34 - ANTHROPOMETRIC, METABOLIC AND HEMODINAMIC CHANGES IN MEN AGED 25-35, SUBMITTED TO A STRENGTH TRAINING PROGRAM.

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INTRODUCTION

Currently, population is seeking more and more gym clubs and facilities to engage in some physical activity program. Among these activities, the most popular, mainly among men, is weight training, basically for the following reasons: muscular strengthening, aesthetics, self-esteem, injury recovery and well being.

Usually, weight training followers share common goals such as body composition changes derived from increases in muscle mass (muscular hypertrophy).

The usual member of gym clubs is trying to achieve his/her goals (mostly aesthetics), in a short period, in order to be "ready" for summer. This training period usually begins four months prior to summer, and people are desperately going to these places, mainly in the period between August and September (in Brazil), trying to get in shape for summer (December to February). However, it is possible to achieve some benefits with short period training programs, lasting between 6 and 24 weeks (Fleck and Kraemer, 1999).

On the other hand, we can notice an overall sedentarism in modern society, influenced by automation and effortless tasks performed with the help from technology that decreases energy expenditure and results in more leisure time available. It establishes an ever growing physical inactivity scenario which in turn represents a threat to our body, since it impairs normal body functions (Pollock and Wilmore, 1993). Among problems caused by inadequate body functions and sedentarism, high rates of death by cardiovascular diseases must be emphasized, since with time many young and (apparently) healthy people are dying due to these problems (Alfieri and Duarte, 1993).

From another point of view, connecting physical exercise, life quality and health benefits, besides external parameters (muscle mass), this study aimed at measuring physiologic chronic responses to a physical exercise program. As recommended by Nunes et al (1997), currently hemodynamic parameters are great to evaluate body physiologic responses to a training method. Resisted training may result in many beneficial hemodynamic alterations. On the other hand, hemodynamic changes after strength training are either controversial or rarely reported; thereafter it remains a poorly understood exercise physiology area.

Present study aimed at verifying changes in hemodynamic, anthropometric and metabolic changes in 25-35 year old males, after a strength training program.

METHODS

The studied population comprised men, 25 to 35 year old, who were not engaged in any kind of strength training program. Sample was split into two groups, an Intervention Group (IG) with ten subjects, and a Control Group (CG) with fifteen subjects. All men were voluntary. Control Group subjects could not have enrolled strength training programs over the three previous years of the experiment and were told to not exercise during data collection. All subjects were asked to not change dietary patterns after enrolling the program.

Training program was conducted by a Physical Education teacher, during 20 weeks, 3 sessions per week, 90 minutes each, a total of 60 workouts. Each training session comprised 3 main blocks: Part 1 - a 10-minute warm up; Part 2 - The training program employed an alternating body segment strategy. 3 sets of 12-15 repetitions (upper and lower body, respectively). After 65% of Maximal Strength Test (MST), repetitions decreased to 8-10 (upper and lower body, respectively), according to the protocol suggested by Dantas (1998); Part 3 - Stretching (5 minutes).

By the start of the program, subjects were working with light workloads (50% MST). For the remaining of the program, training intensity was 80% of MST (Fleck and Kraemer,1999).

To establish anthropometric parameters, we followed the protocol suggested by Carnaval (1998), and the equations suggested by Jackson and Pollock (1978). These equations were validated for males aged 18 - 61. To evaluate aerobic conditioning, the Maximum Oxygen Consumption test was performed on a treadmill, as suggested by Bruce (apud Nunes, 1999). Resting and maximal hemodynamic parameters were obtained.

Descriptive statistics were employed (mean and standard deviation) as well as inferential ("t" test for dependent and independent samples), comparing pre and post-test parameters. Significance level was set to 5% for all tests.

RESULTS AND DISCUSSION

Ten subjects in intervention group attended three weekly training sessions for 20 weeks. Adherence among the subjects was nearly 95%, therefore, all subjects were included in the final analysis.

