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Effects of power training on quality of life and postural stability in elderly

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ABSTRACT

Introduction: The muscular strength exercises can be an effective intervention to prevent falls and to favor the functional capacity (FC) in the elderly. However, few studies have reported the benefits of power training (PT) and the subjective perception of the elderly on these activities. **Objective:** to evaluate the repercussions of a power training protocol on functional capacity and subjective health parameters in the elderly. **Method:** It was a prospective study involving 48 elderly people. Two groups were composed: a power training group (PG) with 22 participants with a mean age of 68.14 (5.46) years and the control group (CG) was composed of 32 elderly individuals aged 68.03 (4.83) years. Health-related quality of life was measured from the Medical Outcomes Study 36 – Item Short-Form Health Survey (SF-36). The FC was measured by the Berg Balance and Time Up and Go tests. The PT was performed 2x/week, with duration of 50 min/session, for 14 weeks (first two weeks of adaptation; first six weeks 3X/10-15 repetitions of 40-50% of the Subjective Perceived Exertion (SPE) / 6 following weeks 3X/6-10 repetitions of 60-70% of the SPE). The CG performed rhythm activities with the same frequency and weekly duration. **Result:** It was observed favorable results in FC after 14 weeks of power training. There was also a positive evaluation of most sf-36 domains, with emphasis on physical and emotional aspects. However, the perception of the elderly in relation to the pain domain presented negative results. **Conclusion:** The PT positively influenced the FC, the physical and the emotional aspects of the elderly; negatively affected the pain and maintained the low risk of fall after 12 weeks of intervention, without presenting intercurrences during the intervention.

Keywords: Physical Education and Training; Aged; Quality of Life; Activities of Daily Living.

INTRODUCTION

Aging is a process characterized by musculoskeletal changes probably induced by reduced quality, quantity and muscle function[1,2]. These modifications tend to reflect negatively on the ability of the elderly to live independently and to perform movements that satisfy basic daily needs, a concept assumed by the authors as functional capacity.

Accidental injuries caused by external causes are another problem related to aging and to the locomotor system that need attention at this stage of life. Falls generally occur due to the physical, cognitive and affective losses of senescence associated with comorbidities and previously installed chronic conditions[3]. These decreases are called geriatric syndromes and involve a number of aspects, among them loss of muscle strength, commonly managed from physical interventions achieving favorable results[4,5]. Discussions on the mechanisms of falls in the elderly encompass several aspects and there is evidence of reductions in strength in falling elderly,[6,7] condition possibly related to sarcopenia and reduction of gait velocity performance.

In this scenario muscular power (PT) has been studied as a predictor of functional performance more adequate than muscular strength[8,9, 10], since this would be associated with movements such as climbing stairs, getting up from the chair, changing direction while walking and recovering imbalances[8]. Also, there is evidence on the association between low muscle power and the presence of falls[6,11], and positive interactions between PT training and the functionality of the elderly[12,13], and these findings were not unanimous [14,15].

Despite the undoubted relevance of these health parameters, it is believed that at this stage of life individual health perceptions should be considered, supported by the theory that objective measures of physiological and functional anatomical parameters do not always coincide with the elderly's understanding of their condition[16,17]. In addition,

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some studies failed to identify benefits in the perception of functionality in the elderly without severe health conditions with only resistance exercises,[17,18] despite positive results achieved in aerobic activities[19].

In view of the above and seeking a greater understanding of the benefits of strength exercises performed with maximum velocity in the eccentric phase of execution in the health of the elderly, the present study was carried out, whose objective was to evaluate the repercussions of a power training protocol on the functional capacity and subjective health parameters in the elderly.

METHODS

The present study was approved by the Research Ethics Committee of the Centro Universitário de Anápolis (protocol number 1.105.284) and followed the ethical norms of research with human beings according to the resolution 466/12.

