Different aerobics exercise’s intensities in overweight men’s fat free mass

ABSTRACT: The purpose of this study was to determine the effect of 14 wks of high intensity versus moderate intensity aerobics exercise of equal work output on fat free mass (FFM) in overweight men (BMI between 25 – 29.9 kg/m²). Sixteen sedentary military men (18 - 33 yrs) were randomized in 2 equal groups (n = 8): 1) moderate intensity exercise (MIG; 60 - 70% of their maximum heart rate – HRmax), and 2) high intensity exercise (HIG; 75 - 90% HRmax). The aerobics exercise (jogging/running) training program was performed three days/wk. The jogging/running distance was 3-km during the first 5 wks and 4-km during the last 9 wks. Relative body fat (%BF) was assessed by Dual Energy X-ray Absorptiometry (Lunar DPX - IQ). To better control internal validity all the subjects slept and had their meals inside the military base. Significant differences between and within the groups were analyzed using a two-way split-plot analysis of variance (SPANOVA). Statistical significance was accepted at an alpha level of p< 0.05. Although, there was a decrease in FFM on both groups, there were no significant differences on LBM between after de treatment. After the 14 wks of the aerobics exercise program the mean FFM of the HIG significantly (p < 0.05) decreased to 55.09 ± 3.03 kg (D = 2.49 kg). The decrease in mean LBM (D = 1.39 kg) in the MIG was also significant (p < 0.05). Therefore, the results suggest that the aerobics physical exercise of moderate intensity (60 to 70% HRmax) and high intensity (75 to 90% HRmax) it seems to induce FFM loss in individuals with physical characteristics similar to the present study.

Keywords: Aerobic exercise, obesity, corporal composition, fat free mass.
RESUMEN

Efectos de diferentes intensidades de ejercicio aeróbico en la masa corporal magra en hombres con sobrepeso

El objetivo del presente estudio fue a determinar los efectos de diferentes intensidades de ejercicio aeróbico en la masa libre de grasa (MLG) en adultos con sobrepeso (IMC entre 25,0 – 29,9 kg/m²). La muestra fue compuesta por 16 militares, sedentarios, voluntarios, con edades entre 18 y 33 años, aparentemente saludables. Los individuos habían sido separados aleatoriamente en 2 grupos: un grupo (n=8) realizó ejercicio físico aeróbico en moderada intensidad (60 a 70 % FCmáx) y el otro grupo (n=8) realizó ejercicio físico aeróbico en alta intensidad (75 a 90% FCmáx). El ejercicio físico aneróbico se constituyó en correr, tres veces por semana, a distancia de tres km durante cinco semanas y cuatro km durante las nueve últimas semanas. Con el objetivo de mejorar controlar la validez interna de este estudio, los voluntarios dormían y se alimentaban en la base militar. Para el análisis estadístico, fue utilizada análisis de variancia Split-Plot (SPANOVA). El nivel de aceptación adoptado fue de p < 0,05. A pesar de la disminución de la MLG de ambos los grupos, los resultados de la SPANOVA no demostraron diferencias significativas en la reducción de la MLG entre los grupos. Sin embargo, tras el tratamiento, la media de la MLG de los sujetos del grupo de MI fue reducida para 57,40 ± 7,83 kg (D = 1,39 kg) y la media del grupo de AI fue reducida para 55,09 ± 3,03 kg (D = 2,40 kg), habiendo, por lo tanto una diferencia significativa (p < 0,05) entre el pre-test y el tras-test de ambos los grupos. Los resultados sugieren que el ejercicio físico aeróbico de carrera realizado en moderada (60 a 70% FCmáx) y en alta intensidad (75 a 90% FCmáx), asociado a restricción calórica, parece inducir la perdida de la MLG en individuos con las características similares as de la muestra del presente estudio.

Palabras clave: Ejercicio aeróbico, obesidad, Composición Corporal, Masa corporal magra.