Table 1 shows mean results of anthropometry, pre and post-test for the intervention group. We must highlight that post-test results for the control group were not different for any of the studied variables.

TABLE 1. Mean values, standard deviations and "t" test for anthropometric variables in Intervention group, before and after training.

Variable	Pre-Test	Post-Test	“t” test
Height (m)	1.72±0.05	1.72±0.05	0.000
Body weight (kg)	79.04±10.82	79.60±10.79	-0.176
Body fat (%)	20.85±5.65	19.82±5.82	0.609
Body fat (kg)	16.92±6.44	16.21±6.57	0.370
Lean body mass (kg)	62.12±5.75	63.40±5.40	-0.778

$p < 0.05$

In respect to body weight, we could verify a small increase, as previously noticed by Ludo et al (1997), submitting a young group to a 20-week strength training with 3 weekly sessions and observed small changes in body weight.

Although we could notice a decrease in body fat (%), the change was not statistically significant. Similarly to what Harris and Holly (1987) found, submitting 32 year old men to a strength training program, for 9 weeks, observing reductions in body fat as small as 2.7%. According to Ludo et al (1997), small changes in fat mass derive from low energy costs of simple weight training. In addition to that, weight training leads to increases in resting metabolic rates, which could result in small body fat reductions.

Lean body mass and Fat body mass were not significantly different as well, emphasizing that weight training program did not alter LBM, which is important since it is a strength training. The increase of 1.3 kg in LBM is similar to what Harris and Holly (1987) found in circuit weight training, with borderline hypertensive subjects.

To study hemodynamic parameters we evaluated Maximal Oxygen Uptake (VO_2max) in both groups. During pre-test, "t" test value for independent samples was equal to 0.266 (p0,05), showing no difference between groups, indicating that both were similar regarding this variable.

Table 2 presents average values for groups, pre and post testing, with no significant differences (Student's "t" test for dependent samples - p0.05). Slight increases in conditioning of the participants is supported by Harris and Holly (1987), who previously evaluated VO_2max in weight training athletes, and found a result of 44.0 ml.kg-1min-1. Therefore, indicating that high intensity strength training (85% of maximal testing) does not result in cardiovascular function increases.

TABLE 2. Pre and post-test mean values, standard deviations and "t" test for VO_2max (ml/Kg.min) in Control and Intervention groups.

Groups	Pre-test	Post-test	“t” test
Control	42.21 ± 5.09	42.12 ± 4.86	0.061
Intervention	42.54 ± 3.12	43.53 ± 2.36	-1.192

$p < 0.05$

The effects of a 20-week training over strength indexes in the intervention group are presented in Table 3. Maximal strength, measured by maximum weight testing, increased along the training, on an average of 33.4 a 57.6%. Differences were observed (significance of 0.01%), showing the efficacy of the training for the increase in isotonic maximal strength.

TABLE 3. Mean values, standard deviations and "t" test for strength indexes between pre and post-test in Intervention group.

Exercises	Pre-test	Post-test	“t” test
1	50.9 ± 8.97	69.4 ± 10.84	-6.285*
2	63.0 ± 8.23	85.3 ± 11.28	-7.669*
3	42.4 ± 8.19	63.1 ± 14.61	-5.936*
4	28.0 ± 4.99	42.6 ± 5.23	-9.656*
5	69.5 ± 7.25	92.5 ± 8.15	-10.095*
6	32.1 ± 5.17	50.0 ± 4.89	-12.080*
7	41.0 ± 5.16	56.8 ± 7.01	-8.709*
8	63.0 ± 11.83	96.0 ± 11.83	-8.700*
9	50.0 ± 6.24	71.3 ± 9.47	-9.011*
10	38.3 ± 6.22	58.6 ± 11.26	-7.544*
11	194.6 ± 30.87	282.8 ± 27.11	-10.293*

p < 0,01; *t = 3,768

Hemodynamic variables were as follows: resting systolic blood pressure (RSBP) and resting diastolic blood pressure (RDBP), resting heart rate (RHR), maximal systolic blood pressure (MSBP), maximal heart rate (MHR), maximal cardiac output (MCO) and maximal systolic volume (MSV), at the beginning and at the end of the Strength Training Program.

