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Bone Density and Functional Autonomy in Post-Menopausal Women Submitted to Adapted Capoeira Exercises and Walking

Schneyder R. Jati[1,2], Cláudio J. Borba-Pinheiro[2,4], Rodrigo G. S. Vale[2,5,6], Adnelson J. Batista[3]; Carlos S. Pernambuco[2,5], Marco J. M. Souza[7], Arlisson S. Moura[8], Dagoberto L. V. Mota[9], Delson L.de Figueiredo[2,10], Estélio H. M. Dantas[2,10]

[1]Centro Universitário Estácio da Amazônia, Brasil; [2]Laboratório de Biociências da Motricidade Humana (LABIMH), Universidade Federal do Estado do Rio de Janeiro (UNIRIO), Brasil; [3]Instituto Federal de Educação, Ciência e Tecnologia de Roraima (IFRR), Brasil; [4]Instituto Federal de Educação, Ciência e Tecnologia do Pará (IFPA) Campus de Tucuruí-PA, Brasil; [5]Universidade Estácio de Sá, Cabo Frio, RJ, Brasil; [6]Universidade do Estado do Rio de Janeiro (UERJ); [7]Instituto Federal Educação, Ciência e Tecnologia de Pará (IFPA) Campus de Itaituba-PA, Brasil; [8]Fundação de Hematologia e Hemoterapia do Amazonas (HEMOAM), Brasil; [9]Universidade Estadual de Roraima, Brasil; [10]Universidade Tiradentes (UNIT), Brasil

ABSTRACT

Jati SR, Borba-Pinheiro CJ, Vale RGS, Batista AJ, Pernambuco CS, Souza MJM, Moura AS, Mota DLV, Figueiredo DL; Dantas EHM. Bone Density and Functional Autonomy in Post-Menopausal Women Submitted to Adapted Capoeira Exercises and Walking. **JEPonline** 2018;21(2):214-226. The aim of this study was to assess the effects of two training programs (adapted capoeira and walking) on bone mineral density (BMD) and functional autonomy in post-menopausal women. This is an experimental study with a randomized design. Twenty-eight women were randomly assigned to one of two training groups: (a) adapted capoeira (ACT); and (b) walking (WT). Dual-energy x-ray absorptiometry (DXA) measured BMD, and the GDLAM functional autonomy protocol measured functional autonomy. This study obtained positive results after six months, since there was an improvement in BMD measures and functional autonomy in the ACT group compared to the WT group. Adapted capoeira may be a physical activity alternative for post-menopausal women, since it helps to preserve BMD and performance in the activities of daily living.

Keywords: Adapted Capoeira, Functional Autonomy, DMO

INTRODUCTION

Physical activity and regular exercise are associated with numerous benefits, including lower risk of developing stroke and type 2 diabetes as well as preserving bone mass that reduces the risk of falls (28) in elderly men and women (11,22). Conversely, the absence of activity may have a negative influence on the bone mass of individuals of all ages (4). It also affects the ability of elderly people to participate in activities of daily living (ADL), which can decrease functional autonomy (19,16).

Low bone mineral density (BMD) and physical inactivity are serious risk factors (7) that may evolve and lead to osteoporosis, which is associated with risk of falls and fractures (8,12,15). Osteoporosis, the most common osteometabolic disorder, accounts for a high morbidity and mortality index among the elderly. It affects around one-third of post-menopausal women, especially having a negative impact on quality of life and the level of independence in the individuals that suffer from the disease (27).

To minimize this impact, walking and running have been used to enhance physical condition and improve BMD (27,34). On the other hand, anaerobic exercises, such as combat sports, have also been reported as a way to prevent or attenuate osteopenia and osteoporosis in order to reestablish bone health and decrease the risk factors for falls (17,25).

Interestingly, middle and high-impact combat sports include judo, karate, kung fu, and boxing, which stimulate osteogenesis by causing microfractures in bone tissue (25,21,5). However, combat sports are still rare as an alternative exercise modality for post-menopausal women. Capoeira, on the other hand, may be an alternative for individuals who need to preserve bone health, decrease the risk of fractures, and improve performance in the activities of daily living.

