aerobic training for 6 weeks until the twelfth week at 70-75% HRmax.

Results. After 8 weeks of aerobic training, a significant increase in distance covered during the Cooper test ($p < 0.001$) and a significant increase in VO₂max ($p < 0.001$) were observed.

Conclusions. In this study, it was found that 12 weeks of aerobic training have a positive impact on VO₂max improvement and, therefore, completing 3 sessions of this type of training per week has a positive impact on aerobic parameters.

Keywords: aerobic exercise, aerobic training, VO₂max, Cooper test, aerobic program.

Introduction

The aerobic exercise is frequently used to promote cardiorespiratory and musculoskeletal fitness, and it is now also well-established that it exerts powerful effects on the brain (Mang et al., 2016, Kramer et al., 2018; Cirillo et al., 2009). These aerobic exercise effects on the brain include an impact on neuroplasticity and have been investigated in terms of chronic effects related to with long-term aerobic exercise training (Cotman et al., 2002; Moscatelli et al., 2016).

The inherent advantages of physical exercise stem from an increase in cardiac output and an enhancement of the

innate ability of muscles to extract and utilize oxygen from the blood. This benefit is further compounded by the benefit physical exercise has on high-density lipoprotein cholesterol (HDL-C) (Williams et al., 1996), adipose tissue distribution (Schwartz et al., 1991), increased insulin sensitivity (Rosenthal et al., 1983), improved cognitive function (Spirduso 1980), enhanced response to psychosocial stressors (McDonnell et al., 2013), as well as a deterrent of depression. With the benefit of physical exercise well established, the question remains which type of exercise provides the most effective and efficient means to help deter CV disease.

The American College of Sports Medicine (ACSM) defines aerobic exercise as any activity that uses large muscle groups, can be maintained continuously and is rhythmic in nature (Haskell et al., 2007). As the name implies, muscle groups activated by this type of exercise rely on aerobic metabolism to extract energy in the form of adenosine

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triphosphate (ATP) from amino acids, carbohydrates and fatty acids. Examples of aerobic exercise include cycling, dancing, hiking, jogging/long distance running, swimming and walking. These activities can best be accessed via the aerobic capacity, which is defined by the ACSM as the product of the capacity of the cardiorespiratory system to supply oxygen and the capacity of the skeletal muscles to utilize oxygen (Ludyga et al., 2016). The criterion measure for aerobic capacity is the peak oxygen consumption (VO_2), which can be measured either through graded exercise ergometry or treadmill protocols with an oxygen consumption analyzer or via mathematical formulas. The value of peak VO_2 can be appreciated by a study performed by Vaitkevicius et al. (1993), in which the VO_{2max} was calculated along with other dimensions, to conclude that higher physical conditioning status was directly correlated with reduced arterial stiffness. It is now customary to attend equipped sports centers about three times a week, therefore the aim of this study was to verify the effect of three sessions of aerobic training, for a period of 12 weeks, on VO_{2max} and on the distance covered during the test.

Material and Methods

Participants

Fifteen male were recruited in this study (Age: 24.5 ± 2.1 years; Height 175.1 ± 3.2 cm; Body mass 73.2 ± 3.3 Kg). The subjects involved in the study were students of the University of Foggia (Italy). All subjects were sedentary, which was defined as engaging in ≤ 60 min of exercise/week. The local Institutional Ethics Committee approved the study. Participants were provided both written and oral information regarding the possible risks and discomforts and were ensured that they were free to withdraw from the study at any time.

Aerobic Cooper's test

The VO_{2max} can be measured in different ways and is generally detected through the use of indirect tests such as the 12-minute Cooper (CRT) run test. This is one of the most popular tests and only takes one meter to determine the distance traveled in 12 minutes (Bandyopadhyay 2015) India, to bypass the exhaustive and complicated protocol of direct estimation of VO_{2max} . Eighty-eight sedentary male university students recruited by simple random sampling from the University of Calcutta, Kolkata, were randomly assigned to the study group ($N = 58$). The test was performed on a 400 meter track and the subject underwent a test before becoming familiar with the nature of the experiment a few days before the actual day of the test. Subjects who lost part of the procedure were asked to cover the maximum possible distance by walking / running for 12 minutes.

After 12 minutes the subjects were asked to stop running / walking immediately. Thus the total distance in meters covered after 12 minutes by the experimental subjects was recorded. VO_{2max} was predicted using the following formula: VO_{2max} (ml / kg / min) = $(22,351 \times \text{distance traveled in kilometers}) - 11,288$.