Data from intervention group hemodynamic parameters are presented in Table 4. Although the IG presented resting SBP average values within normal range (=140 mmHg, LUNA, 1985) before training, a resting SBP 9.3% decrease was observed after strength training, supporting the hypothesis of resting SBP reduction induced by strength training.

TABLE 4. Mean, Standard deviation and "t" test for the hemodynamic parameters in Intervention Group before and after strength training.

Variable	Pre-Test	Post-Test	“t” test
RSBP (mmhg)	130±8	118±6	5.755*
DBP (mmhg)	88±10	74±8	5.243*
MSBP (mmhg)	155±18	163±9	-1.909
RHR (bpm)	74±7	72±5	1.117
MHR (bpm)	196±7	193±8	1.353
MCO (l/min)	20.79±2.52	21.25±2.16	-0.978
MSV (ml/systole)	106.03±13.62	110.30±13.94	-1.051

p < 0.05; *t = 2.069

Similar to RSBP, DBP's initial average measures are near and below normal measure of up to 90 mmHg (Luna, 1985). Even though, IG obtained a DBP reduction with the Strength Training Program of 16.1%.

The remainder hemodynamic covariates (MSBP, MCO, MSV, MHR and RHR) did not change significantly. Regarding MSBP, similarly to Araújo (1986), measurements obtained are below normal values range, from 180 from 220 mmHg.

Small reduction observed in RHR proves that a short time weight training program does not produce significant physiological responses among practitioners. Paulo and Forjaz (2001), state that resting bradicardy depends on the length of training period, and its magnitude is according to the athlete's fitness level. These results are contrary to those by Antoniazi et al (1999), who observed a resting HR reduction among elderly people engaged in a weight training program. Although small, HR changes found in the present study are within population normal range (Leite, 1984).

With respect to MHR, the chronotropic response observed among the subjects was normal, since they exercised between 98.46% and 105.9% of the predicted MHR, and this value can be considered around 85% of the MHR (Astrand and Rodahl, 1980). MHR reduction after training is analogous to the observed by Hurley et al. (1984), although the researchers found MHR values below our data (185 for 180 beat/min).

MCO obtained during effort, both pre and post-test, is near lower limit of normal measurements, from 20 to 30 l/min (Araujo, 1986; Vivacqua and Hespanha, 1992), it probably derives from the low average VO_{2max} values, even though IG displayed an improvement of 2.16%. Hurley et al. (1984) also found no changes in CO studying individuals submitted to high intensity strength training. Small differences were also observed in MSV, similar to Menapace et al. (apud Paulo and Forjaz, 2001), maybe due to cardiac hypertrophy, due to a thickening of the left ventricular wall could be considered irrelevant. At 75% of VO_2max, according to Hurley et al. (1984), no increase is observed in the estimated maximum systolic volume, in agreement with our data. MSV observed during exercise, pre and post-test, below normal range from 180 to 200 ml/systole (Araujo, 1986; Vivacqua and Hespanha, 1992). Yet, IG presented an improvement of 3.87%.

CONCLUSIONS

The study aimed at identifying anthropometric, metabolic and hemodynamic parameters changes in men submitted to a strength training program, and provided the following conclusions:

A) with regard to anthropometric changes caused by a strength training program, we could not observe improvements in body fat (absolute values or percent) and lean body mass, since the differences were not statistically significant between studied groups;

B) with regard to muscular strength training, we noticed a significant improvement in strength for the twelve exercises performed, achieving the training's purposes;

C) with regard to the effects of training on hemodynamic parameters, we could observe improvements in systolic blood pressure and resting diastolic blood pressure, since these parameters were statistically different between groups and from pre to post-testing; for the parameters maximum systolic blood pressure, resting heart rate, maximum heart rate, maximum cardiac output, maximum systolic volume and maximum oxygen consumption, we could not observe differences within or between studied groups.