INTRODUCTION

Obesity is defined as an excessively high amount of body fat and is currently one of the most serious public health problems. Its prevalence has been growing accentually in the last decades, also in the developing countries, which led to the condition of a global epidemic (WHO, 1998).

It is known that the excess of corporal fat, besides being a risk factor for diverse illnesses, it damages the physical performance, by limiting movements and inducing the precocious fatigue due to the overload imposed to the organism. According to the American College of Medicine of Exercises (2000), obesity is associated to the risk of developing cardiovascular illnesses, hypertension, diabetes, certain types of cancer, and other chronic illnesses.

Physical exercises are widely used in corporal mass’ reduction programs and its benefits are well accepted (TREMBLAY et al., 1990). Scientific evidences suggest that the combination between alimentary modification and physical exercise is the more effective method for behavioral change and for the loss of corporal fat. However, when aerobics physical exercise is combined to a low-caloric diet, the Fat-Free Mass (FFM) can be reduced and, in this way, reducing the total daily caloric expense (ACSM, 2001).

Regarding aerobic exercises’ effects in the corporal composition, it’s necessary to know the frequency, the duration and the ideal intensity. The studies on the ideal intensity of aerobic exercises, without caloric restrictions in the weight excess’ combat, has started in the 70’s (GIRANDOLA, 1976; SWENSON & CONLEE, 1979). After the first studies, other ones have also reported alterations in the corporal fat with aerobic exercises in different intensities (BRI- NER et al. 1997; DORIEN et al. 2002; GREDIAGIN et al. 1995), however, besides the fact that these studies have reported conflicting results; the alterations of the FFM have not been discussed.

Besides, there are controversies in scientific literature regarding the preservation of the FFM in a program of aerobics physical training combined with a caloric restriction. Certainly the aero- bics exercise provides some conservation of the FFM during the loss of weight as it shows a goal-analysis of 21 studies carried through for GARROW and SUMMERBELL (1995). On the other side, previously, WILMORE (1983) reported, in a revision study, that the FFM diminished in 17 studies with program of physical exercise and caloric restriction. However, BLIX and BLIX (1995) had disclosed that the aerobics training does not modify the composition of the FFM.

Therefore, due to the controversies in literature, it is seen necessity of better evaluating the effect of different intensities of aerobic exercises in the FFM in men who present excess of corporal fat. Being thus, the objective of the present study was to determine...
the effect of the high and moderate combined intensity of the aerobics exercise with caloric restriction in the fat-free mass in overweighted adults.

**MATERIALS AND METHODS**

**Sample**

This study was approved and developed according to the rules of the Catholic University’s Committee of Ethics, in Brasilia (UCB). 16 male individuals, residing in Brasilia-DF, Brazil, were randomly selected for sample. All of them were at least 4 months without doing physical exercises regularly, presented CMI (corporal mass index) between 25 kg/m² and 29.9 kg/m² and were between 18 and 33 years old. The participants were informed about the objectives of the research, the procedures, possible discomforts and risks and benefits of the study before signing the term of free and clarified consent. The individuals who took part in the research were only accepted as object of the study after a medical evaluation. Those who had any health problem that impeded the accomplishment of the proposed physical exercises were not included in the study.

**Stature**

The stature’s mensuration was done with the body as elongate as possible. As recommended by LHOMAN et al. (1998), the measures were taken triplicately and the average stature was registered. It was measured with an estadiometer (Country Technology®, Gays Mills, WI; model 67031), with a resolution of about one centimeter.

**Corporal Mass**

The weighing machine used in the corporal mass measurement was the electronic/digital Filizola®, with a 100 grams resolution (model “Personal Line”). The measured person was stood up with his backs heading towards the weighing machine scale, with feet lateral distance and with the platform between them. Next, the person was put in the center of the platform, erect, glancing at a fixed point up his/her front.