It was a prospective study involving people over 60 years enrolled in the program "Universidade Aberta para a Terceira Idade" (UniATI) of the Centro Universitário de Anápolis. The UniATI has 200 elderly people distributed in diverse activities like practice of exercises, manual works, workshop of music, psychological orientation and courses of computer science. Of these, 120 elderly had the possibility to register in the workshops of physical practices distributed in the modalities water gymnastics (60 vacancies), resistance exercise (30 vacancies) and dance (30 vacancies). Of the 60 possible elderly, 04 did not meet the inclusion criteria, totaling 54 people evaluated.

To participate in the study, the elderly could not be performing strength training or practicing any other type of physical exercise. Elderly patients with acute osteomioarticular problems at the time of selection, coronary disease and uncontrolled hypertension and prescribed medical contraindication were excluded. Two groups were composed, being a power training group (PG) with 22 participants with mean age of 68.14 (5.46) years and the control group (CG) with 32 elderly individuals aged 68.03 (4.83) years. The study was carried out between February and June 2016. We opted for a control group that would perform physical activities with the same frequency, even a period of time, that would not knowingly interfere with muscle power.

Instruments: The variables of characterization of the sample evaluated were: age, sex, profession, marital status, schooling level, religion. Health-related quality of life was measured from the Medical Outcomes Study 36 – Item Short-Form Health Survey (SF-36). It is a generic instrument of evaluation subdivided in eight domains: functional capacity, physical aspects, social aspects, emotional aspects, pain, vitality, general state of health and mental health. For each of the eight dimensions a score is obtained. The higher the values obtained, the more favorable will be the quality of life[20]. The measurement scale ranges from zero (low quality of life) to 100 (high quality of life). Appropriate quality of life values were considered close to the midpoint of the scale with ± 10 points. Excellent values would be close to the upper quartile (75 ± 5 points), and the inadequate ones to the inferior quartile (25 ± 5 points)[21].

Functional capacity was measured by the Berg Balance and Time Up and Go tests.

To evaluate the risk of falls, the Berg Balance Scale (BSE) test was used, which has the capacity to evaluate the risk of falls, being composed of 14 tasks, with five items each, and a score of 0-4, with 0 being incapable of performing the task and 4 performs the independent task. The total score ranges from 0-56 points. The lower the score, the higher the risk for falls[22]. Score between 56 and 54, each point less would be associated with a 3% to 4% increase in the risk of falls; score between 53 and 46, each point is associated with an increase of 6% to 8% chance, being below 36, the risk is almost 100%[23].

The basic functional mobility was measured by the Time Up and Go (TUG)[24]. Its execution consists in the task of getting up from a chair, walking 3 linear meters to a visible mark on the floor, turning on the axis, walking back to the chair and sitting again, being considered the average of three attempts in seconds. The chair was standardized with armrest and 46 cm high. Performing the test within 10 seconds was considered adequate, values between 11-20 seconds would indicate a low risk of falls, over 20 seconds suggests a significant deficit in physical mobility and a high risk of falls[25]. Therefore, the shorter the test execution time, the greater the functional mobility.

Intervention Protocol: Pre- and post-intervention evaluations lasted two weeks. The first two weeks were to familiarize the elderly with physical practices (Figure 1). The power training protocol was composed of five exercises: calisthenics (AC), vertical bench press (SV), leg press 45º (Leg 45º), pulley high (PAP) and flexor bench (BF), alternated by body segment. The individuals in the PT program had two weeks of familiarization in which the initial training load was identified. After the adaptation phase, were performed three sets of 10-15 repetitions in the initial six weeks, with an approximate intensity of 40-50% of the SPE scale (score between 9-11). In the following six weeks the three sets of 6-10 repetitions were maintained, increasing the intensity to 60-70% of the scale (score between 12-14). The interval between the series was of 90 seconds, and the load adjusted weekly, from the scale of subjective perception of effort (SPE) (Row, Knutzen and Skogsberg; 2012). The training frequency of the subjects was three times a week and the session was approximately 50 minutes, resulting in a total volume of 36 workouts in 14 weeks.

