EFFECTS OF AEROBIC EXERCISE ON THE BODY COMPOSITION AND LIPID PROFILE OF OVERWEIGHT ADOLESCENTS

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ABSTRACT

The aim of this study was to evaluate the effect of an aerobic physical exercise program without dietary intervention prescribed with blood lactate levels on body composition and lipid profile of overweight adolescents. A randomized study consisting of pre- and post-treatment tests was conducted on overweight adolescents who were randomly divided into an experimental group submitted to an aerobic exercise program and a control group. The exercise program lasted 12 weeks. After the intervention, a reduction in triceps skinfold thickness, percent body fat and fat mass and an increase in fat-free mass and lipid profile (HDL-c) were observed in the experimental group ($p<0.05$). These findings indicate a possible reduction in the risk of cardiovascular diseases in overweight adolescents who regularly exercise.

KEYWORDS: Exercise; Overweight; Cholesterol; Anaerobic Threshold.

INTRODUCTION

Over the past few years, excess body weight (manifest as overweight and obesity) has become significantly more prevalent in developed and developing nations (WORLD HEALTH ORGANIZATION, 2004). In developing countries such as Brazil, excess body fat is clearly an issue in young adults living in high-and low-socioeconomic status settings alike (NETTO-OLIVEIRA et al., 2010). Adolescence is considered a critical period for worsening of obesity, as overweight adolescents are more likely to become obese adults (INTERNATIONAL OBESITY TASK FORCE, 2005).

Excess body fat produces severe adverse consequences on health, such as high blood pressure and changes in lipid profile constituents, including total cholesterol (TC) (CÂNDIDO et al., 2009), high-density lipoprotein (HDL) cholesterol (LEITE et al., 2009), low-density lipoprotein (LDL) cholesterol (KANG et al., 2002), and triglycerides (TGs) (LUNARDI; PETROSKI, 2008). When combined, these factors predispose to chronic non communicable diseases such as type 2 diabetes mellitus and cardiovascular disease (WORLD HEALTH ORGANIZATION, 2004).

One possible way of avoiding these health risks is prevention of overweight and obesity. However, lifestyle changes brought about by technological advances, such as sedentary behavior, inadequate dietary habits and stress, make prevention of excess body weight very challenging (INTERNATIONAL OBESITY TASK FORCE, 2005). In response to this challenge, several options for treatment of excess weight have been attempted, from the development of a variety of pharmaceutical agents (BIRCH et al., 2009) to simple behavioral changes such as physical exercise and adherence to adequate dietary habits (INTERNATIONAL OBESITY TASK FORCE, 2005; NETTO-OLIVEIRA et al., 2010).

In this context, the implementation of physical exercise programs for adolescents has been vehemently encouraged by government agencies, with the goal of tackling and preventing overweight and obesity and associated risk factors. Both domestic and international interventions have been developed with this objective in mind (ALVES et al., 2008; CARREL et al., 2005; LEITE et al., 2010; ZAHNER et al., 2006), however, results have been variable and inconclusive, which suggests that the creation of strategies for facing the issue of overweight is far more complex than commonly believed.

Researchers have shown that aerobic exercise-based interventions promote positive changes in the body composition of adolescents, such as reductions in body mass index (BMI) and body fat percentage (BF%) (BEN OUNIS et al., 2008). Positive effects on lipid profile have also been reported—specifically, increased HDL cholesterol and decreased TG levels (LEITE et al., 2009), thus reducing the odds of cardiovascular disease. The various studies that have shown these effects also included guidance on proper dietary habits as part of the intervention. This strategy makes it impossible to determine whether positive responses are to physical exercise or dietary changes (WORLD HEALTH ORGANIZATION, 2004).

Another characteristic of interventions targeting adolescents is that physical exercise has long been prescribed using physiological indicators that are susceptible to external variation, such as heart rate, which can fluctuate depending on emotional factors (IVARSSON et al., 2009). Maximal oxygen consumption (VO2max) is also widely used (CARREL et al., 2005). Although heart rate and VO2max are classical variables to determine physical exercise intensity and are somewhat easy to access for field works, other biomarkers are considered more accurate for exercise prescription. Indicators based on blood lactate response are considered more accurate, as they are more dependent on oxidation capacity, oxidation being the main route for lactate removal (DENADAI et al., 2002; FAUDE; KINDERMANN; MEYER, 2009; MCLELLAN; GASS, 1989). To the best of our knowledge, no intervention studies carried out in overweight adolescent populations have used lactate values as a basis for prescription of physical exercise and ascertained the effect of physical exercise on body composition and lipid profile.

