

Research

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Impact of Resistance Training on Quality of Life and Ischemia Modified Albumin Levels in Men with Cardiovascular Risk Factors

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ABSTRACT

Purpose: There are limited data concerning the effects of Resistance Training (RT) on the components of Quality of Life (QOL) and Ischemia Modified Albumin (IMA) serum levels, even though QOL is an important characteristic related to the treatment success involving non communicable diseases. Studies regarding IMA and physical activity have focused only in the acute effects of exercise. Thereby, the purpose of this study is to investigate the effects of a moderate intensity RT on Health-related Quality of Life (HRQoL) and IMA levels in men with cardiovascular risk factors.

Methods: Nineteen sedentary men (59 ± 8.63 years old) with metabolic syndrome (MS) components underwent a RT with sessions three times a week, comprising 12 exercises, during 12 weeks. The Short-Form 36 was administered to evaluate the domains of physical and mental components of HRQOL pre and post-intervention. Body composition and serum biochemical parameters were analyzed.

Results: Volunteers had total body fat content and total muscle mass unchanged along the intervention. With regard to serum analysis, triglycerides and IMA levels remained unchanged with RT, while increased HDL levels ($p < 0.001$) and reduced ratio between total and HDL cholesterol ($p = 0.006$) were observed. Moreover, improvements in the HRQOL subscales of role-physical ($p = 0.048$), general health ($p < 0.001$), vitality ($p < 0.001$), social functioning ($p = 0.044$) and mental health ($p = 0.006$) were verified after the RT.

Conclusions: It was concluded that a moderate RT is useful in providing benefits on quality of life in men with cardiovascular risk factors, despite the maintenance of IMA levels.

KEYWORDS: Quality of Life; Middle aged; Strength training; Health, Metabolic Syndrome X; Ischemia-modified serum albumin.

MAIN KEY FINDINGS

- Resistance training provides improvements on physical and mental components of quality of life in men with cardiovascular risk factors;
- Benefits on quality of life outcomes afforded by moderate resistance training are independent of changes in ischemia modified albumin levels and body composition adaptations.

ABBREVIATIONS: BMI: Body Mass Index; CVD: Cardiovascular diseases; HDL: High-density cholesterol; HRQoL: Health-related Quality of Life; IMA: Ischemia Modified Albumin; LDL: Low-Density Cholesterol; MS: Metabolic Syndrome; QoL: Quality of Life; RT: Resistance Training; SF-36: 36-Item Short-Form Health Survey; TC: Total Cholesterol; 1RM: One maximal repetition.

INTRODUCTION

It is widely known that sedentary lifestyle and high caloric diets are related to the development of Cardiovascular diseases' (CVD) risk factors, such as hypertension, insulin resistance, dyslipidemia and central obesity.¹ In this regard, evidences demonstrate that middle-aged and elderly male have more frequently unknown diabetes, hypertension, apolipoprotein and cytokines levels than women,² besides android fat distribution that accelerate CVD onset. Moreover, Brazil is among the first five countries in the world with the biggest number of obese people,³ with men presenting almost 10% more unconditional probability of dying between 30 and 70 years old due to non-communicable diseases than women in the same conditions (rates of 479/10,000 and 333/10,000 in 2010, respectively).⁴ In addition to the main traditional risk factors of CVD,¹ increased Ischemia Modified Albumin (IMA) levels reflect a reduced capacity of albumin to bind to cobalt, which is considered a marker of myocardial ischemia and myocardial necrosis linked to inflammation and hyperglycemia,⁵ despite criticisms of low specificity in clinical practice. In this respect, very few studies have investigated the effects of relatively few weeks of intervention with exercise training on IMA levels.