The CG performed the rhythm activities twice a week for a period of 14 weeks, with a total volume of 28 classes. The classes lasted an average of 50 minutes, divided into 5 minutes of warm-up with joint and stretching exercises

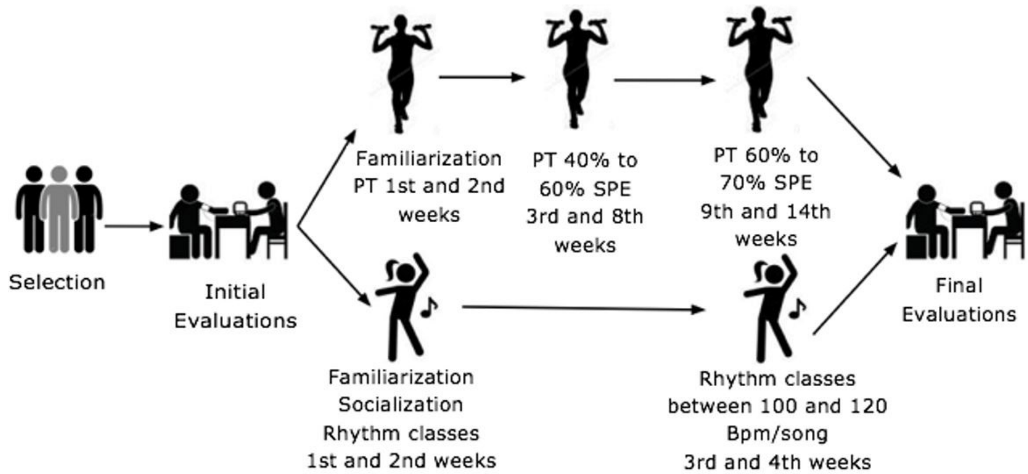

Figure 1: Design of the protocol of evaluations and interventions in the training and control groups

Note: PT = power training; SPE = subjective perception of effort; bpm = beats per minute

and 15 minutes of localized exercises, with overload (1 to 2 kg) for the main muscle groups. The remaining 30 minutes were intended for the rhythm class consisting of choreographies that prioritized the coordinating capacities, balance, displacement movements with focus on the change of direction. The intensity of the lesson was controlled by beats per minute (BPM) of the songs, ranging from 100 to 120 bpm. The activities were closed with calm and stretching.

The data were presented by the descriptive statistics in frequency and percentage for the categorical variables and standard deviation for the continuous variables. The difference between the groups was tested by the Mann-Whitney test and the comparison between the pre-and post periods of each group was verified by the Wilcoxon test and the correlations by the Sperman's ρ. The level of significance was $p \leq 0.05$. The software used was Statistical Package Social Science (SPSS, version 21 for Windows).

RESULTS

The participants in both groups were mostly female, with retired elderly who exercised activities in the household the majority (table 01). Regarding marital status, both groups had a higher frequency of married and widowed and basic education levels were reached by 78.9% of the elderly in the PG group and 75.4% in the CG. The Catholic religion was the most prevalent.

Regarding the presence of health alterations (table 02), it was found that a high number of elderly people, more than half of the total volunteers, had suffered some fracture. The most chronic condition detected was systemic arterial hypertension in both groups and most of them use two drugs were continuously. Regarding the habits of life, it was verified that the preponderance of the volunteers did not have the habit of smoking and consuming alcoholic beverages.