Concerning hemodynamic, anthropometric and metabolic parameters, we could show small improvements due to strength training program, since all parameters were better for the Intervention group, although not all statistically significant. It somehow confirms that this kind of program could be employed in male (25-35 year old) populations.

To better understand the effects of strength training programs on human body, we suggest new studies with diverse populace and longer follow-ups.

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ANTHROPOMETRIC, METABOLIC AND HEMODINAMIC CHANGES IN MEN AGED 25-35, SUBMITTED TO A STRENGTH TRAINING PROGRAM.

ABSTRACT

This study aimed at verifying changes in anthropometric, metabolic and hemodynamic parameters in a male population, 25-35 year old, submitted to a strength training program. Sample comprised a 10-man Intervention Group (IG) and a 15-man Control Group (CG), all voluntary with no weight training participation over three previous years. Intervention was carried out for 20 weeks, on a three weekly session basis, 90 minutes each, a total of 60 training sessions. We measured Percent of Body Fat (%BF), Fat Body Mass (FBM) and Lean Body Mass (LBM), Resting Systolic Blood Pressure (RSBP) and Diastolic (DBP), Maximal Systolic Blood Pressure (MSBP), Maximal Heart Rate (MHR), Maximum Cardiac Output (MCO), Maximum Systolic Volume (MSV) and Maximum Oxygen Uptake (VO_{2MAX}). Interpreting anthropometric, metabolic and hemodynamic parameters observed, the conclusion is that a strength training program leads to small improvements in all parameters, and some are relevant (RSBP and DBP), suggesting that this kind of program is useful for 25-35 year-old males.

key words: strength training, anthropometric and physiologic parameters.

ALTÉRATIONS ANTHROPOMÉTRIQUES, MÉTABOLIQUES ET HÉMODYNAMIQES CHEZ LES HOMMES, ENTRE 25 ET 35 ANS, SOUMIS À UN PROGRAMME D'ENTRAÎNEMENT DE FORCE MUSCULAIRE

RÉSUMÉ

Cette étude a eu comme but la vérification des altérations dans le comportement des paramètres anthropométriques, métaboliques et hémodynamiques chez des adultes du sexe masculin de 25 à 35 ans, soumis à un programme d'entraînement de force. L'échantillon est un groupe expérimental (GE) formé par 10 hommes volontaries et un groupe contrôle (GC) avec 15 hommes volontaires qui n'ont pas pratiqué la musculation despuis 3 ans. La période expérimentale a duré 20 semaines, avec 3 sessions de 90 minutes par semaine, ce qui signifie 60 sessions d'entraînement. On a évalué le Pourcentage de Graisse Corporelle (%G), la Masse Corporelle Graisse (MCG) et la Masse Corporelle Maigre (MCM), la Tension Arterielle Systolique (PASR) et Diastolique (PAD) de Repos, la Tension Arterielle Systolique Maximale (PASM), la Fréquence Cardiaque de Repos (FCR), la Fréquence Cardiaque Maximale (FCM), le Débit Cardiaque Maximal (DCM), le Volume Systolique Maximal (VSM) et la Consomation Maximale d'Oxigène (VO_{2MAX}). En analisant les résultats des paramètres anthropométriques, métaboliques et hémodynamiques, on a remarqué qu'avec le programme d'entraînement de force musculaire on a obtenu des améliorations discrètres dans toutes les variables étudiées dans le Groupe Expérimental. Quelques variables se sont améliorées de forme significative (PASR et PAD), ce qui démontre qu'il est valable d'utiliser un programme d'entraînement de force musculaire pour des personnes du sexe masculin ayant entre 25 et 35 ans.