There are few data concerning Quality of Life (QoL) outcomes and Resistance Training (RT) in sedentary men with Metabolic Syndrome (MS), when compared with aerobic training.⁶ In this sense, a better Health-related Quality of Life (HRQoL) is influenced by increased adherence to therapies and reduced use of medications and number of hospitalizations in patients with diabetes and/or MS.^{7,8} An impaired QoL is recognized as a predictor of increased CVD risk⁹ and obese individuals were found to have worse HRQoL, more mentally unhealthy days and more activity-limiting days than healthy adults.¹⁰ The regular physical exercise has been strongly recommended for the prevention and treatment of CVD and their risk factors.¹¹ Moderate intensity RT, for instance, promotes whole-body insulin sensitivity,¹² mitochondrial¹³ and cardiovascular system adaptations.¹¹ Considering that there are limited data about the impact of RT as a unique intervention on self-reported QoL in middle-aged and elderly male and that studies regarding IMA and physical activity have focused in the acute effects of exercise, this study has the purpose of investigating the effects of a moderate intensity RT on HRQoL and IMA levels in men with cardiovascular risk factors. We hypothesize that 12 weeks of moderate intensity RT in middle-aged and elderly male would

improve physical components of HRQoL and decrease the IMA levels.

MATERIALS AND METHODS

Subjects

After media advertisements about the study and a meeting where they were fully informed about the protocol, nineteen men were recruited to participate. The inclusion criteria consisted of being sedentary men (no participation in regular and structured exercises in the previous six months), non smokers, aged between 45 and 74 years old, body mass index (BMI) > 25 kg/m² and the presence of the following risk factors: triglycerides levels \geq 150 mg/dL or specific drug treatment, High-Density Cholesterol (HDL) levels \leq 40 mg/dL or specific drug treatment, fasting glucose levels \geq 100 mg/dL or specific drug treatment, systolic blood pressure \geq 130 and/or diastolic \geq 85 mmHg or specific drug treatment and waist circumference \geq 90 cm.¹ It is clear that each of the above characteristics is treated as independent cardiovascular risk factor, and these may or may not act in an additive manner.¹ Men with liver, renal and heart diseases, muscular or joint disability were excluded from the study. It is clear that each of the above characteristics is treated as independent cardiovascular risk factor, and these may or may not act in an additive manner.¹ Besides, the subjects were instructed to maintain their habitual food intake during the intervention. This study was approved by the institutional Ethics Committee (permit number: 0032.0.243.000-07), was in accordance to the Declaration of Helsinki and all the participants signed a written informed consent.

Resistance Training

The supervised RT took place in the Physical Education and Sports Center gym of the Universidad Federal de Santa Maria and was performed three days per week during 12 weeks, with 48-72 h of recovery between sessions. In the beginning of the RT sessions, there was a low intensity indoor walking for 10 min. The 12-week RT consisted of the following exercises, alternating upper and lower resistance machines: chest press, rower machine, lat pull-down, triceps pulley extension, biceps curl, leg press, leg curl, ankle plantar flexion, hip abduction and adduction, trunk extension and abdominals. After one week of adaptation in which the volunteers performed two sets of 12 repetitions in each exercise, they performed three sets of 12 repetitions until the end of the training. The exercises of RT were established at 50% of one Maximal Repetition (1MR), and a good technique practice was emphasized, reducing the potential for excessive muscle soreness and injury.¹¹ In the end of sessions, the stretching was performed individually, with emphasis in the upper and lower back, shoulders, arms, chest, abdomen, thighs and calves.

Functional Assessments

To estimate the largest load that an individual can

move in a single maximal effort and thus prescribe the training load, a submaximal test was used to estimate the 1MR in the bench press, rower machine, leg press and knee flexion exercises.¹⁴ The cardiorespiratory fitness was assessed with Bruce's modified treadmill protocol.¹⁵ Moreover, the resting levels of systolic and diastolic blood pressure were measured with a digital sphygmomanometer (Omron, Kyoto, Japan) and the flexibility of lumbar and hamstring muscles were assessed by the sit-and-reach test.¹⁶

Anthropometric Measurements

The subjects were weighted in a scale (Plenna, São Paulo, Brazil), heighted in a stadiometer (Cardiomed, Curitiba, Brazil) and the abdominal circumference was measured with a spring-loaded metal tape (Cardiomed, Curitiba, Brazil). Total body fat and muscle contents were estimated by the tetrapolar impedance technique (Maltron, Rayleigh, UK), according to manufacturer's instructions.

