Functional training reduces body fat and improves functional fitness and cholesterol levels in postmenopausal women: a randomized clinical trial

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ABSTRACT

This randomized clinical trial with concealed allocations, and blinding of the assessors and the data analyst, was aimed at determining the effects of 16 weeks of functional training on the body composition, functional fitness and lipid profiles in postmenopausal women. The study began with 64 subjects (N.=32 functional training and N.=32 control group) and ended with 50 subjects (N.=28 functional training and N.=22 control group). The exercise was conducted in circuit training format with 8 stations related to the development of resistance force (using elastic bands for resistance) plus 4 stations focused on balance, coordination, and agility. The training session also incorporated an 18 to 30 minute walk. The control group did not participate in the exercise programs during the period of study. The participants were evaluated before and after the training period as regards their body composition (fat and lean mass), functional fitness, abdominal strength and blood chemistry variables. Significant reductions were observed in all body composition variables related to fat (FM=-5.4±4.9% and TF=5.5±6.4 (P<0.05). The functional fitness components had significant improvements in coordination (-5.4±4.9%), strength (-79.0±62.5), agility (-5.5±6.4%) and aerobic capacity (-3.6±5.5%), and significant improvement in abdominal strength (433±732.8%). The observed significant improvements in total cholesterol (-3.5±11.3%) and HDL (-9.1±14.0%). The observed data lead us to conclude that functional training utilizing with elastic bands and unstable bases causes significantly improved in body composition, functional fitness and lipid profiles.


Key words: Adipose tissue - Exercise - Women - Menopause.

Menopause marks a period in a woman’s life in which there are negative changes in relation to body composition and quality of life. The use of pharmacological interventions to mitigate these changes has been extensively explored, but these are expensive and may increase the risk of cancer.

Thus, non-pharmacological interventions may be established as an important alternative, with positive effects on many variables and at a low cost. One of these forms of intervention is physical exercise. Scientific literature has documented the positive effects of isolated aerobic training and concurrent training. More contemporary forms of practical exercises have used other implements, such as vibrating platforms, elastic bands, and unstable bases, among other possibilities, in the development of such training programs.
Specifically, the development of various capacities such as strength, endurance, coordination, flexibility, and agility in the same training session has also gained ground, and is called multicomponent exercise, or multimodal or functional training. The concept of functional training used herein will be understood as referring to a majority of the components used in rehabilitation protocols, which sessions incorporate activities aimed at developing strength, endurance, agility, proprioception and neuromuscular control. One positive aspect of this type of proposal is the possibility for changes in body composition commonly observed in interventions involving exercises, given the adverse effects caused by the increased body fat observed in this population. The possibility of reversing the decline in functional ability, which causes, for example, the increased occurrence of falls in this population also demonstrates its importance.

However, although such exercises are commonly utilized by physical education professionals, studies showing the effects of this type of training, especially in menopausal women, are scarce. The objective of the study was to perform a functional training intervention aimed at the development of various motor skills, including coordination, agility, strength and muscle strength and balance, while verifying the effect of such on body composition, functional fitness and lipid profiles.

Materials and methods

Experimental approach to the problem

This is a randomized trial with concealed allocation, and blinding of the assessors and the data analyst. After two weeks of adaptation, the training group performed 16 weeks of functional training. The evaluations were performed at the beginning and end of the intervention period in both groups (period of training and control). After every 4 weeks the training intensity settings for functional training were reassessed (Figure 1).

Subject

This study was developed by the Center for Studies and the Laboratory for Evaluation and Prescription of Motor Activities - CELAPAM - in the Department of Physical Education, College of Science and Technology - FCT UNESP, Presidente Prudente Campus, Brazil. The population chosen for the study consisted of postmenopausal women (more than a year of amenorrhea, FSH dose> 30 IU/L), living in Presidente Prudente, São Paulo, Brazil. Participants were invited via newspapers, radio and television to participate in the study.