Table 1- Demographic data of the elderly evaluated

Variables	PG (n= 22)	CG (n= 32)
Gender	**n (%)**	**n (%)**
Female	14 (63.6)	28 (87.5)
Male	08 (36.4)	04 (12.5)
Occupation		
Retired	04 (19.0)	11 (34.4)
Merchant	03 (14.3)	-
Housewifely/Househusband	04 (19.0)	14 (43.8)
Domestic Services	02 (9.5)	01 (3.1)
Seamstress	02 (9.5)	02 (6.2)
Others	06 (28.8)	03 (1.9)
Marital Status		
Single	02 (9.1)	01 (3.1)
Stable union	-	04 (12.4)
Married	08 (36.4)	13 (40.6)
Widower	08 (36.4)	10 (31.2)
Divorced	04 (18.2)	04 (12.5)
Education Level		
Literate	03 (15.8)	06 (23.1)
Incomplete primary education	02 (10.5)	01 (3.8)
Complete primary education	04 (21.1)	07 (26.9)
Incomplete high school	01 (5.3)	02 (7.7)
Complete high school	06 (31.1)	03 (11.5)
Incomplete Higher Education	-	03 (11.5)
Complete Higher Education	03 (15.8)	04 (5.4)
Religion		
No	01 (4.5)	01 (3.1)
Catholic	11 (52.4)	21 (67.7)
Evangelical	09 (42.9)	09 (29.0)
Spiritism	01(4.8)	-
Others	-	01 (3.2)

Note: PG- power group; CG- control group.

In relation to the objective measures of functional capacity (table 03), both elderly PG and CG presented a low risk of falls (approximately 15% chance); in addition, all elderly patients evaluated had excellent functional mobility, with higher PG scores in the pre-intervention period (p= 0.045) when compared to the CG. After 14 weeks of intervention the TUG execution time was reduced (p= 0.021), significantly increasing the functional mobility of the elderly of the PG. Even though there was a reduction (p <0.001) in the balance scale scores after intervention, the risk of falling rating did not change. In the control group, no changes were observed. There were no differences between groups in the Berg Scale in the pre- and post-intervention periods.

Table **2 – Clinical aspects of the elderly evaluated**

	PG (n= 22)	CG (n= 32)
Clinical variables	n (%)	n (%)
Visual Deficits	19 (86.4)	26 (81.2)
Hearing Deficits	01 (4.5)	03 (9.4)
Auxiliary devices for locomotion	-	01 (3.1)
Previous Fractures	11 (39.3)	09 (25.7)
Internment in last year	01 (4.5)	05 (15.6)
Chronic Conditions		
Heart diseases	03 (13.6)	05 (15.6)
Hypertension	11 (50.0)	18 (56.2)
Diabetes	-	08 (25)
High Cholesterol	08 (36.4)	12 (37.5)
Arthrosis	09 (40.9)	11 (34.4)
Medication		
None	07 (31.8)	05 (15.6)
01 medicament	02 (9.1)	03 (9.4)
02 medicaments	13 (59.0)	24 (75.0)
Life habits		
Smoking	01 (3.6)	03 (8.6)
Alcoholism	03 (10.7)	09 (25.7)

Note: PG- power group; CG- control group.

With the exception of the pain domain in both groups and mental health in the PG, the SF-36 domains indicated adequate quality of life (Table 4). Comparisons at baseline indicated that PG had lower pain scores (p = 0.031) and lower mental health (p <0.001) when compared to CG. After the intervention there was improvement in the physical and emotional aspects of PG as expressed by the size of the effect (Table 3). The CG, that was instructed to perform the dance, obtained significant increases in the emotional aspects domain (p=0.03). When we observed the variations of the scores in the pre- and post-intervention period to identify the clinically relevant minimum differences, it was found that both interventions were very efficient in favoring the emotional and physical aspects in the elderly, and also had a negative impact on the perception of pain and social aspects.

Moderate correlations were found between functional capacity (r= -593, p=0.007) and pain at the beginning of the intervention (r= 666, p= 0.002) and postoperative pain in the PT group. Suggesting that those with better functional capacity and more favorable perception of pain in the initial period would be correlated with the most unfavorable scores at the end.

DISCUSSION

The present study showed favorable results in functional mobility and in maintaining the risk of falls in the elderly after 14 weeks of power training. There was also a positive evaluation of most of the sf-36 domains, with emphasis on physical and emotional aspects. However, the perception of the elderly regarding the pain domain presented below-expected results.

