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Influence of functional and traditional training on muscle power, quality of movement and quality of life in the elderly: a randomized and controlled clinical trial

Influência dos treinamentos funcional e tradicional na potência muscular, qualidade de movimento e qualidade de vida em idosas: um ensaio clínico randomizado e controlado

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Abstract – Aging causes a reduction in the adaptive capacity of the organism. Therefore, there is a decrease in physical fitness, making it difficult to perform basic movements and the development of muscular power. Thus, to minimize this reduction, functional and traditional training can both be used; however there is no clarity about which is most effective. The aim of this study was to identify the influence of functional and traditional training on muscle power, quality of movement and quality of life in the elderly. Forty-four older women were randomly divided into functional group (FG n=18), traditional group (TG n=15) and control group (CG n=11). Thirty-six sessions lasting 50 minutes were performed. Quality of life (WHOQOL-bref), quality of movement (FMS) and muscular power were evaluated. FG and TG increased significantly in relation to control group and to the initial FMS values. In FG and TG, muscle power significantly improved compared to pre-test, but not in relation to the control group. Regarding quality of life, only FG presented significant improvement. Both applied methods demonstrate the ability to improve the quality of movement and muscle power. However, functional training achieved better results in quality of life and movement.

Key words: Activities of daily living; Aging; Exercise.

Resumo – *O envelhecimento ocasiona uma redução na capacidade adaptativa do organismo. Por conseguinte, há uma diminuição na aptidão física dificultando a realização de movimentos básicos e o desenvolvimento de potência muscular. Desse modo, entre a formas de minimizar essa redução tanto treinamento funcional quanto o tradicional podem ser utilizado, contudo não há clareza sobre qual o mais eficaz. Objetivou-se identificar a influência dos treinamentos funcional e tradicional na potência muscular, qualidade de movimento e de vida em idosas. Quarenta e quatro idosas foram randomicamente divididas em grupo funcional (GF n=18), tradicional (GT n=15) e controle (GC n=11). Foram realizadas 36 sessões com duração de 50 minutos. Foram avaliadas a qualidade de vida (WHOQOL-bref), qualidade de movimento (FMS) e potência muscular. O GF e GT aumentaram significativamente em relação ao grupo controle e aos valores iniciais no FMS. Na potência muscular os grupos GF e GT melhoraram significativamente comparado ao pré-teste, mas não em relação ao controle. Na qualidade de vida apenas o GF apresentou melhora significativa. Ambos os métodos aplicados demostram a capacidade de melhorar a qualidade de movimento e potência muscular. Contudo o treinamento funcional obteve resultados superiores na qualidade de vida e de movimento.*

Palavras-chave: *Atividades Cotidianas; Envelhecimento; Exercício.*

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INTRODUCTION

In the aging process, a series of physiological, psychological and structural events occur, impairing the quality of movement, functional capacity and autonomy[1]. Consequently, aspects such as decreased strength (dynapenia), muscle mass (sarcopenia), muscular power and joint mobility, directly reflect in the incidence of falls and the performance of activities of the daily living (ADL) in this population[2-4].

The main functional movements performed in everyday activities are a combination of strength, balance, resistance, power among other capabilities that at satisfactory levels allow safety and efficiency[5,6]. In addition, factors such as mobility and joint stability are fundamental to provide better performance in movements such as squatting, carrying some external load and overcoming obstacles. An example is the functional walking action, in which there is a relationship among ankle mobility, hip mobility and knee stability[7].

In this context, functional training (FT) appears as an option to improve the quality of movement used in ADLs and to stimulate the different components of physical fitness in the elderly[5,8]. This method consists in the application of integrated, multi-joint and multiplanar exercises aimed at improving movements, core strength gains and neuromuscular efficiency to the specific needs of each individual[9].