Therefore, intervention programs that test alternative bases for exercise prescription and focus exclusively on the effect of physical exercise on body composition and lipid profile may contribute to the practice of sports medicine and general healthcare providers, by increasing understanding of the actual effect of exercise on management of excess weight and associated cardiovascular risk factors. In this context, this study aims to determine the effect of an aerobic physical exercise program without dietary intervention prescribed with blood lactate levels on body composition and lipid profile of overweight adolescents.

METHODS

STUDY DESIGN

This study was part of a larger project entitled “Effects of physical exercise in adolescents with metabolic syndrome”, which was approved by the Federal University of Santa Catarina (UFSC) Research Ethics Committee with judgment no. 396/07.

This was an experimental, randomized, pre/post-intervention study. The study sample comprised overweight male and female adolescents aged 13 to 17, living in the city of Florianópolis, state of Santa Catarina, who took part in an exercise program at UFSC (SILVA; PETROSKI; PELEGRINI, 2009). The study was conducted throughout the second half of 2008. In order to take part in the program, adolescents were required to meet the following criteria: excess body weight as diagnosed by BMI, using the cutoff points defined by Cole et al. (2000); no weight loss diets or nutritional interventions for at least three months; adherence to current dietary habits during the training period; no participation in any other exercise or training program, other than Physical Education classes at school; and no use of any medications that could aid weight loss for at least 3 months prior to or during the intervention period.

SUBJECTS

Adolescents were recruited by means of ads placed online and in print media and through TV spots. The initial sample comprised 36 adolescents who were randomly assigned into an experimental group (EG, n = 23) or a control group (CG, n=13). Some criteria for exclusion were defined so as to prevent any issues with the internal and external validity of the study. Adolescents who joined any other physical exercise or training program were excluded from the sample (n=2), as were those who failed to attend at least 75% of exercise sessions (n=17) and those who suffered a musculoskeletal injury (n=3). The final sample comprised 9 participants in the EG and 5 participants in the CG.

INSTRUMENTS AND PROCEDURES

Both groups underwent anthropometric, body composition and lipid profile assessment before and after the intervention period, which ran for 12 consecutive weeks. During this period, subjects in the EG followed an exercise program, while those in the CG were not subjected to any intervention.

1) Anthropometric examination – Body mass (BM) was measured using a digital scale (Plenna®) with 100 g resolution. Height was measured using a wall-mounted stadiometer (Cardiomed®) precise to 0.1 cm. These measurements were used to calculate body mass index (BMI = BM / height^2). Waist circumference (WC) was measured with precision anthropometric tape (Cardiomed®, 0.1 cm scale). Triceps skinfold thickness (TSF) was measured with a Cescorf® skinfold caliper (0.1 mm resolution). All anthropometric measurements were obtained in accordance with the standard procedures described by Petroski (2007), at the same time of day (both in the pre- and post-intervention examinations), by two trained examiners. Technical error of measurement (TEM) was estimated in a group of 20 overweight adolescents. Intra-rater TEM was 3.5% for skinfold measurement and 1% for waist circumference and height, whereas inter-rater TEM was 7% for

skinfold measurement and 1% for other measurements. The examiners were thus adequately prepared to obtain anthropometric measurements (GORE et al., 2005).

2) Body composition – A tetrapolar bioelectrical impedance analysis (BIA) device (BF-310, Biodynamics®) was used to measure resistance and fat-free mass as water for computation of BF%, according to manufacturer instructions. In addition to standard BIA protocols, the pre-test procedures suggested by Heyward were also followed (Heyward, 1998). After estimation of BF%, fat mass [FM = BM (BF%/100)] and fat-free mass (FFM = BM – FM) were calculated.

3) Lipid profile – The biochemical variables measured were triglycerides, total cholesterol, HDL cholesterol and LDL cholesterol. Blood samples were collected before and after the study intervention period at the University Hospital from UFSC clinical biochemistry laboratory, in the morning, after a 10 to 12-hour fast. Venous blood samples were collected by trained phlebotomists into sterile vacuum tubes, and plasma levels of the aforementioned lipid fractions were measured using a Dimension® RxL clinical chemistry system.