The evaluation of VO_{2max} was performed before training (T0) and after 4 weeks (T1), 8 weeks (T2) and after 12 weeks (T3) respectively.

Aerobic training protocol

Aerobic intervention lasted 12 weeks. The exercise subjects were completed with a 6 weeks supervised aerobic training, 3 times per week at 60-75% of heart rate max (HRmax) (The first two weeks at 60-65% of HRmax, third and fourth week at 65-70% of HRmax, fifth and sixth week at 70-75% of HRmax). After that, the subjects continued supervised aerobic training for 6 weeks until the twelfth week at 70-75% of HRmax. Each session started by 10 min of warm up, 30-40 min of aerobic exercise and 5-10 min of cool down activity. Aerobic exercises included running on flat surface with no slope. The intensity of the activity of any person was controlled using the Polar heart rate tester (made in the US). The training was carried out at the Sports Medicine Center of The University of Foggia (Italy).

Statistical analysis

The statistical analysis were performed used R Project for Statistical Computing software (version 3.1.0). Means and SDs were calculated for each of the analyzed variables and statistical significance was set at $p < 0.05$. The Shapiro-Wilk test was used to verify the normal distribution of variables. Data collected from the participants were compared by means of one-way repeated measure ANOVA, followed by Tukey's multiple comparison post hoc test and linear regression analysis.

Results

The ANOVA show significant differences in Cooper's test (m) ($F_{(3, 56)} = 17.16$; $p < 0.001$). The distance covered by the subjects changed from a starting mean value of 1993.26m (± 257.60) before the beginning of the aerobic training, to a mean value of 2274.70m (± 178.25) after 4 weeks of aerobic training, to a mean value of 2359.30m (± 199.75) after 8 weeks of aerobic training, to a mean value of 2525.10m (± 184.80) after 12 weeks of aerobic training (Fig. 1).

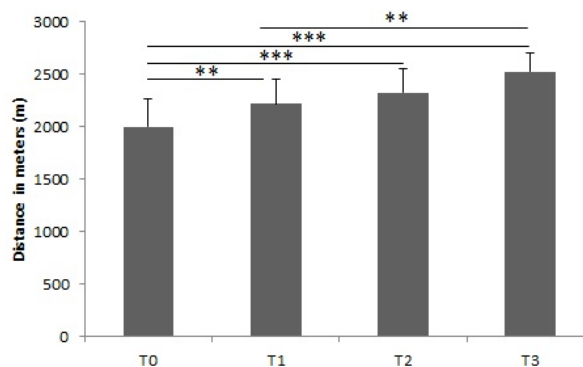


Fig. 1. Distance covered by the subjects during cooper's test: m = meters; T0= before the beginning of the aerobic training; T1 = after 4 weeks of aerobic training; T2 = after 8 weeks of aerobic training; T3 = after 12 weeks of aerobic training; ** $p < 0.01$; *** $p < 0.001$.

The ANOVA show significant differences in VO_{2max} ($F_{(3, 56)} = 17.16$; $p < 0.001$). The VO_{2max} changed from a starting mean value of 33.26 (ml/kg/min) (± 5.76) before the beginning

of the aerobic training, to a mean value of 39.55 (ml/kg/min) (± 4.00) after 4 weeks of aerobic training, to a mean value of 41.45 (ml/kg/min) (± 4.45) after 8 weeks of aerobic training, to a mean value of 45.10 (ml/kg/min) (± 4.15) after 12 weeks of aerobic training (Fig. 2).

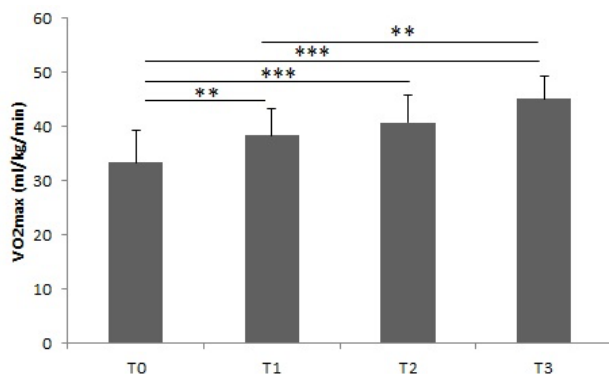


Fig. 2. VO₂max calculated after Cooper's test: T0 = before the beginning of the aerobic training; T1 = after 4 weeks of aerobic training; T2 = after 8 weeks of aerobic training; T3 = after 12 weeks of aerobic training; **p < 0.01; ***p < 0.001.