Milton[4] applied functional exercises in four weeks of intervention and showed a 43% improvement in shoulder mobility, 13% in agility / dynamic balance, 14% and 13% in upper and lower limb strength and 7% in cardiorespiratory capacity in comparison with a group that performed conventional activity. However, it is not clear in the current literature the influence of FT on the mobility and stability required for better quality of movement, as well as its effects on muscle power and quality of life in older adults.

Other studies have analyzed traditional training - here understood as classic bodybuilding, commonly performed in gyms – and found improvements in physical fitness and health of the general population, being also widely used in the elderly population. The gains in physical conditioning associated with this method are very broad; however, we can highlight the development of muscular power as one of the main benefits for older adults[10,11]. Muscle power is directly related to functional parameters, and should be stimulated in different types of interventions, including functional training, but due to the greater control of load and safety provided by fitness equipment, traditional strength training, despite the lower specificity of exercises, can interestingly develop this capacity, reflecting in other aspects related to elderly people such as quality of life[2,3]. Thus, the aim of the present study was to identify the influence of functional and traditional training on the quality of movement, muscle power and quality of life in the elderly. Our hypothesis is that specific training protocols for ADLs should contain multiplanar exercises with greater activation of stabilizing muscles, thus promoting better functionality and quality of life. We believe that training protocols directed to ADLs are more efficient in improving functionality and quality of life in the elderly due to the principle of training specificity.

METHODOLOGICAL PROCEDURES

This is a study with experimental design for applying specific training in groups of individuals, aiming to control the action of intervening factors and to investigate the effects on dependent variables[12].

Sample and sampling procedure

The sample size was calculated using GPOWER 2.0 software according to Pacheco[1], with variable movement quality. Thus, 44 older women were randomly assigned to: Functional Group (FT n = 18, BMI = 29.0 ± 4.9 kg / m^2), Traditional Group (TT n = 15, BMI = 28.5 ± 5.5 kg / m^2), and control group (CG n = 11, BMI = 30.4 ± 5.9 kg / m^2). Baseline data are shown in table 1.

The methodological procedures of the study were verbally explained and participants agreed to voluntarily participate in the research by signing the free and informed consent form. The study flowchart is presented in figure 1.

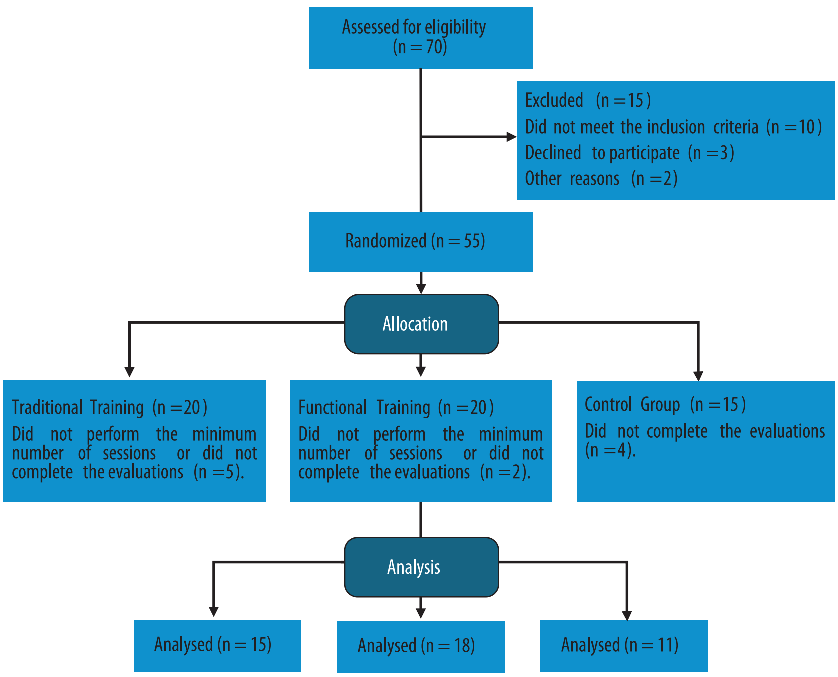

Figure 1. Study flowchart.