The positive association between functional mobility and power intervention has been reported in previous studies[5, 13, 18]. The possible biological mechanisms related to this improvement would be the increase in muscle strength and power, cross-sectional area, glucose tolerance, fast muscle fiber type and oxidative profile as described in the literature[27,13]. These factors would have repercussions on the production of fast force and speed, abilities impaired with aging, and directly linked to the chair lift and gait speed in the TUG.

However, it was observed that even with a significant reduction of the scores, the group that performed PT alone was able to maintain the low clinical risk of falls with data

Table **3- Variables related to the postural stability of the elderly between the groups and the training periods**

	PG (n=22)			CG (n=32)			d
	Pre (M ± SD)	Post (M ± SD)	%Δ	Pre (M ± SD)	Post (M ± SD)	%Δ	
Berg Balance	52.7 (0.8)	52.2 (11.3)*	0.91	50.4 (9.5)	50 (10.7)	0.73	0.2
TUG	8.3 (1.4)	6.23 (1)*	25.1	7.7 (1.0)	7.4 (1.0)	25.1	3.4

Note: M = mean; SD = standard deviation; PG = power group; CG = control group; TUG = time up and go test. Data for p≤0.05.

Table 4 - Scores of the domains of the SF-36 quality of life questionnaire

Variables	PG (n=22)		CG (n=32)		d
	(M ± SD)	Δ	(M ± SD)	Δ	
Functional Capacity					
Pre	74.5 (18.5)		80,9 (19,4)		
Post	77.1 (22.4)	2.6	82.0 (40.4)	1.1	0.1
Physical aspects					
Pre	60.2 (41.3)		78.9 (28.5)		
Post	66.7 (37.3)	6.5	85.7 (23.6)	6.8	0.8
Pain					
Pre	30.0 (22.3)		18.1 (21.2)		
Post	17.1 (19.9)	-12.9	13.0 (19.6)	-5.1	0.2
General health status					
Pre	48.4 (8.5)		50.3 (12.8)		
Post	50.4 (13.0)	1.6	45.4 (13.5)	-4.9	0.4
Vitality					
Pre	49.8 (12.9)		50.3 (12.7)		
Post	48.5 (11.6)	1.3	54.6 (13.5)	4.3	0.4
Social aspects					
Pre	50.0 (8.6)		51.2 (12.0)		
Post	43.8 (16.1)	-6.2	44.0 (19.9)	-7.2	0.01
Emotional Aspects					
Pre	57.6 (48.4)		65.6 (41.0)		
Post	68.1 (33.3)	10.5	88.4 (23.8)*	22.8	0.9
Mental health					
Pre	38.9 (9.9)		56.1 (8.3)		
Post	39.8 (16.9)	0.9	55.3 (11.7)	-0.8	1.3

Note: M = mean; SD = standard deviation; PG = power group; GC = control group; d = effect size. Data for p≤0.05.

also described[28]. It is important to emphasize that balance in the elderly can be affected by a combination of extrinsic factors (floor type, ground irregularities, physical barriers) and intrinsic factors, which are mainly associated with deficits in muscle strength (maximal strength and muscular power)[29] and postural control (dynamic and static balance). Despite the increases in muscle strength achieved by the PT, it is conjectured that unimodal exercises, performed in mechanical systems and explosively, were not able to significantly favor sensorial and proprioceptive mechanisms associated to the joint system that would confer greater stability and, consequently, would reduce the risk of falls[30, 31]. Unlike the TUG, which involves task velocity, the Berg Scale tends to quantify maintaining postures and balance such as: standing unsupported with eyes closed, standing on only one support with eyes closed, reaching objects on the ground from the standing position, etc. These actions require more prominent involvement of the vestibular system, visual acuity, and afferent and efferent command of the nervous system[30]. Supposedly, isolated PT stimuli would be insufficient to benefit all these physiological resources. In addition, there is no robust evidence to establish a direct transfer of anatomic-physiological gains to functionality, especially in complex actions[12]. On the other hand, the control group that performed activities with varied supports, rotations around the axis and changes in direction and rhythm, may have amplified the systems of postural control which would explain the maintenance of the values of the Berg Scale after the training period.