INCREMENTAL TESTING

The ideal intensity of physical exercise for subjects in the EG was determined by means of a cardiorespiratory fitness test carried out at the UFSC Stress Testing Laboratory. A submaximal, incremental ergometer test was performed using an electromagnetically braked ERGO-FIT® brand cycle ergometer (model 167 CYCLE). Seat height and handlebar position were adjusted for subject size. The starting load of 30 watts (stage 1) was increased in 30-watt increments every 3 minutes (subsequent stages). Subjects were required to maintain a cadence of 60 rpm throughout the test. The test was stopped as soon as subjects became unable to maintain this pedaling cadence or their heart rate reached 85% of the previously calculated HRmax (ARMSTRONG et al., 1991).

At each stage of testing, with the subject at rest, a 25-μl non-hyperemic sample of arterialized earlobe blood was obtained for lactate measurements. Samples were immediately transferred to 1.5-μl Eppendorf-type snap-cap polyethylene microcentrifuge tubes containing 50 mL of 1% sodium fluoride solutions. Samples were analyzed immediately after collection, using a YSI 2700 STAT® biochemistry analyzer (YSI Life Sciences, Yellow Springs, Ohio, USA).

The lactate threshold, or LT—the point in time at which the first sustained rise in serum lactate above resting levels occurred (FAUDE; KINDERMANN; MEYER, 2009)—was defined as one of the training targets. The other intensity target was the maximal lactate steady state (MLSS) concentration, determined by the onset of blood lactate accumulation (OBLA) as recommended by Denadai et al. (2002) OBLA was calculated using linear interpolation, adopting a fixed lactate concentration of 3.5 μM (HECK et al., 1985).

TRAINING PROGRAM

The training program consisted of three sessions a week, on Mondays, Wednesdays and Fridays. On Mondays and Fridays, subjects exercised continuously for 40 minutes, with training intensity at the lactate threshold (in watts). On Wednesdays, subjects trained at the OBLA for a 30-minute period, which was divided into six sets of 5 minutes each with a 1-minute break between sets. Prior to the start of training proper, subjects exercised for one week (for a total of three sessions) below the lactate threshold so they could adapt to cycle ergometer training. Ergometer load was increased by 10% every two weeks throughout the intervention period.

STATISTICAL ANALYSIS

The Shapiro-Wilk test was used to verify the normality of data. The variables with a confirmed normal distribution were WC, TSF, BF%, FFM, TC, HDL-C and LDL-C. Those with a non-normal distribution were BM, BMI, FM and TGs. The potential interaction between the study groups (EG and CG) and intervention periods (pre- or post) was then assessed in preparation for two-way analysis of variance (ANOVA). As there was no interaction between the variables, two-way ANOVA could not be performed. The paired *t*-test or Wilcoxon test were used as appropriate for detection of pre- and post-intervention differences in anthropometric parameters, body composition and lipid profile, in both study groups. The t-test for independent samples or Mann-Whitney *U* were used to test for between-group differences in the pre- and post-test periods. The significance level was set at 5% ($p \leq 0.05$).

RESULTS

Table 1 shows pre- and post-intervention anthropometric parameters for the experiment and control groups. A significant reduction in TSF was detected among EG subjects in the post-intervention period ($p < 0.05$).

Table 1. Pre- and post-intervention anthropometric parameters in overweight adolescents in the experimental and control groups. Values expressed as mean ± standard deviation.

	Time		%Δ
	Pre-intervention	Post-intervention	
BM (kg)			
EG	79.4±14.9	79.5±14.2	0.3±3.2
CG	71.3±7.9	71.1±6.6	-0.1±2.9
Height (m)			
EG	1.61±0.1	1.61±0.1	0.6±0.7
CG	1.65±0.1	1.65±0.1	0.3±1.1
BMI (kg/m²)			
EG	30.6±5.2	30.3±5.1	-0.9±2.4
CG	26.0±0.9	26.0±0.6	-0.7±4.4
WC (cm)			
EG	90.1±11.8	89.4±11.3	-0.6±3.1
CG	81.7±8.1	80.6±6.4	-1.3±2.4
TSF (mm)			
EG	30.4±7.3	26.1±6.5*	-14.0±9.9
CG	27.9±4.4	27.0±3.6	-3.3±18.2

BM, body mass; BMI, body mass index; WC, waist circumference; TSF, triceps skinfold thickness; EG, experimental group; CG, control group; %Δ, percent change.
*$p<0.05$ (pre vs. post), paired *t*-test.