Inclusion and exclusion criteria

Inclusion criteria were: (1) 60 years of age or older, (2) complying with initial assessments (medical, physical and nutritional), (3) not having any joint or cardiac instability that would impair training, (4) agree in not participating in any other type of regular physical activity other than the prescribed training. Those who did not reach attendance of at least 85% of training sessions were excluded from the sample.

Intervention

All groups performed training three times a week for 12 weeks, the time for interval between sessions was 48 hours and each session lasted 50 minutes. In TG and FG groups, the OMNI-GSE[13] scale was used to control and normalize the overall training intensity between groups.

After evaluations, participants went through two weeks of familiarization, in which 60% of the volume planned for the first session was applied, and then they completed 36 sessions of progressive training.

Box 1. Activities applied in block 2 of the functional training group, and activities performed in block 3 of the functional and traditional training groups.

Exercises Block 2 – Functional Training			
Phase 1 (1-18 sessions)		Phase 2 (18-36 sessions)	
Up and down the step		Jump under the step	
Rope training linear		Rope training linear	
Vertical Throwing		Ground Throwing	
Displacement between cones		Run and jump between cones	
Ladder of linear agility		Ladder of lateral agility	
5 activities, 3 passages, 1' per station, density of 1/1. OMINI-GSE: 6 to 7 at 60-70% of $_{HR}$max		5 activities, 3 passages, 1' per station, density of 2/1. OMINI-GSE: 6 to 7 at 60-70% of HR_{max}	
Exercises Block 3 – Functional (FG) and traditional training (TG)			
FG (1-18)	TG (1-18)	FG (18-36)	TG (18-36)
Ground lifting (ketlebells)	Squatting (Smith)	*Shouldering* (bulgarian bag*)*	Squatting (free)
Horizontal pull (Suspension strap, OW)	Vertical pull (Articulated row)	Horizontal pull (Suspension strap, OW)	Vertical pull (Articulated row)
Sit and stand up from bench	Knee extension (Leg press 45 °)	*Goblet Squats* (Ketlebells*)*	Knee extension (Extension chair)
Vertical push up (elastic)	Vertical push up (Vertical supine)	*Push-ups* (40 cm bench, OW)	Horizontal push up
Farmers walk (ketlebells)	Knee flexion (Flexor table)	Farmers walk (ketlebells)	Knee flexion unilateral (ankle weight)
Vertical row (elastic)	Front row	Vertical row with knee lift (elastic)	Front row with neutral grip
Pelvic elevation (OW)	Bilateral standing calf (OW)	Pelvic elevation (OW)	Calf (leg press 45 °)
Front plate (40 cm bench)	*Stiff* (bar and weights)	Front plate (step)	Abdominal (curl up)

* The Anglo-Saxon name of some exercises described above is due to the frequent in the training area in Brazil, own weight (OW).

Functional Group (FG)

The training session was divided into 4 blocks: (1) 5' of joint mobility with 1 series of 8" per exercise for the main body joints (waist, pelvic, knees and ankles); (2) 15' of activities organized in circuit that developed coordination, power and agility; (3) 18' also in circuit with multifunctional, integrated and multi-joint exercises, specific to their daily needs, with 8 exercises, 2 series of 08-12 repetitions maximum at 70-85% of 1 RM and OMINI-GSE scale between 7 and 8; (4) 5' of high-intensity cardiometabolic work (HIIT), through activities such as: tug of war, interval running and aerobic gymnastics, with density of 1/1 and scale OMNI-GSE between 8 and 9. The exercises performed in blocks 2 and 3 are shown in Box 1.

Traditional Group (TG)

The training session was divided into 4 blocks: (1) the same way as for FG; (2) 15' of continuous walking, with OMINI-GSE from 6 to 7; (3) 18' of traditional exercises in predominantly analytical machines with more isolated neuromuscular work composed of 8 exercises, with 2 series of 08-12 maximum repetitions at 70-85% of 1 RM and OMINI-GSE scale between 7 to 8, also performed in circuit; (4) 5' of high-intensity cardiometabolic work (HIIT), also performed in the same way as for FG.