Biochemical Assays

After 12 h fasting and 48 h without exercise practice, the blood samples were taken from an antecubital vein. The samples were drawn into serum separator tubes (BD Diagnostics, Plymouth, UK) and routinely centrifuged at 1500 g for 15 min. Afterwards, the serum was frozen at -80 °C until analysis. The triglycerides, Total Cholesterol (TC) and HDL levels were determined spectrophotometrically, with commercially available assay kits (Labtest, Lagoa Santa, Brazil). The concentration of low-density cholesterol (LDL) was estimated¹⁷ and the TC/HDL ratio was also calculated. The levels of IMA were measured calorimetrically on a automated analyzer (Cobas MIRA®, Roche Diagnostics, Basel, Switzerland), based on albumin's properties of bind to cobalt as previously described.⁵

Quality of Life

The HRQoL was assessed using the 36-Item Short-Form Health Survey (SF-36), which was previously translated and validated to the Brazilian population.¹⁸ It should be emphasized that a bibliographic study about the growth of QoL measures identified SF-36 as the most widely generic used questionnaire in the evaluation of patients' health.¹⁹ The scoring of each of the eight subscales (physical functioning, role-physical, bodily pain, vitality, general health, social functioning, role-emotional, and mental health) range from 0 (poor state) to 100 (good state of HRQoL) and were calculated by standard scoring protocol.²⁰

Statistical Analysis

After the Shapiro-Wilk normality test was performed, Student's t test or Wilcoxon Rank Test were used to determine significant differences between the pre and post-training means. The Statistical Package for Social Sciences (SPSS 14.0, Chica-

go, USA) was used and statistical significance was set at $p < .05$. The data were expressed as mean \pm standard deviation.

RESULTS

The analyzed sample ($M = 59$, $SD = 8.63$ years old) comprised six former smokers and thirteen nonsmokers. Moreover, 42.10% of them took antihypertensive agents, 31.50% took lipid-lowering agents and 26.30% took oral hypoglycemic agents. Table 1 demonstrates that RT resulted in increased levels of diastolic blood pressure [$t(18) = -2.45$, $p = .025$], greater distance reached in flexibility test [$t(18) = -4.96$, $p < .001$] and increased VO_2 max [$t(18) = -2.16$, $p = .044$] levels. Furthermore, volunteers presented decreased total exercise test duration [$t(18) = -2.167$, $p = .044$] and TC/HDL ratio [$t(18) = 3.12$, $p = .006$] and increased TC [$t(18) = -2.34$, $p = .031$] and HDL levels [$t(18) = -5.76$, $p < .001$] in comparison with baseline levels. Contrary to our hypothesis, 12 weeks of moderate intensity RT did not decrease IMA levels in middle-aged and elderly male. Other anthropometric, functional and biochemical variables did not change after the exercise intervention.

Variables	Pre-training	Post-training
Body Mass (kg)	93.66 \pm 16.30	94.2 \pm 16.68
BMI (kg/m ²)	31.46 \pm 5.56	31.63 \pm 5.62
Abdominal Circumference (cm)	109.64 \pm 12.31	109.57 \pm 13.13
Total Muscle Mass (kg)	63.19 \pm 6.38	63.02 \pm 6.15
Total Body Fat Content (kg)	31.62 \pm 10.25	31.85 \pm 10.64
Systolic Blood Pressure (mmHg)	124.21 \pm 17.31	128.42 \pm 16.87
Diastolic Blood Pressure (mmHg)	70.94 \pm 10.79	75.94 \pm 10.35*
Total Exercise Test Duration (min)	9.26 \pm 2.72	9.6 \pm 2.55*
VO_2 max (mL/kg/min)	34.88 \pm 8.00	35.89 \pm 7.52*
Sit-and-reach test (cm)	17.74 \pm 10.87	19.97 \pm 10.45**
Triglycerides (mg/dL)	147.45 \pm 71.59	139.14 \pm 83.62
Total Cholesterol (mg/dL)	217.31 \pm 43.05	241.42 \pm 56.36*
HDL (mg/dL)	45.57 \pm 12.86	60.15 \pm 20.29**
TC/HDL	4.97 \pm 1.25	4.21 \pm 1.05**
LDL (mg/ dL)	142.24 \pm 38.26	153.43 \pm 51.42
IMA (UABS)	0.468 \pm 0.069	0.482 \pm 0.121