The results demonstrated that PT exercises were effective in promoting clinically relevant differences in physical and emotional limitations in the elderly, and there were not many studies that verified the benefits of PT on quality of life[18, 32]. The rhythm protocol also induced similar changes.

Probably, both interventions led to the physical benefits by different mechanisms, the first one for musculoskeletal anatomopathological changes and the second for aspects related to proprioception and balance. These findings lead to the theory about the benefits of multimodal exercises in functional capacity and risk of falls in the elderly, in which it is postulated that strength training concomitant with proprioceptive and walking activities would result in more significant and broad gains than isolated practices.[33, 34] Programs aimed at the functionality and balance of the elderly should take into account not only the physical benefits, but also the individual taste, the economic and social limitations faced by the great majority of the elderly, and the possibility of accomplishing them in the community in which they live and in their homes seeking to increase adherence to such practices[31]. As for the emotional aspects, these were favored in both interventions, but significantly in the control group. Probably due to the type of practices performed that include greater playfulness, personal interaction, social contact when compared to strength training in handsets.

In contrast, self-reported pain values were significantly reduced in the PT group after training and these reductions in the SF-36 scale indicate worsening of the subjective health assessment. It is important to point out that the elderly who started the practices with higher scores of functional capacity and low perception of pain were the ones that showed the greatest decreases in the end. It is hypothesized that this perception is associated with late pain induced by exercise[35] and that the individuals with greater functionality at the beginning of the training would be able to mobilize higher loads and perform the exercises in an optimal way, potentiating the mechanisms of muscle damage and increasing pain after PT. The elderly with prominent initial pain derived from chronic health conditions would have this perception exacerbated by the presence of pain induced by exertion.

Stress-induced late pain may be pronounced in power training due to elevated tendon and joint overload[36]. On the other hand, pain related to mobilization of the neurosensiomotor system is a common and pervasive condition in the elderly due to the degenerative processes expected in aging and that may affect mobility, physical activity levels and risk of fall[37]. The elderly population may have difficulties in distinguishing and dealing with painful situations, since the greater frequency of chronic diseases and / or health treatments are associated with painful or negative events, impairing the subjective perception of the elderly. To minimize this, future interventions should include educational health processes that clarify to the elderly prior to the physical practices which require overload that late muscle pain may arise as an adaptive process for the gain of function. Also, longer periods of adaptation to the loads should be observed, due to the physiological specificities of the elderly population. No studies were found to associate power training with improvements in pain perception except in samples with chronic pain conditions[38, 37].

The strengths of the study would be the use of validated and robust protocols to measure postural stability in the elderly in a subjective evaluation that allowed us to monitor the effects of the proposed protocols not only from the evaluator's perception but also from the people being submitted to interventions. Since most of the studies attempt to understand only the objective results of the tests, disregarding the impact of training on variables related to well-being, it has also become important because it reinforces the difference in earnings between different trainings. In addition, no other Brazilian studies were found to measure quality of life after strength training with emphasis on muscle power. The proposed intervention was safe since there were no intercurrences during the practice and, generally, studies using high-speed movements report a high frequency (63% in 6 months) of injuries or injuries in a program of high-speed force[39]. Few studies have reported dropouts and injuries over power training period. The limitations would concern the lack of randomization, which limits the conclusions of the study, the reduced sample size precluding the more robust statistical inferences and the lack of specific measure of strength in the group that performed the power training.

CONCLUSION

The present study concluded that power training positively influenced the functional capacity, physical and emotional aspects of the elderly, negatively in the perception of pain and maintained the risk of falling after 12 weeks of intervention. Characterizing as a safe and feasible intervention for this population without reporting intercurrences.

AUTHORS' CONTRIBUTIONS

Conceptualization and Investigation: GPL, VS, PEMV, JLM and IOS; Data curation and Formal analysis: GPL, PRL, AVMF, WAL, JTJ and IOS; Writing , review and editing: GPL, VS, PEMV, DAAPO AND IOS; Final approval of the version to be published: all authors.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest.

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