Both groups performed exercises at maximum concentric velocity and the training progression occurred according to the level of ability and comfort of the volunteer, for maintenance of 8 to 12 maximal repetitions performed at density of 1/1 (30": 30"), with load readjustment whenever the range of repetitions was exceeded.

Control group

Participants performed stretches with submaximal joint amplitude levels and relaxation practices, with frequency of three weekly sessions and duration of approximately 50 min / session in order to maintain the sample.

Data collection procedures

Initially, anamnesis was carried out with questions regarding the characterization of the level of health and physical activity (report of activities of daily living and work). Afterwards, nutritional assessment was made through a usual dietary recall[14], to control and monitor feeding during the training period.

The test battery was performed in three moments: pre-test (M1); retest after two weeks of familiarization (M2); and after 12 weeks of intervention (M3). Tests were performed in the following order: anthropometric measurements, Questionnaires (Mini Mental State Examination and WHOQOL-Bref), Functional movement screen and muscle power.

Tests

For the anthropometric characterization, body weight (kg) was measured through a scale (Lider®, P150C, São Paulo, Brazil), with maximum capacity of 150 kg. Height (cm) was determined through a stadiometer (Sanny, ES2030, São Paulo, Brazil).

For better distribution of participants in the training programs, the Mini Mental State Examination (MMSE) was used, which consists of a score ranging from zero to 30 points that aims to provide data on various cognitive parameters of any geriatric population[15].

Quality of life was assessed based on the WHOQOL-Bref structured questionnaire[16], which values individual perception in different groups and situations. The test consists of 26 questions including four domains of life: physical, psychological, social and environmental. Responses follow the Likert scale (from 1 to 5; the higher the score, the better the quality of life).

The quality of movement has been verified through the Functional

Movement Screen™, which involves seven movement patterns that qualitatively evaluate mobility, stability and strength and assign a numerical score to each pattern. The score of each test varies from 0 (pain during the execution of the movement), 1 (non-execution of the movement), 2 (execution of the movement with some compensation) and 3 (perfect execution of the movement). Each movement pattern was performed three times, including bilateral ones, in order to obtain the best result. The final score recorded will be the best judgment on each side and the final result will be the worst score between the two sides for each standard (in the case of tests that are bilaterally performed). The FMS ™ total score is the sum of all separate scores and the highest possible score is 21 points[17,18].

Muscle power was evaluated from two basic movement patterns, push (vertical bench press and 45º leg press) and pull (articulated row). The load established to evaluate muscle power was 50% of the value of a maximum repetition for each standard and to quantify this value, the Muscle Lab[TR] software connected to a linear encoder was used. Ten repetitions were performed with a standardized load for each standard (Supine - 15 kg, Row - 10 kg, Leg press - 70 kg), then five repetitions were performed at maximum concentric speed and only the highest value obtained for analysis was considered.

Data analysis

Data were expressed through descriptive statistics (mean and standard deviation) for all variables obtained. Then, 3x2 ANOVA with post hoc Bonferroni test was performed to compare means and detect differences among interventions. Data normality was measured by the Shapiro-Wilk test and homogeneity by the Levene test.

Data were tabulated and analyzed using Statistical Package for Social Sciences (SPSS), version 22, adopting significance level of 5% ($p \leq 0.05$). All tests were two-tailed and the Effect Size (ES) was calculated according to methodological procedures defined by Cohen[19].

RESULTS

FG and TG increased significantly in relation to the control group and to the initial values in the FMS™ (FG = 24.4% / ES: 1.1 / p: 0.004; TG = 13.4% / ES: 0.5 / p: 0.002). Regarding muscle power, FG and TG improved significantly in relation to pretest (FG - 12.8% / TG - 15.7% - mean of three standards), but not in relation to CG. Regarding quality of life, both FG and TG improved in relation to CG, but only FG showed significant improvements in relation to pretest (p: 0.001 / ES: 0.9). The results of interventions on movement and life quality are presented in Figure 1 and muscle power in Table 1.