Values expressed as mean \pm SD. BMI: Body Mass Index. VO_2 max: maximal oxygen uptake. HDL: High-Density Cholesterol. LDL: Low-Density Cholesterol. IMA: Ischemia Modified Albumin. UABS: Units of Absorbance. * $p < 0.05$ post vs. pre resistance training.

Table 1: Anthropometric, functional and biochemical characteristics of men with metabolic syndrome risk factors pre and post-training.

Table 2 shows the results of the submaximal strength test pre and post-training. Increases in the load moved in the bench press [t(18) = -9.07, $p < .001$], leg press [t(18) = -5.26, $p < .001$], rower machine [t(18) = -14.14, $p < .001$] and knee flexion [t(18) = -8.63, $p < .001$] exercises were observed.

Exercises	Pre-training	Post-training
Bench Press (kg)	58.83 ± 17.31	68.45 ± 17.88**
Leg Press (kg)	124.55 ± 22.67	138.56 ± 25.28**
Rower machine(kg)	44.12 ± 6.62	54.96 ± 8.38**
Knee Flexion (kg)	17.50 ± 2.59	21.78 ± 2.39**

**p < 0.01 and *p < 0.01 post vs. pre-training.

Table 2: Load moved in the strength test pre and post-training.

As to HRQoL, men with cardiovascular risk factors showed increases on the role-physical [t(18) = -2.92, $p = .048$], general health [t(18) = -2.92, $p < .001$], vitality [t(18) = -4.79, $p < .001$], social functioning [t(18) = -2.22, $p = .044$] and mental health [t(18) = -3.01, $p = .006$] scoring scales after the training protocol (see Table 3).

Scales	Pre-training	Post-training
Physical Functioning	83.15 ± 12.38	84.31 ± 11.69
Role-physical	65.78 ± 29.11	78.94 ± 33.60*
Bodily Pain	67.89 ± 22.48	69.00 ± 21.96
General Health	67.84 ± 20.19	74.94 ± 16.91**
Vitality	55.26 ± 6.34	74.73 ± 16.02**
Social Functioning	79.6 ± 22.13	89.47 ± 15.73*
Role-emotional	75.43 ± 33.03	84.21 ± 34.00
Mental Health	75.15 ± 17.81	81.68 ± 16.12**

Values are expressed as mean ± SD. *p < 0.05 and **p < 0.01 post vs. resistance training.

Table 3: SF-36 questionnaire subscales scoring of men with cardiovascular risk factors pre and post-training

DISCUSSION

The main findings in this study include that a 12-week moderate intensity RT improved QoL parameters, both in physical (role-physical and general health) and mental components (vitality, social functioning and mental health) in men with cardiovascular risk factors. Middle-aged and elderly men also demonstrated increases on HDL and TC/HDL parameters, despite no changes in body composition and IMA levels after the exercise intervention. Moreover, the moderate intensity RT program was sufficient to induce functional adaptations, such as increases in lumbar and hamstring muscles' flexibility, in VO_2 max values, in the total time elapsed in cardiorespiratory test and loads moved in the strength tests. RT is known for reducing body fat percentage and increasing lean body mass.⁸⁻¹¹ However, our results did

not corroborate these findings, as well as previously studies encompassing moderate intensity RT.²¹⁻²² Thus, it is speculated that more intensive RT programs and/or more weeks of training are necessary to significantly improve body composition parameters in men.