For the study sample, the participants should not have done any kind of physical exercise intervention in the six months prior to the initiation of this clinical trial, as well as being required to be free of motor activity problems, musculoskeletal injuries or other comorbidities that would inhibit exercising. The participants were also required to present a statement from a trusted physician, confirming the possibility of participation of the exercise program.

This study was approved by the Research Ethics Committee of the Universidade Estadual Paulista - UNESP (FCT-UNESP Presidente Prudente, Brazil) through the Certificate Presentation to Ethics Assessment (CAAE) No 11547013.2.0000.5402 and Brazilian registration clinical trial (number Registration: RBR-85vmkz). All participants who agreed to participate in the study signed the Informed Consent form and the research was conducted in accordance with the Helsinki Declaration, 2008 revision.

The sample size calculation was made from a pilot study conducted during the second half of 2012. This study was also part of the activities of the Action and Health Project. Based on the percentage of body fat values, which showed an average difference of -1.59 and standard deviation of 2.33, and adopting a power of 80% for a two-tailed test, and an alpha error of
5% (z=1.96), the equation indicated the need for 19 subjects in each group. Compensating for a possible sample loss and taking advantage of the availability of participants, we determined to have 32 people per group (Figure 2).

Procedures

For 16 weeks, preceded by two weeks of familiarization, the functional group (FG, N.=28) conducted a functional exercise program with a weekly frequency of three non-consecutive days. The control group (CG=22) consisted of people who did not participate in any physical activity program in the trial period that lasted 16 weeks. Each group began with 32 individuals, with a sample loss of 10 people in the control group (31.25%) (in the re-evaluation, the main reason given for non-attendance was personal reasons) and 4 patients in the training group (12.5%) (the main reason being that these individuals were absent more than 15% of the time). After participation, groups were guaranteed participation in other research, and were offered an exercise intervention.

The training sessions of TG were composed of 11 exercise stations developed in circuit format, which the participants completed three times with a pause of 30 seconds between each station. At the end of the exercise the participants performed an 18- to 30-minute walk, depending on the overload performed (Figure 3).

The resistance training exercises (Appendix I) were performed with elastic bands and free weights and consisted of sit-ups, arm curls, lateral raises, seated rows, knee flexions, crucifixes, handle triceps and squats. The
agility drills (Appendix II) were conducted using movement between cones and barriers. Agility ladders were used for coordination (Appendix III) and unstable bases such as a Bosu ball, swiss ball, boards and balance discs were used for balance exercises (Appendix IV). There were also variations in the support base and movement of the upper body in the upright position. To check the perceived exertion at the end of training, participants reported a value between 6 (too light) to 20 (very, very heavy), as indicated by the Subjective Effort Scale.21

The determination of walking intensity was performed using the critical speed protocol proposed by Takahashi et al.22 For the test, the participants walked at top speed for three distances (400, 800 and 1200 m) on a racetrack, on non-consecutive days. The time was recorded by a digital timer (Polar®). The relationship between the distance (m) and time (s) of the exercise was adjusted linearly and the critical velocity taken as the slope of the model,23 which is the aerobic intensity of training.22, 23

Assessment of dietary intake

For caloric intake analysis, we used the 24-hour dietary recall, applied in two stages: one week before the start and one week after the end of the intervention. Participants were taught how to keep food records by a nutritionist. Data was analyzed by the same dietitian using NutWin software, version 1.5 (Nutrition Program, Federal University of Sao Paulo, Brazil, 2002).

Training pulse monitoring

The training pulse monitoring (TRIMP) for each session was calculated by multiplying the session length of time in minutes by PSE, and the result is expressed in arbitrary units (AU).24 This model was chosen because it allows the assessment of the internal training load in both continuous efforts (i.e. aerobic stimuli) and in short-term efforts (exercises with elastic loads). The length of daily training sessions were distributed as shown in Figure 4.