Table 1. Characteristics of participants of the functional training (FG), traditional training (TG) and control groups (CG) at the beginning of intervention. Values presented as mean and standard deviation (M ± SD).

	FG n=18	TG n=15	CG n=11
Age (years)	65.6±5.44	65.6±5.10	62.5±2.98
Weight (kg)	68.9±12.60	65.8±12.82	72.5 ±14.43
Height (cm)	154.0±5.28	152.0±6.98	154.4 ±7.84
BMI (kg/m²)	29.0±4.95	28.5±5.51	30.4 ±5.91
MMSE (points)	25.2±2.90	25.7±3.63	24.1±2.84

BMI: Body mass index; MMSE: Mini mental state examination. Significant difference between groups *.

Table 2. Changes in muscle power after 12 weeks of functional, traditional and control training in pre-frail elderly women.

Tests	Pre	Post	Δ%	ES	P
Vertical Supine (Watts)					
FG	118.3±41.1	134.5±35.7*	13.60	0.39	0.001
TG	113.1±36.1	133.7±41.5*	18.20	0.57	0.001
CG	119.8±33.2	115.2±33.2	-3.90	-0.13	0.761
Leg Press 45º (Watts)					
FG	337.0±91.6	376.4±107.4*	11.60	0.43	0.003
TG	337.7±96.8	371±111.1*	9.80	0.34	0.028
CG	322.8±88.8	343.1±107.5	6.20	0.22	0.458
Articulated row (Watts)					
FG	152.6±43.8	173.4±49.4*	13.60	0.47	0.001
TG	144.4±39.6	172.2±42.2*	19.20	0.70	0.001
CG	158.6±39.4	165.6±45.3	4.40	0.17	0.596

Functional training (FG), traditional (TG) and control group (CG), Effect Size (ES). Statistical difference from pre to post *, statistical difference in relation to GC [A].

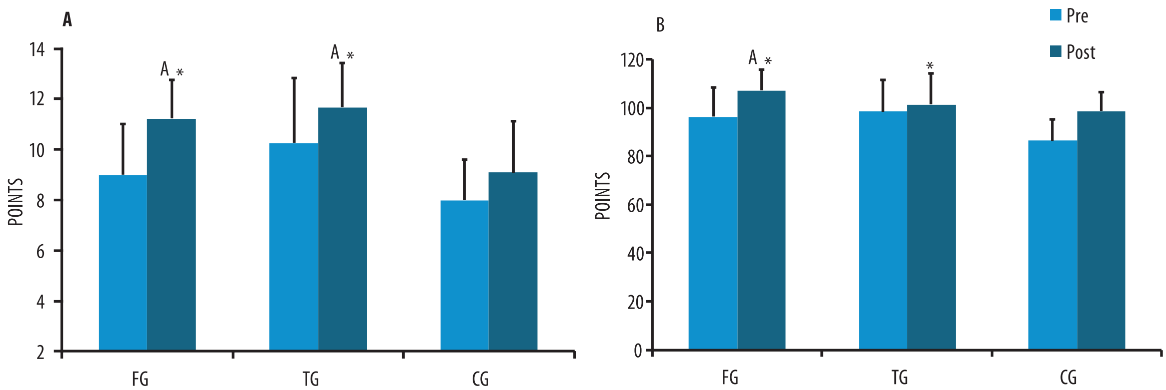

Figure 1. A - Changes in movement quality after 12 weeks of functional (FG) and traditional (TG) training. B - Changes in quality of life after 12 weeks of functional (FG) and traditional (TG) training. Statistical difference from pre to post *, statistical difference in relation to CG A.

DISCUSSION

The main finding of the present study was that in muscle power, both training methods were efficient. However, only FG achieved significant improvements in quality of movement and quality of life. Thus, physical exercises performed at maximum concentric speed in more functional actions have greater influence on measures related to the performance of daily activities in the elderly.