Increased levels of HDL induced by RT are clinically relevant, since previous studies suggest that HDL possess anti-atherogenic and antioxidant properties by inhibiting LDL oxidation, anti-inflammatory functions as it inhibits pro inflammatory signalling cascades, besides antiplatelet and antithrombotic functions, stimulating reverse cholesterol transport and providing a decreased risk of CVD.²³ In this regard, another study showed that elevated systemic levels of HDL were accompanied by the modulation of lipoprotein lipase and hepatic lipase activities in sedentary individuals who underwent six months of aerobic training.²⁴ The mechanisms by which moderate intensity RT may increase the HDL levels are yet to be elucidated. With regard to TC/HDL ratio, a RT thrice a week lasting 9 weeks also induced a decreased ratio (~17.5%)²⁵, similar to our findings (~15.5%).

Most investigations involving IMA and physical activity have focused on the acute effects of exercise,²⁶⁻²⁹ but only one study was found to investigate the chronic effects of exercise training (aerobic) in non-athletes³⁰ and no studies were found regarding RT and IMA levels. In this matter, three months of moderate-intensity walking unchanged IMA levels in type 2 diabetes mellitus patients, while its levels increased in the sedentary group.³⁰ The authors argue that the unchanged IMA levels in exercised group may be a result of increased antioxidant markers concentrations provided by physical training, which can prevent oxidation changes of albumin and, consequently, IMA synthesis.³⁰ Another hypothesis is that the decreased blood pressure obtained as a result of aerobic training may improve circulation and prevent ischemia, partially inhibiting the increase of IMA levels.³⁰ In our study, RT did not decrease blood pressure values. The effects of other RT programs on IMA levels and/or with other populations require further clarification.

A recent meta-analysis reported that adults with higher BMI had reduced physical HRQoL, with a dose relationship across all BMI categories, while mental HRQoL was only reduced in grade III obese subjects.³¹ In this context, associations have been demonstrated between obesity and anxiety and depression disorders, particularly among severe obese individuals and women.³² Our findings corroborate the hypothesis that weight loss is not mandatory for improvements in HRQoL when cardiovascular fitness is increased in obese individuals.³³ Accordingly, a study with young men demonstrated associations between higher physical fitness levels and increased scores in vitality and general and mental health subscales of HRQoL.³⁴ In fact, it is clear that a better QoL is linked to reduced health public costs.^{7,8} Most studies involving physical training and

HRQoL have studied the consequences of an aerobic training on QoL outcomes,⁶ leaving aside the RT. In our study, a 12-week RT performed three times a week improved role-physical, general health, vitality, social functioning and mental health domains. Similarly, studies demonstrated that RT performed thrice a week for 7 weeks benefits QoL, mental health and well-being of sedentary adults³⁵ and that QoL subscales of vitality and social functioning were improved by 10-week RT in depressed elder.³⁶ In this regard, data published elsewhere showed associations between muscle strength and QoL and that its improvement facilitates the performance in daily living activities, such as climbing stairs, dressing, cleaning and carrying objects.⁸ On the same line of research, previous data suggest that the preservation of muscle strength promoted by RT may positively impact functional outcomes and health indices related to QoL.³⁷ This study includes as limitations the small sample size, the lack of a control group and that seasonal factor that may have influenced blood pressure levels along the intervention.

CONCLUSION

In conclusion, it was demonstrated that resistance training presents positive effects on physical and mental components of health-related quality of life, despite the maintenance of ischemia modified albumin levels in men with cardiovascular risk factors. Future trials are necessary to investigate the impact of different resistance training protocols in quality of life parameters, since its understanding is important for the reduction of health public costs.

DISCLOSURE OF INTEREST

The authors declare no conflict of interest concerning this article.

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