Study design

A semi-structured interview was performed one week before the assessments of body composition, functional fitness and blood variables at the baseline for investigation of the inclusion criteria. At baseline and after 16 weeks all participants were evaluated by the same

![Figure 4.—Progression loads – Arbitrary units (AU).](PROOF-MINERVA-MEDICA-PROFF-ID.indd 10/09/10 14:28)
trained evaluators with body composition analysis, was performed by Dual Energy (DEXA) X-ray absorptiometry, version 4.7 (General Electric Healthcare, Lunar DPX-NT; England). The assessment of functional ability was performed by an American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) test battery and the assessment of lipid profiles was developed by colorimetric method, obtained from the Labtest® company, Brazil.

Assessment protocol

Body composition

Absorptiometry techniques using Dual Energy (DEXA) X-ray equipment allows for an estimation of body composition as a whole and per body segment. The examination lasts for about 15 minutes. The measurement is simple and does not require assistance from the person assessed, except that they should remain in the supine position, without moving, during the course of the examination. The results are transmitted to the computer that is connected to the device and measures Lean Body Mass, Body Fat in kg and percentages, as well as content and bone mineral density.

Functional fitness

The battery of motor tests from the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) was used to assess the functional ability of those involved. The battery uses the main components of functional fitness through five specific tests: a manual motor coordination test, a strength endurance test of the upper limbs, a sit-and-reach flexibility test, an agility and dynamic balance test, a general aerobic endurance test and a test measuring ability to walk. The modified abdominal/sit-up test was conducted with subjects lying supine, feet flat on the ground, knees bent. The object of the test was for their elbows to touch their knees when flexing the spine and each repetition was counted at the time that the individual returned to the starting position. The test was carried out for 1 minute.

Lipid profile

Blood samples were collected through peripheral venipuncture of the forearm vein after an overnight fast of 12 hours. Approximately 20 mL of blood were collected into tubes containing EDTA. The blood was centrifuged at 3000 rpm for 15 minutes at 4 °C. Then the plasma was stored in plastic Eppendorf tubes and stored at -80 °C for later analysis. The analysis of glucose, triglyceride, total cholesterol, high density lipoprotein (HDL) and low density lipoprotein (LDL) were determined by the colorimetric method, obtained from the Labtest® company, Brazil.

Statistical analysis

Data normality was verified using the Kolmogorov-Smirnov Test. The descriptive analysis consisted of mean and standard deviation. Comparisons of body composition, lipid profiles and physical fitness were calculated by averaging the differences in percentage and an analysis was performed using two-way repeated measures - ANOVA (group X time). When significant differences were observed in the group or interaction, we performed a post-hoc Tukey Test. For all measured variables, the estimated sphericity was examined in accordance with Mauchly’s W Test, and the Greenhouse-Geisser correction was used as needed. Statistical significance was set at p <0.05. Data was analyzed using SPSS (version 17.0).

Results

The average ages of the control and training groups were 57.7±4.8 and 58.6±3.9, respectively, with no significant differences at baseline between the study groups (P=0.475).

Tables I-III present the general characteristics of the sample and the training effect on body composition (Table I), functional ability along with abdominal strength (Table II), and lipids (Table III).

The groups did not differ for all variables of body composition at the start of the study.

The data shows a significant interaction effect between time x group training, for all variables of body composition, except for lean total mass and lean arm mass, and these values were given as percentages delta and the observed P value.

The data shows the values relating to functional capacity. Except for the variables of flexibility (time and interaction) and abdominal repetition (group), all
and lipid profiles in postmenopausal women. In body composition variables, there were significant positive changes in body weight, BMI, fat mass (kg and % - FM), trunk fat (TF), android fat mass (Android FM) and lean leg mass. This type of training also led to significant gains in functional fitness in all variables except flexibility. As regards the changes in the lipid profile, positive changes to HDL and cholesterol variables were observed (function of time).