Mots-clés: entraînemet de force, paramètres physiologiques et anthropométriques.

ALTERACIONES ANTROPOMÉTRICAS, METABÓLICAS Y HEMODINÁMICAS DE HOMBRES ENTRE 25 Y 35 AÑOS, SOMETIDOS A UN PROGRAMA DE ENTRENAMIENTO DE FUERZA MUSCULAR

RESUMEN

Este estudio objetivó verificar las alteraciones en el comportamiento de los parámetros antropométricos, metabólicos y hemodinámicos de adultos del sexo masculino, de 25 a 35 años, sometidos a un programa de entrenamiento de fuerza. La muestra fue compuesta por un grupo experimental (GE) de 10 hombres voluntarios y un grupo control (GC) conteniendo 15 hombres voluntarios, los cuales no podrían haber practicado musculación en los últimos tres años. El período experimental fue de 20 semanas con tres sesiones semanales de 90 minutos cada, totalizando 60 sesiones de entreno. Se evaluó el percentual de gordura corporal (%G), masa corporal gorda (MCG) y masa corporal delgada (MCD), presión arterial sistólica (PASR) y diastólica (PAD) de reposo, presión arterial sistólica máxima (FCM), débito cardiaco máximo (DCM), volumen sistólico máximo (VSM) y consumo máximo de oxígenio (VO_{2max}). Analizándose los resultados de los parámetros antropométricos, metabólicos y hemodinámicas, se observó que el programa de entrenamiento de fuerza muscular mostró mejoras discretas en todas las variables estudiadas en el Grupo Experimental, y algunas mejoraron significativamente (PASR y PAD), mostrando la validez de la utilización de un programa de entrenamiento de fuerza muscular para personas del sexo masculino, entre 25 y 35 años de edad.

Palabras clave: entrenamiento de fuerza, parámetros fisiológicos y antropométricos.

ALTERAÇÕES ANTROPOMÉTRICAS, METABÓLICAS E HEMODINÂMICAS DE HOMENS, ENTRE 25 E 35 ANOS, SUBMETIDOS A UM PROGRAMA DE TREINAMENTO DE FORÇA MUSCULAR.

RESUMO

Este estudo objetivou verificar as alterações no comportamento dos parâmetros antropométricos, metabólicos e hemodinâmicos de adultos do sexo masculino, de 25 a 35 anos, submetidos a um programa de treinamento de força. A amostra foi composta por um grupo experimental (GE) de 10 homens voluntários, e um grupo controle (GC) contendo 15 homens voluntários, os quais não poderiam ter praticado musculação nos últimos 3 anos. O período experimental foi de 20 semanas, com 3 sessões semanais de 90 minutos cada, totalizando 60 sessões de treino. Avaliou-se Percentual de Gordura Corporal (%G), Massa Corporal Gorda (MCG) e Massa Corporal Magra (MCM), Pressão Arterial Sistólica (PASR) e Diastólica (PAD) de repouso, Pressão Arterial Sistólica Máxima (PASM), Freqüência Cardíaca de Repouso (FCR), Freqüência Cardíaca Máxima (FCM), Débito Cardíaco Máximo (DCM), Volume Sistólico Máximo (VSM) e Consumo Máximo de Oxigênio (VO_{2MAX}). Analisando os resultados dos parâmetros antropométricos, metabólicos e hemodinâmicos, observou-se que o programa de treinamento de força muscular mostrou melhoras discretas em todas as variáveis estudadas no Grupo Experimental, e algumas melhoraram significativamente (PASR e PAD), mostrando a validade da utilização de um programa de treinamento de força muscular para pessoas do sexo masculino, entre 25 e 35 anos de idade.

Palavras-chave: treinamento de força, parâmetros fisiológicos e antropométricos.