**Corporal Composition**

CMI was evaluated dividing the corporal mass in kilograms (kg) for the individual’s stature in meters to the square. The corporal composition was obtained using the Double Energy X-ray Absormetry (DXA) method, lunar model DPX-IQ (version 4.6A). This method is of high precision (0.0063%) to evaluate the corporal composition (HERGENROEDER & KLISH, 1990), as long as it is manipulated by a specialized technician. During the test, the individual remained in the lying prone position on a table, with their inferior members relaxed and slightly separated and the superior members positioned along the body, with the forearms in pronation. The person didn’t have any metal type that could interfere with the result of the test in his/her garment. That test comprehends a complete sweeping of the body through an x-ray source and a detector, both passed with a slow (~20 minutes) speed.

Looking forward to avoiding internal validity’s compromising, all the tests have been done by a specialized technician and have been analyzed in a “blind way” by an experienced and accredited doctor. All the tests have been done with maximum break of two days between the day of the evaluation and the first day or the last day of the treatment.

**Maximum Oxygen’s consumption (VO₂max)**

For a better description of the sample and to help in the physical exercise’s prescription, it was used the maximum race test with Cooper protocol (12 minutes racing) to estimate the VO₂max. The field tests’ base is the existent linear relationship between VO₂max and the speed of the race. The individual ran/walked in an athletics trail, delimited every 50 meters, for 12 minutes, traveling the largest distance possible, trying to maintain the constant speed.

**Procedures**

For the accomplishment of this research, the sample (n = 16) was randomly divided in two groups of eight individuals:

1) group moderate intensity (MI), which accomplished continuous aerobic exercise (walk/race) with moderate intensity (60 to 70% of the maximum heart frequency - FC_max);

2) group of high intensity (HI), which accomplished high intensity aerobic exercise of walk/race (75 to 90% of FC_max).

The treatment was accomplished three times a week and had the duration of 14 weeks. There had been a training overload, enlarging the distance to be coursed, soon after adaptations in the training program were made. The distance was enlarged from three to four kilometers in the sixth week. There were two weeks of participants’ preparation for the sample, in which all of the individuals of the sample participated in three alternate walking days (50 to 65% FC_max). All the individuals of the treatment groups were accompanied by two professionals of the physical education area, for the physical exercises’ coordination, and each one accompanied one group. All the individuals didn’t accomplish any other type of physical exercise in the weeks of the study. The heart frequency during the physical exercise was measured by Polar® (Favor model) monitors of heart frequency. Aiming to find a larger ecological validity for the study, the protocol for calculation of the maximum heart frequency was about 220 less the individual’s age in years (220 - age).

For the elaboration of alimentary reeducation, we included the use of conduct modification techniques, aiming to eliminate the alimentary habits which contribute to an inadequate diet, according to ACSM (2000).

**Statistical Analysis**

For the data’s analysis, the program Statistical Package for the Social Sciences (SPSS 10.0 for Windows) has been used. The description of the sample was accomplished through the descriptive statistics (average and standard deviation). The data was evaluated by Split-Plot Variance Analysis (SPANOVA). In case of
significant differences in SPANOVA the test of student “t” (post-hoc) was used to determine the differences inside the groups (pre-test and post-test).

RESULTS

For a better visualization of the results obtained in this study, the data was presented in the following way: a) Descriptive characteristics of the sample and b) results of the corporal composition (corporal mass and FFM).

Descriptive characteristics of the sample

The chart 1, as follows, shows the groups’ physical characteristics average before the treatment. As it can be seen in the chart 1, the sample presented an average age of 24.86 ± 4.94 years in the group of moderate intensity (MI) and of 26.25 ± 5.90 years in the group of high intensity (HI). Regarding stature, the sample presented an average of 172.60 ± 6.14 cm in the MI group and 171.00 ± 6.74 cm in the HI group.

Corporal composition’s Results

The corporal mass (CM) before the treatment in the MI group had an average of 82.63 ± 9.1 kg and in the HI group there was an average of 82.25 ± 8.51 kg. After the treatment, the MI group had a significant reduction in the CM average (78.5 ± 9.44 kg), as well as the HI group (74.5 ± 6.95 kg).