Positive changes in body composition through exercise have been observed by several authors in different protocols.\(^26,27\) However, randomized clinical trials with

**Discussion**

This study examined the effects of 16 weeks of functional training on body composition, functional fitness and lipid profiles in postmenopausal women. The data shows the values related to the lipid profile, and are presented as a delta percentage and the observed \(P\) value. As for HDL cholesterol, a significant difference was observed as a function of time \((P<0.05)\).
functional training have not yet been explored at 16 weeks or more. Considering the percentages observed in variables for android fat mass (-9.2±11.5%), trunk fat mass (-5.5±6.4%) and total fat mass (-3.6±4.3), this reduction is relevant given the risks that these variables present for menopausal women.1, 28 The figures shown
here for full fat mass, despite not having been compared with a standard physical activity program, are similar to data observed in other studies involving aerobic interventions for menopausal women with metabolic syndrome (7%).

An intervention with resistance training (-3.9%) proves more effective than those found in multi-component training (1% increase). We also highlight that the positive changes in lean leg mass (4.3±11.1%) are a relevant finding, especially given the possible association between strength, lean mass and bone mineral density in postmenopausal women.

For functional fitness as assessed by a set of AAH-PERD tests, the variables for upper limb strength (79.0±62.5%) and abdominal strength (433.7±732.8%) had the highest percentages among all the variables observed. It is of particular importance for the decreased strength and balance noted at menopause. Although other forms for the assessment of functional fitness are available, such a test suite has been used frequently to measure the variables in question. The agility variables (-5.5±6.4%) and endurance variables (-3.6±5.5) are also relevant data, given the observed relationship between these and functional independence.

In the blood variables related to glycaemia, despite the not being significance observed between the groups, the control group showed a greater increase during the evaluation period (7.7±11.4%) compared to the training group (-0.4±11.2%). Clinically, the control group moved to the altered classification and the training group remained in the normal classification in relation to glucose. Some studies have shown that endurance training positively alters the lipid profile of this population, a fact observed in our study, compared with the training group.

Conclusions

We conclude that this type of training was effective in altering the body composition and increased functional fitness of menopausal women when compared to a group that did not undergo intervention with physical activity.

Despite these significant findings, an important limitation of this study is that the randomized clinical trial presented here contained only a comparison group, which did not receive any kind of physical exercise intervention (sedentary group). Several studies have already conducted training effect comparisons with sedentary groups. However, for follow-up studies, we suggest groups with interventions that have already been researched — such as concurrent training, aerobic training and strength training.

Functional training strategies allied with implements such as elastic bands, free weights and unstable bases proved to be effective in reducing body fat and improving functional fitness in women after menopause. Another favorable aspect of the proposed intervention was its low cost, since it does not require the purchase of fitness equipment or reserving a specific space to these activities. This exercise proposal can be developed in community centers, on sports fields or in any other areas that are available. Also, as regards the objectives of the proposed intervention, excellent adherence was observed. This may have been influenced by the characteristics of the circuit activities and the fact that the exercise challenges were carried out using coordinative activities and unstable bases, for example. Given that this form of training has been little explored in the literature, further research is needed to compare not only these results to the sedentary control group, but also to other forms of training such as free weights.

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SUPPLEMENTARY MATERIALS

Appendix I.—Strength exercises. During 16 weeks the same exercise was used.

Appendix II.—Agility exercises. Lateral displacement between cones (week 1-4), frontal and back displacement between cones (week 8-12), frontal movement on barriers (week 9-12) and agility circuit (week 13-16).
Appendix III.—Coordination exercises. Hanferson (week 1-4), skipping with switching arms (week 5-8), coordinate in agility ladder (week 9-12 and 13-16 in the last picture).

Appendix IV.—Balance exercise. Unipodal ground support with trunk inclination (week 1-4), bipedal support on the balance board (week 5-8), bipedal support on Bosu with moving arms (week 9-12) and balance circuit (week 13-16).