Table 2 shows the pre- and post-intervention values of body composition variables. After the intervention period, EG subjects exhibited significant reductions in BF% and FM and increases in FFM ($p<0.05$).

Table 2. Pre- and post-intervention body composition variables in overweight adolescents in the experimental and control groups. Values expressed as mean ± standard deviation.

	Time		%Δ
	Pre-intervention	Pre-intervention	
BF%			
EG	28.8±5.4	27.6±5.6*	-4.2±3.8
CG	22.8±5.4	20.7±5.9	-9.9±10.2
FM (kg)			
EG	23.3±8.8	22.4±8.6*	-4.2±3.8
CG	16.2±3.6	14.6±3.8	-9.9±10.2
FFM (kg)			
EG	56.2±7.0	57.1±7.1*	1.7±1.5
CG	55.0±7.5	56.5±8.1	2.7±2.6

BF%, body fat percentage; FM, fat mass; FFM, fat-free mass; EG, experimental group; CG, control group; %Δ, percent change.
*$p<0.05$ (pre vs. post), paired *t*-test.

Lipid profile results are shown in Table 3. After the intervention period, EG subjects exhibited a 10.6% increase in HDL levels ($p<0.05$).

Table 3. Pre-and post-intervention lipid profile in overweight adolescents in the experimental and control groups. Values expressed as mean ± standard deviation.

	Time		
	Pre-intervention	Pre-intervention	%Δ
TC (mg/dL)			
EG	164.4±18.3	162.0±31.9	-2.1±10.4
CG	139.8±30.4	141.2±45.1	-0.3±18.1
HDL-C (mg/dL)			
EG	45.4±6.0	49.9±4.8*	10.6±9.9
CG	45.6±8.4	48.6±14.9	5.6±17.7
LDL-C (mg/dL)			
EG	95.9±15.4	89.4±23.4	-7.6±13.8
CG	80.2±24.6	76.8±27.6	-5.4±13.4
TG (mg/dL)			
EG	94.2±53.0	111.9±86.7	10.6±38.7
CG	89.0±44.0	76.2±30.3	-8.7±27.6

TC, total cholesterol; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TG, triglycerides; EG, experimental group; CG, control group; %Δ, percent change.
*$p<0.05$ (pre vs. post), paired *t*-test.

DISCUSSION

The objective of the present study was to ascertain the effect of a physical exercise program on body composition and lipid profile in overweight adolescents. Our main finding was that aerobic exercise, prescribed according to lactate threshold and OBLA, induced changes in body composition and lipid profile in this population. This was the first study to use these biomarkers in overweight adolescents.

The blood lactate response to exercise is a highly accurate marker for measurement of exercise-induced physiological stress and has been widely used to characterize cardiorespiratory capacity and control exercise intensity (DENADAI et al., 2002; FAUDE; KINDERMANN; MEYER, 2009; NORMAN et al., 2005). Two intensities associated with the lactate response are considered sufficient for exercise to induce organic adaptation and improvement in cardiorespiratory capacity: the intensity that immediately precedes a rise in blood lactate levels from baseline during incremental load exercise (commonly known as the lactate threshold or aerobic threshold) (FAUDE; KINDERMANN; MEYER, 2009), and MLSS or OBLA, which is the highest exercise intensity at which muscle lactate output into the bloodstream is equal to the lactate clearance rate and lactate levels remain stable throughout the exercise period (DENADAI et al., 2002). These intensities have been employed to great effect as a basis for exercise prescription for athletes (DENADAI et al., 2002) and non-athletes (NORMAN et al., 2005) alike; however, no studies had ever characterized the effect of an exercise intervention based on these intensities on body composition and associated risk factors in overweight adolescents.

TSF is an anthropometric measurement that has been widely used for diagnosis of obesity in young populations (ADDO; HIMES, 2010), due to its consistently high correlation with total body fat (SARRÍA et al., 2001), its low cost, easy examiner training, and ability to diagnose lipid profile changes (LUNARDI; PETROSKI, 2008; SARRÍA et al., 2001). In the present study, adolescents in the experiment group experienced a decrease in TSF thickness, which did not occur in controls.