The results obtained showed that the average of FFM of the individuals of the moderate intensity (MI) group before the treatment was 58.79 ± 7.22 kg and the average of the high intensity (HI) group was 57.49 ± 3.50 kg, without any significant initial difference among the groups (p > 0.05). After the treatment, the individuals’ FFM average of the MI group was reduced to 57.40 ± 7.38 kg (= 1.39 kg) and the average of the HI group was reduced to 55.09 ± 3.03 kg (= 2.40 kg), existing, therefore, a significant (p < 0.05) difference between the pre-test and the post-test in both groups. SPANOVA didn’t identified any significant difference in FFM reduction in the groups (p > 0.05).

DISCUSSION

The impact of combined diet and physical exercise in TMR is an extremely important theme in corporal weight reduction programs, specifically in the FFM preservation, in which the resting metabolic rate is a fundamental determiner of the individuals’ daily energy expense. Thus, a TMR reduction by diet can become easier if the person puts on weight back during the maintenance. The exercises aim to prevent the TMR decline and constitute a viable mechanism, linking the exercises to the corporal weight maintenance, in a long term (WILLIAMS, 2002).

BOUCHARD (2000) reviewed the studies that investigate the additional benefits of exercises in FFM preservation, in the moment of the fat loss and the increase of TMR, during the dietary restriction. The author verified that the evidences in favor of the exercises were clearly in the sense of FFM preservation and the increase of fat loss. On the other hand, some studies reported that exercises don’t prevent TMR decline.

These indexes related to the exercises’ paper in the prevention of TMR reductions induced by the diet continue obscure.

For example, WELTMAN et al. (1980) mentioned by BALLOR et al. (1990) found that the percentage corporal fat loss in relation to corporal mass was larger in the group that combined diet and exercises (79%) than the ones who were just on a diet (68%). HAGAN et al. (1986) discovered that adding exercise to the caloric restriction regime doesn’t increase the percentage of corporal fat loss in relation to corporal mass for obese men (diet plus exercise: 69% vs only diet: 70%) or women (diet plus exercise: 79% vs only diet: 89%).

In contrast, the results presented by SWENSON & CONLEE (1979) diverged in a study that evaluated the corporal composition of a group composed by 15 adult men in a program of twelve weeks. The participants were divided in a low intensity group and other in high intensity group. The program consisted on exercises of 45 minutes in a cicloergometer, five days per week. They have maintained the normal caloric ingestion during the whole treatment. The results found showed that both groups had significant corporal fat loss. However, there were a insignificant increase of

<table>
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<tr>
<th>Chart 1 - Descriptive characteristics of the sample (Average ± DP)</th>
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<tr>
<td>Variable</td>
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<tr>
<td>Age (years)</td>
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<tr>
<td>Stature (cm)</td>
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<td>Corporal Mass (kg)</td>
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<td>Fat % (DXA)</td>
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<td>VO2max (ml/kg/min)*</td>
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In which: * (p < 0.05) between the groups.

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<tr>
<th>Chart 2 - Mass Free Fat (MFF) initial (pre-test) and final (post-test)</th>
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<tr>
<td>Group</td>
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<tr>
<td>Moderate Intensity (n =8)</td>
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<td>High Intensity (n = 8)</td>
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In which: * p < 0.05 intragroups; MFF = Mass Free Fat; D = Pre-teste – post-teste.
FFM in the low intensity group (2.4 kg ± 0.9) and in the high intensity group (3.3 kg ± 3.2).

According to LEUTHOTZ et al. (1994), that realized a study with 40 obese individuals (33 women and 7 men) in which they were divided in two exercise groups. Both groups realized exercises according to the intensity, corresponding to 40% (low) and 60% (high) of retained cardiac frequency. The training volume was similar for both groups (around 300 kcal per session), three times a week, for 12 weeks. There weren't significant initial difference between the groups regarding corporal weight, corporal fat and FFM. After the program, the corporal mass has has decreased the average of 15.7 ± 5.3 kg in the high intensity group and 15.0 ± 8.4 kg in the low intensity group, considering that FFM has decreased in the low intensity group (0.2 ± 2.1 kg), and has increased in the hight intensity group. That hasn't been any significant difference between the post and the pre-test.

