Effects of two kinds of aerobic training on body fat content
and serum lipid profile in cadets

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Summary

Study aim: To assess the effects of aerobic training on body fat content and serum lipid profile.

Material and methods: A group of 45 male members of Brazilian Military Police Academy, aged 18 – 32 years, were subjected randomly assigned into 3 subgroups and to 12-week programmes: aerobic fatmax zone training (FG; n = 18), traditional military training (TM; n = 15) and non-training control group (C; n = 12). Body fat content (3 skinfolds), serum lipid profile (total cholesterol, LDL, HDL and triglycerides), waist circumference (WC) and VO2max (12-min test) were determined.

Results: VO2max significantly (p<0.05) increased and body fat content decreased in both experimental group compared with the control one. Significant (p<0.05) reductions in WC and LDL vs. control group were observed in the TM group only.

Conclusions: The applied aerobic training induced a decrease in percent body fat irrespectively of the kind of training.

Key words: Fatmax zone – Military training – Body fat content – Serum lipid profile

Introduction

The prevalence of obesity has increased dramatically over the last decades. Sedentary lifestyle enhances adipose tissue synthesis and the need of preventing and reducing obesity concerns the entire human population [4], and the prevalence of dyslipidemia, obesity and cardiovascular disorders steadily increases [5,11,28]. Exercise was shown to reduce lipid levels and fat storage thus helping to control and prevent some of these risk factors [6,10,14,31]. The impact of regular physical activity on serum lipid profile and body fat content prompted examining the effects of aerobic exercise [16,20,24,29]. It was demonstrated that physical activity-induced body fat and weight reductions combined contribute to protecting the cardiovascular system and to controlling the serum lipid profile [3].

The American College of Sports Medicine (ACSM) and American Heart Association (AHA) recommend healthy adults practicing physical activities at least twice weekly [9]. Many studies have been published regarding the effects of diverse exercises on fat oxidation, the Fatmax Zone intensity programme serving as an example [1,15,30]. That programme consists of applying loads from 55 ± 3 to 72 ± 4% VO2max or from 68 ± 3 to 79 ± 3% HRmax, respectively [2] and was shown to positively affect the body fat content [22] and serum lipid profile [23]. The aim of this study was thus to compare the effects of two aerobic trainings: the Fatmax Zone and the conventional military training on body fat content and serum lipid profile of Military Force Police cadets.

Material and Methods

Subjects: A group of 45 randomly selected healthy male cadets from the Military Police Academy, aged 18 – 32 years, volunteered to participate in this study. The were randomly assigned into 3 groups: aerobic fatmax zone training (FG; n = 18), traditional military training (TM; n = 15) and non-training control group (C; n = 12).
Aerobic training and body fat and serum lipid profile

All participants signed informed consent forms, the experimental procedures being in accordance with the Declaration of Helsinki (1964) guidelines and approved by the local Human Research Ethics Committee. Their age and BMI are presented in Table 1.

Table 1. Mean values (±SD) of age and BMI of military police cadets

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age (years)</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td>18</td>
<td>23.5 ± 3.4</td>
<td>24.4 ± 3.3 (17.9 – 32.6)</td>
</tr>
<tr>
<td>TM</td>
<td>15</td>
<td>26.0 ± 3.8</td>
<td>23.8 ± 2.4 (19.5 – 27.3)</td>
</tr>
<tr>
<td>C</td>
<td>12</td>
<td>26.3 ± 3.9</td>
<td>23.3 ± 2.3 (19.7 – 26.7)</td>
</tr>
</tbody>
</table>

Training: The FM and TM groups were subjected to 12-week training, 5 day a week. The FM group performed 50-min running sessions in the Fatmax intensity zone; the sessions consisted of two 20-min runs separated by a 10-min intermission. The running intensities amounted to 58% VO₂max (weeks 1 – 4), 68% VO₂max (weeks 5 – 8) and 76% VO₂max (weeks 9 – 12). All training sessions occurred in the morning. The TM group performed regular military training which included 40 min of physical activity consisting of aerobic running sessions (Monday – Friday) and a neuromuscular circuit (Tuesday through Thursday); once weekly they had self-defence training. The control subjects were requested to avoid intense physical activities throughout the study.