Intervention studies using other physiological markers for exercise prescription (such as heart rate and VO2max) (BEN OUNIS et al., 2008) and those based on lifestyle change recommendations alone (CARREL et al., 2005; ZAHNER et al., 2006) have also reported positive changes in TSF; however, in these studies, nutritional guidance was also provided to participants, which makes it very difficult to ascertain the actual effectiveness of exercise for altering this variable. Based on the design of the present study, we can state that the exercise program prescribed herein was effective in producing reductions in TSF thickness and, possibly, decreasing the risk of further complications associated with excess adiposity in overweight adolescents.

Regarding body composition, the exercise program prescribed in this study, using intensities based on the lactate threshold and OBLA, led to reductions in BF% and FM and FFM gains. This demonstrates that physical exercise can indeed promote positive changes in body composition even if no caloric restrictions are implemented. This finding may be explained by the high circulating levels of free fatty acids (↑FFA) found in individuals with excess adiposity and the ready availability of this substrate for exercise. Ivi et al. (1981) were the first authors to report that subjects with ↑FFA must exercise to a higher %VO2max in order to reach the lactate threshold. Therefore, a 12-week exercise program for overweight individuals that necessarily requires a given exercise intensity will prove efficient; the higher exercise intensity will have an impact on the use of body fat as an energy substrate, ultimately producing reductions in BF% and FM.

Excess body fat in adolescents and adults correlates with high TC (CÂNDIDO et al., 2009) and TG (LUNARDI; PETROSKI, 2008) levels and low HDL-C levels (LEITE et al., 2009). The effect of physical exercise on cardiovascular risk factors has been investigated in younger populations, and studies have shown that while exercise may not produce quantitative reductions in total cholesterol and LDL cholesterol levels, it does lead to changes in LDL subfractions, increasing the concentration of large LDL and reducing levels of small LDL (KANG et al., 2002). The most marked effects of exercise are on HDL-C and triglyceride levels (THOMAS et al., 2007). In the present study, as in several others before it (KANG et al., 2002; LEITE et al., 2009; THOMAS et al., 2007), lipid profile was improved after exercise, with a 10.6% increase in HDL levels in the experiment group. Conversely, there were no significant changes in TC, LDL-C or TG levels after our 12-week training program. This non-improvement may be due to the reduced number of individuals in both groups. However, other studies that in addition to physical exercise, also used nutritional guidance, found no differences in TC, LDL-$_C$ and TG (KANG et al., 2002; LEITE et al., 2009).

HDL-C is considered a major mediator of reverse cholesterol transport, a process whereby free cholesterol from peripheral tissues (such as arterial walls) moves back to the liver (SHAH et al., 2001). These findings confirm the hypothesis that, by increasing HDL-C levels, physical exercise contributes cardiovascular risk reduction (KANG et al., 2002). Shah et al. (2001) maintain that every 1-mg/dL increment in HDL-C levels is associated with a 3% reduction in coronary heart disease (CHD) risk. Assuming this is indeed the case, subjects in the experimental group of the present study would have achieved an approximate 12% reduction in CHD risk, as their HDL-C levels rose significantly by 4 mg/dL.

In Brazil, some physical exercise programs geared to adolescents have been tried with positive outcomes (ALVES et al., 2008; LEITE et al., 2009). In a study by Alves et al. (2008) that attempted to ascertain the efficacy of physical exercise alone for management of overweight in children, the study intervention led to a significant reduction in BMI. In the present study, there were no significant changes in BMI; however, this index does not appear to be the best choice for assessment of post-intervention changes in body composition, as BMI changes may be due to growth and fat-free mass buildup (NEOVIUS et al., 2004). Furthermore, validity studies that have used BMI for identification of excess adiposity in children and adolescents have found only low to moderate sensitivity, and there is insufficient evidence from prospective studies to establish a definitive link between excess weight (as measured by BMI) in adolescence and increased morbidity and mortality in adulthood (NEOVIUS et al., 2004).

After a 12-week intervention (LEITE et al., 2009), adolescents displayed improvements in their metabolic profile. However, this study differed from the present one because adolescents also received nutritional guidance, which makes it impossible to determine whether physical exercise, as prescribed, had real effects on the variables of interest.