Similar to the results of the present study, was the study realized by BALLOR et al. (0.2 ± 2.1 kg), when 27 obese women (36.7% of corporal fat average) took part in a eight weeks treatment, three times a week, using a cicloergometer. The participants was divided in two groups of treatment: 1) caloric restriction and high intensity exercise (85% VO2max) (n=14) e 2) and caloric restriction and low intensity exercise (42.5% VO2max) (n=13). The results showed a significant difference in FFM, which decreases (1.4 ± 1.1 Kg) in the high intensity group and (0.9 ± 1.2 kg) in the low intensity group. It seems that when exercise is combined to caloric restriction, the FFM loss is more likely to happen, due to a bigger effect of the diet in the FFM loss in comparison to the exercises that preserve it.

In a study realized by GREMILAGIN et al. (1995), 12 women with overweight were divided randomly in two groups: 1) high intensity exercise (80% VO2max) and 2) moderate intensity exercise (50% VO2max). They accomplished the exercise four times a week, during 12 weeks. The two groups have done the same volume of exercise (around 300 kcal per session). The participants were asked to maintain the same physical activity and alimentary ingestion patterns. GREMILAGIN’s study drawing was very similar to the present study. However, the results diverged from each other. FFM has increased in the high intensity group (+4.3 ± 5.4 libras) and also in the moderate intensity group (+1.8 ± 5.0 libras). The results seems to explain that when an accompanied caloric restriction is done, the FFM reduction happens significantly, however, when it is required that participants keep the patterns of alimentation normal, the FFM seems to be significantly reduced.

The corporal weight reduction induced by low caloric diets must cause simultaneous reduction both in fat level and the FFM component. The bigger is the caloric restriction, the bigger is the FFM (and the fat itself) loss. Considering that FFM presents higher energetic consumption than fat, the FFM preservation must positively rebound, not only during the weight reduction process, but, especially in corporal weight maintenance.

Corporal weight control program with the practice of physical exercises accompanied or not by inconsistent diets are associated to more favorable indexes FFM loss. Many studies showed that the regular practice of aerobics exercises, even together with caloric restrictions, can produce significant reductions in corporal fat quantity with the minimum FFM loss (BOUCHARD, 2000).

The ACSM (American College of Sports Medicine) recommends that to stimulate corporal fat loss, the physical exercise must be done at least three times a week (with a caloric consumption of about 300 kcal per session). However, conflicting results have been reported when the great intensity duration is prescribed for corporal loss fat and FFM maintenance. It was reported that the diets and the exercises aren’t usually faithfully controlled. A research in literature has shown that no study has controlled the training volume, which means the energetic cost of the exercise.

While the majority of the researches have aborted the corporal mass loss phase, the maintenance implications in a long term is very important. A person who keeps active during the maintenance, will probably take advantage of FFM preservation and minimize TMR reductions. In a clear way, more researches are necessary to explain the results of this discrepancy among the results presented so far. The inconsistencies might exist due to the differences between the studies, either variable or caloric restriction, exercise type or quantity or the diet’s macronutrients tenor. It’s also possible that initial differences regarding population variables such as the initial physical preparation level, the overweight degree, obese genotype or age have appeared.

CONCLUSION

Therefore, the results suggest that aerobics with run accomplished in moderate intensity (60 to 70% FCmax) and in high intensity (75 to 90% FCmax) associated with basic caloric restrictions seems to favor the FFM loss significantly in individuals with characteristics similar to the sample of the present study.

From the accomplished study, we could find the following suggestions for new studies: that other studies are realized aiming to verify the effects of the aerobic physical exercise in high and moderate intensities and with a daily control of caloric restriction, in order to observe the effects of the physical exercise and the alimentary ingestion more rigidly, to realize similar studies with a larger number of individuals per sample and also with different population subgroups: children, women, elderly people and individuals with a higher obesity degree (BMI > 30 kg/m²).

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