Measurements: On the first day, anthropometric data were collected: body height and mass using digital scale with stadiometer (Filizola, Brazil) and body mass index (BMI). Relative body fat content (%F) was determined from 3 skinfolds according to Jackson and Pollock [13], using skinfold caliper (Cescorf, Brazil). Waist circumference (WC) was measured using a metal tape (Sanny, Brazil). On the second day, venous blood was sampled at 7:00 after 12-h fasting and 24-h abstaining from physical activities and alcoholic beverages. The following measurements were conducted: total cholesterol (TC), triglycerides (TG), high-density (HDL) and low-density lipoproteins (LDL) using enzymatic colorimetry [12].

On the last day, all subjects performed the 12-min Cooper’s test at an official race track (400 m), the total running distance (m) being measured. From this, the maximal oxygen consumption (VO₂max) was estimated [7] using the equation: VO₂max = (D – 504)/45, where D is the running distance. The test/retest procedure for that estimate performed twice, 48 h apart, rendered an intraclass correlation coefficient equal to 0.93. The measurements were performed twice – at the beginning (Pre) and at the end (Post) of the study period.

As follows from Table 2, no significant training-induced differences were found in the control group while in both experimental groups significant (p<0.001) increases in VO₂max and decreases (p<0.01) in body fat content were noted. Waist circumference significantly (p<0.001) decreased in the TM group and tended to decrease (p<0.10) in the FM group. The post-training values of VO₂max and %F were significantly (p<0.05) different from those in the control group as shown also by the Post-to-Pre ratios. Both experimental groups had also significantly (p<0.05) lower Post-to-Pre ratio for waist circumference compared with Group C.

Data analysis: The SPSS 14.0 software was used. Shapiro-Wilk’s test was used to check distribution normality. Wilcoxon’s and Student’s t-tests were used to assess the between-group differences and Student’s t-test for dependent data to assess the within-group (Post-Pre) ones. Moreover, the Post-to-Pre ratios were computed for all variables and subjected to ANOVA followed by Scheffe’s post-hoc test. The level of p≤0.05 was considered significant.

Results

The results of anthropometric variables (body fat content, waist circumference) and of VO₂max are presented in Table 2 and those of serum lipid profile in Table 3. All those values correspond to the initial and final examinations (Pre and Post, respectively) and to their ratios (PPI).

Table 2. Mean values (±SD) of VO₂max, body fat content (%F) and waist circumference (WC) determined in 3 groups of male cadets subjected to a 12-week aerobic training

<table>
<thead>
<tr>
<th>Group</th>
<th>VO₂max</th>
<th>%F</th>
<th>WC</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>46.3 ± 4.8***</td>
<td>17.0 ± 5.5**</td>
<td>85.8 ± 8.2a</td>
</tr>
<tr>
<td>Post</td>
<td>50.8 ± 3.5$</td>
<td>14.6 ± 4.4</td>
<td>84.3 ± 6.1</td>
</tr>
<tr>
<td>PPI</td>
<td>1.10 ± 0.08</td>
<td>0.88 ± 0.19</td>
<td>0.99 ± 0.04</td>
</tr>
<tr>
<td>Pre</td>
<td>47.0 ± 2.6***</td>
<td>17.0 ± 5.0**</td>
<td>84.9 ± 5.4***</td>
</tr>
<tr>
<td>TM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>52.2 ± 2.3$</td>
<td>14.5 ± 3.3</td>
<td>81.8 ± 3.8</td>
</tr>
<tr>
<td>PPI</td>
<td>1.11 ± 0.05$</td>
<td>0.88 ± 0.16$</td>
<td>0.96 ± 0.03$</td>
</tr>
<tr>
<td>Pre</td>
<td>46.8 ± 2.8</td>
<td>16.2 ± 5.2</td>
<td>84.2 ± 5.4</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>47.3 ± 2.0</td>
<td>17.6 ± 3.2</td>
<td>86.0 ± 4.7</td>
</tr>
<tr>
<td>PPI</td>
<td>1.00 ± 0.08</td>
<td>1.20 ± 0.50</td>
<td>1.03 ± 0.08</td>
</tr>
</tbody>
</table>

Legend: Pre – Before training; Post – After training; PPI – Post-to-Pre ratio; FM – Fatmax zone training; TM – Conventional military training; C – Non-trained controls
Different from the Post value: a p<0.10; ** p<0.01; *** p<0.001; $ Significantly (p<0.05) different from the control group

Table 3. All those values correspond to the initial and final examinations (Pre and Post, respectively) and to their ratios (PPI).
Table 3. Mean values (±SD) of serum lipid profile components (mg/dL) determined in 3 groups of male cadets subjected to a 12-week aerobic training