Discussion

The results of this study show that aerobic training done at a frequency of three times a week has a positive impact on the improvement of VO₂max and the distance covered during the Cooper test. These results show that it is enough to carry out 3 training sessions to have positive effects on the level of physical efficiency and, consequently, an improvement in health conditions with a reduction of risk factors related to physical inactivity. Our results are in line with the guideline by the World Health Organization (WHO) that provided activity recommendations based on three different age groups: Ages 5-17, 18-64, and > 64 years of age. In the age group of 5-17 years, individuals should accrue at least 60 min of moderate activity daily. Those in the group of 18-64 years should perform at least 150 min of moderate activity or at least 75 min of vigorous activity throughout the week. Finally, individuals above the age of 65 years are recommended similar length and intensity exercise programs as the prior group, but with a focus on activities to help enhance balance and to prevent falls. The inherent advantages of physical exercise stem from an increase in the cardiac output and an enhancement of the innate ability of muscles to extract and to utilize oxygen from the blood. This benefit is further compounded by the benefit physical exercise has on high density lipoprotein cholesterol (HDL-C) (Williams 1996).

An important meta-analysis showed a decrease in the risk of all cardiovascular (CV) outcomes and diabetes mellitus incidence with increasing levels of physical activities (Whaid et al., 2016). Another meta-analysis suggested that high level of leisure time physical activity had a beneficial effect on CV health by reducing the overall risk of incident CHD and stroke among men and women by 20% to 30%, while moderate level of occupational physical activity might reduce 10% to 20% risk of CVD (Li et al., 2012). Furthermore, cardiac rehabilitation, which is physical exercise based (Mampuya et al., 2012; Kaminsky et al., 2013; Messina et al

2015; Monda et al., 2017) is a promising field which showed a favorable outcome among patients with heart failure and post CVD events (Moscattelli et al., 2021; Monda et al., 2017; Moscattelli et al., 2020).

Conclusion

In conclusion, our data seem to show that aerobic training carried out regularly three times a week can have a positive impact on the improvement of the physical efficiency of sedentary subjects and, consequently, there can be significant reductions in risk factors related to sedentary lifestyle.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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ДВНАДЦЯТЬ ТИЖНІВ АЕРОБНИХ ТРЕНУВАНЬ ДЛЯ ПОКРАЩЕННЯ ПОКАЗНИКА МАКСИМАЛЬНОГО СПОЖИВАННЯ КИСНЮ (VO₂max) В МОЛОДИХ ЧОЛОВІКІВ, ЯКІ ВЕДУТЬ МАЛОРУХЛИВИЙ СПОСІБ ЖИТТЯ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 5 с., 2 рис., 25 джерел.

Мета дослідження. Метою дослідження було перевірити вплив аеробних тренувань протягом 12 тижнів, по 3 заняття на тиждень, на показник максимального споживання кисню (VO₂max) та на відстань, яку долають учасники під час тесту.

Матеріали та методи. До участі в цьому дослідженні було залучено 15 чоловіків, які ведуть малорухливий спосіб життя. Показник VO₂max досліджували за допомогою тесту Купера. Аеробне втручання тривало протягом 12 тижнів. Вправами, які учасники виконували протягом 6 тижнів, були контрольовані аеробні тренування, 3 рази на тиждень за інтенсивності 60-75% максимальної ЧСС (HRmax) (перші два тижні – за інтенсивності 60-65% максимальної ЧСС, третій і четвертий тиждень – за інтенсивності 65-70% максимальної ЧСС, п'ятий і шостий тиждень – за інтенсивності 70-75% максимальної ЧСС). Після цього учасники продовжували контрольовані аеробні тренування протягом 6 тижнів до двадцятого тижня за інтенсивності 70-75% максимальної ЧСС.

Результати. Після 8 тижнів аеробних тренувань спостерігалось значне збільшення відстані, яку учасники долали під час проведення тесту Купера ($p < 0,001$), і суттєве зростання показника максимального споживання кисню VO₂max ($p < 0,001$).

Висновки. За результатами цього дослідження було встановлено, що 12 тижнів аеробних тренувань позитивно впливають на покращення показника максимального споживання кисню VO₂max, а отже, виконання тренувань цього типу по 3 заняття на тиждень позитивно впливає на аеробні показники.

Ключові слова: аеробні вправи, аеробні тренування, максимальне споживання кисню (VO₂max), тест Купера, програма аеробних тренувань.

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