Regarding the quality of movement, of studies analyzed, only Pacheco[1] applied FMS™ in this population and did not find significant differences between functional and traditional exercises in active and independent older adults. A possible explanation for this result is the evaluation method used. It may not be sensitive enough to evaluate individuals who do not have common dysfunctions of this age group. The physiological adaptations in this variable are mainly at the level of motor control[5], thus, it seems that a multi-component, multi-joint and multiplanar training, as applied in the present study can provide better results due to the greater neuromotor complexity when compared to training performed on guided machines. This is because such machines do not provide the motor and neural readjustments during exercises, which are necessary in daily and highly developed functional movements in FT.

In this way, for FMS™, which qualitatively evaluates motor control through joint mobility and stability, the training that most provided these characteristics obtained higher results.

Comparing similar functional components, Krebs[20] found that the group that performed exercises within the TF proposal presented higher maximal torque in the knee, better dynamic balance and coordination during the execution of daily activities, in relation to the group that performed strength training with elastics. In another study, Vreed [7] showed that functional exercises produce greater gains in functional capacity when compared to traditional exercises.

Muscle power is considered a better predictor of functionality for the elderly population[21]. Byrne[22] reported that a good intervention with physical training should develop strength and muscle power for better performance in the ADLs. In this variable, both types of training presented significant increases in relation to pretest, since they emphasize the maximum concentric velocity in the performance of movements. Corroborating the results of this manuscript, Cadore[2] using a combination of force exercises performed at maximum concentric speed, balance and gait, also verified significant increases in the muscle power of 24 fragile elderly women. It is worth mentioning that in the present study, FG performed two blocks of exercises with emphasis on the maximum execution speed (blocks 2 and 3) and although TG performed only one (block 3), it is possible to visualize the specificity of training performed by TG with the tests applied, that is, the same exercises used in the evaluation were trained during intervention and may have contributed to the results found.

The quality of life of the elderly population is directly related to the ability to perform daily tasks safely and effectively[23]. The practice of physical activity in general has a positive effect on quality of life[24]; however, training programs focusing on multicomponent work, muscle power and functional movement patterns have been efficient in this variable[5]. In the present study, only FG demonstrated significant improvement in relation to pretest and high Effect Size. These results are consistent with Whitehurst[25], which when assessing QOL through the 36-Item Short-Form Health Survey

(SF-36), observed increases in the functioning scores and physical vitality of subjects as a consequence of improved mobility after circuit of functional exercises. After 25 weeks of functional balance training, Karóczi[26] did not find significant improvement in this variable, since there was no improvement in the physical fitness components that are important for the daily life of subjects and, consequently, for quality of life. The quality-of-life questionnaire applied in the present study was the WHOQOL-Bref, which includes four domains (physical, environmental, psychological and social) even with global movements and focusing on the muscle power of the FT, both methods influence physical domain, the other evaluated components can be influenced by questions such as group cohesion and practice space, for example, TG performed most of the training in an enclosed space (bodybuilding room), while FG performed training in a more open space, and these conditions may have contributed to affect the perception of participants on the environment and how they feel about it.

The present research aimed at comparing the adaptive responses to training protocols considered functional, due to differences among the characteristics of each intervention and the test applied. Although the present study has provided important information about the benefits of FT and TT in muscle power, quality of movement and life, future studies should apply longer interventions with greater number of volunteers by adding specific test battery for the analysis of performance in ADLs. We believe that this study may stimulate further research to confirm these findings.

CONCLUSIONS

Both methods demonstrate the ability to improve the quality of movement and muscle power. However, functional training presented better results regarding quality of life and movement. The present research shows that a physical training program aimed at promoting multi-system adaptations favorable to the health of older adults should focus on the improvement of physical fitness components in specific exercises for the activities of the daily living performed at maximum concentric speed, respecting the of safety and functionality criteria.

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