In this context, the present study adds to the existing pool of investigations that assessed the effect of physical exercise on the body composition and lipid profile of overweight adolescents. Furthermore, it adds data on the effectiveness of a program consisting exclusively of aerobic exercise on a cycle ergometer, prescribed according to lactate threshold and OBLA, with no changes in dietary habits. We can safely state that participants in both groups were fully dedicated to the study program, as information on daily activities collected through a recall instrument (BOUCHARD et al., 1983) confirmed that subjects did not take part in other physical exercise programs and did not change their habitual activities (data not shown).

Some limitations of this study should be mentioned, such as 1) the small number of participants who completed the 12-week study period; 2) reduced number of participants in the CG, which may have limited the appearance of statistical differences between the pre- and post-training periods; 3) the difficulty in recruiting adolescent subjects and having subjects meet criteria for final analysis; 3) and the absence of a dietary recall instrument to enable potential exclusion of subjects who may have changed their dietary habits. This may explain the trend toward increased triglycerides in EG subjects. Nevertheless, despite the absence of a formal instrument, investigators questioned subjects as to their dietary habits and other criteria for exclusion during each exercise session.

Another aspect that can be considered as a limitation was the improvement that occurred in some CG variables, which although not significant, may indicate possible improvements. Such improvements can be attributed to some aspects, such as the change in the eating habits of adolescents, sporadic practice of physical activities and behavior modification. Although the researchers of this study have sought to control these variables, no procedure to assess and monitor the daily habits of adolescents from the CG has been adopted.

In view of the results of the present study, we conclude that a physical exercise program designed for overweight adolescents, consisting exclusively of aerobic exercise on a cycle ergometer prescribed using indicators of the blood lactate response, induced positive changes in body composition, whereas adolescents who participated in the physical exercise program showed decreased triceps skinfold thickness, body fat percentage, fat mass and increased fat-free mass and HDL cholesterol. These findings suggest a potential for reduction of the risk of cardiovascular disease in youths. Therefore, we recommend that exercise programs with the intensity used in the present study be prescribed by healthcare and sports medicine providers working with this population.

Efeitos do exercício físico aeróbio na composição corporal e perfil lipídico de adolescentes com excesso de peso

RESUMO: Objetivou-se verificar o efeito de um programa de exercício físico aeróbio, sem intervenção nutricional, prescrito com índices de lactato sanguíneo, na composição corporal e no perfil lipídico de adolescentes com excesso de peso. Este estudo experimental de delineamento de grupos randomizados com testes pré e pós-tratamento foi formado por adolescentes com excesso de peso, divididos aleatoriamente em grupo experimental – GE e grupo controle – GC. A intervenção teve duração de 12 semanas. Após o período de intervenção, o GE diminuiu a dobra cutânea tricipital, o percentual de gordura corporal, a massa de gordura, e aumentou a massa livre de gordura e o perfil lipídico (HDL-c) ($p<0,05$). Estes achados podem, supostamente, diminuir o risco de desenvolvimento de doenças cardiovasculares nos adolescentes com excesso de peso que fizeram exercício.

PALAVRAS-CHAVE: Exercício; sobrepeso; colesterol; limiar anaeróbio.

Efectos del entrenamiento sobre el perfil lipidio y composición corporal de adolescentes con sobrepeso

RESUMEN: Este estudio evaluó el efecto de un programa de ejercicio aeróbico sin la intervención dietética, con los niveles prescritos de lactato en sangre en la composición corporal y el perfil lipídico en adolescentes con sobrepeso. Diseño experimental de este estudio de los grupos al azar con las pruebas antes y después del tratamiento se compone de los adolescentes que tienen exceso de peso, divididos al azar en grupos experimentales - EG y el grupo de control - CG. La intervención duró 12 semanas. Después del período de intervención, GE disminuyó el pliegue del tríceps, el porcentaje de masa corporal grasa, la grasa y el aumento de masa libre de grasa y perfil de lípidos (HDL-C) ($p <0,05$). Estos hallazgos supuestamente pueden reducir el riesgo de desarrollar enfermedad cardiovascular en adolescentes con sobrepeso que hicieron ejercicio.

PALABRAS CLAVE: Ejercicio; sobrepeso; colesterol; umbral Anaerobio.

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Recebido em: 1 set. 2011
Aprovado em: 9 dez. 2011

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