<table>
<thead>
<tr>
<th>Group</th>
<th>TC</th>
<th>TG</th>
<th>HDL</th>
<th>LDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM n=18</td>
<td>Pre</td>
<td>168.7 ± 17.5°</td>
<td>75.1 ± 42.2°</td>
<td>48.9 ± 10.2°</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>173.9 ± 20.6</td>
<td>99.4 ± 69.2</td>
<td>51.9 ± 12.0</td>
</tr>
<tr>
<td></td>
<td>PPI</td>
<td>1.05 ± 0.10</td>
<td>1.34 ± 0.64</td>
<td>1.07 ± 0.14</td>
</tr>
<tr>
<td>TM n=15</td>
<td>Pre</td>
<td>174.1 ± 37.1</td>
<td>59.3 ± 23.8</td>
<td>48.4 ± 7.5**</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>171.7 ± 40.6</td>
<td>66.5 ± 41.7</td>
<td>56.9 ± 10.9</td>
</tr>
<tr>
<td></td>
<td>PPI</td>
<td>1.00 ± 0.09</td>
<td>1.12 ± 0.59</td>
<td>1.21 ± 0.23 $</td>
</tr>
<tr>
<td>C n=12</td>
<td>Pre</td>
<td>167.4 ± 29.0</td>
<td>57.3 ± 26.0</td>
<td>49.8 ± 6.9</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>181.2 ± 38.2</td>
<td>59.2 ± 23.0</td>
<td>48.3 ± 8.1</td>
</tr>
<tr>
<td></td>
<td>PPI</td>
<td>1.14 ± 0.36</td>
<td>1.21 ± 0.76</td>
<td>1.00 ± 0.25</td>
</tr>
</tbody>
</table>

Legend: TC – Total cholesterol; TG – Triglycerides; HDL – High density lipoproteins; LDL – Low density lipoproteins; for explanation of other symbols see Table 2

Different from the Pre value: ° p<0.10; ** p<0.01; *** p<0.001; $ Significantly (p<0.05) different from the control group

Significant training-induced differences were found for HDL (increase; p<0.01) and LDL (decrease; p<0.001) only in the TM group which differed from the C group in the Post-to-Pre ratios (p<0.05). In the FM group, TC, TG and HDL tended to increase (p<0.10).

Discussion

The data presented in this study showed increases in VO₂max in both experimental groups. The same tendency was reported by Pinheiro et al. [22] who compared the effects of aerobic running at fatmax intensity and a similar military training on body fat content and waist circumference.

Individuals who associate physical activity with restricted energy intake seem to attain better results in body fat reduction, mostly visceral fat, than those who engage in physical activity only [26]. Savage et al. [27] reported that in obese subjects remaining on isocaloric diet, engaged for 4 months in aerobic sessions lasting 60 – 90 min, 5 – 7 days a week, VO₂max and HDL increased, and waist circumference decreased. Also Mayo et al. [18] reported significant reduction of the relative body fat content and of waist circumference. These data are, generally, in accordance with those obtained in this study for the FM group; despite some differences in protocols and results, both training programs lead to benefits for those with cardiovascular disorders and dyslipidemia because of the significant reduction in body fat content.

The risk of developing cardiovascular disorders increases when the serum levels of HDL are low and those of triglycerides high [25]. Miller et al. [19] found that in physically active subjects with dyslipidemia, who observed proper diet and were under medication, HDL levels increased and those of triglycerides decreased. Exercise programmes based on relatively high intensity (65 – 80% VO₂max), and frequency may promote reductions in LDL and TG, and an increase in HDL [17]. In this study, the FM group, that performed the exercise program at such an intensity, similar tendencies (p<0.10) were noted.

Prado et al. [23] compared both forms of aerobic training (military and fatmax) conducted at the same intensity as in this study and found significantly (p<0.05) improved serum lipid profile: reduced TG, LDL and VLDL, and increased HDL in the TM group. Similar reductions were found in the FM group, with the addition of TC. Other reports, however, presented different results in athletes. The results of González-Haro et al. [8] for triathletes agree with those of this study (FM group).

Park et al. [21] reported that in individuals who practiced aerobic activities for 24 weeks the VO₂max and HDL significantly increased. Kelley and Kelley [16] showed significant reduction of LDL brought about by aerobic training. In this study, HDL levels also tended to increase in response to aerobic activities in the FM group, individual values being within acceptable limits for healthy adults [12].

In conclusion, the applied aerobic training induced a decrease in percent body fat irrespectively of the kind of training, thus supporting previous studies in which similar methods were employed. Further studies on other populations would enable comparing aerobic training programmes and study protocols and their effects on the serum lipid profile.
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References


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