Thus, the purpose of this study was to assess the effects of two training programs, using adapted capoeira and walking, on the BMD and functional autonomy of post-menopausal women.

METHODS

Subjects

This is an experimental study with a randomized design of two groups submitted to different interventions (37). Twenty-eight elderly post-menopausal women were randomly assigned to the adapted capoeira training group (ACT) and the walking training group (WT). The descriptive characteristics of the subjects in both groups are in Table 1.

The following inclusion criteria were adopted: (a) being a woman; (b) being in menopause; (c) being in any phenotype group (descendants of Europeans, Blacks or Indigenous peoples); (d) not engaged in regular physical exercises for at least three months; and (e) cleared to engage in physical exercise.

The exclusion criteria included any existing acute or chronic health condition that may compromise engaging in physical activities, any type of invasive surgery in the previous six months, uncontrolled hypertension, early menopause due to ovary removal, individuals with special needs, exhibiting physical dependence, and the use of drugs that induce low BMD, such as glucocorticoids. Initially, 32 women were selected, but 4 women did not meet the eligibility criteria, leaving a total of 28 subjects, 14 in each group.

This study was approved by the Human Research Ethics Committee of the Universidade Federal do Estado do Rio de Janeiro (protocol no. 1.869.352). All subjects were advised of the procedures and gave their informed consent in accordance with National Health Council Resolution no. 466 of 2012 (10).

Procedures

All the tests applied to assess the sample were conducted twice: a pre-test (at the start of the study) and a post-test (6 months after the intervention).

Preliminary Procedures

The preliminary procedures consisted of applying an anamnesis for sample selection, in addition to measuring height and body weight in order to calculate BMI (40). A digital balance scale (Filizola, Brazil) accurate to 0.1 kg (that was equipped with a stadiometer with 0.5 cm gradations) was used to assess the subjects' measurements. The anthropometric measures followed International Anthropometric Assessment guidelines (23).

Assessment of Bone Mineral Density

A dual-energy x-ray absorptiometry scanner (DEXA) (Lunar® DPX-NT, General Electric Healthcare, Little Chalfont, Buckinghamshire, UK), coupled to software (Lunar®, Version 4.7, GE Medical Systems, Madison, WI) was used to evaluate BMD (31). The following reference points were used to determine BMD: right femur (femoral neck and total femur) and lumbar vertebrae (L1-L3). During the assessment, the subjects wore light clothing, were barefoot, without any metal inside or on their body, remained in the dorsal position with their legs resting on a block to form an angle of 30° for 15 min (time required to execute the scan). This procedure is widely used in scientific research involving physical exercise and low BMD (5,21).

Assessment of Functional Autonomy

To assess functional autonomy, the Latin American Development Group for Maturity (GDLAM) was used (15,16,39). This protocol consists of the following tests: 10 m walk (10 mW) (35), rising from a sitting position (RSP) (18), rising from a ventral decubitus position (RVDP) (1), rising from a chair and moving about the house (RCMH) (3), and putting on and removing a t-shirt (PRTS) (16,38). All the tests were applied twice at least 5 min apart, in which the best execution time (sec) was considered. The test results were used to calculate the GDLAM autonomy index (GI), using the following formula (39):

$$GI = \frac{[(10\ mW + RSP + RVDP + PRTS) \times 2] + RCMH}{4}$$

Experimental Procedure

Adapted Capoeira Training

Adapted capoeira training was performed 2 times·wk^{-1} for 60-min each session for 6 months. Capoeira Regional movements, a style developed by a Master, descendant of slaves, called "Master Bimba" (Mestre Bimba in Portuguese) (30), were selected and used with simple exercises adapted to lower the risk of falls.

Music, an essential component of capoeira, was played throughout the training. It is the only combat sport accompanied by musical instruments and chanting. The songs are a form of relaxation and interactivity, and belong to the public domain with no restriction on their use. They are accompanied by hand-clapping and the sound of a pandeiro (a tambourine of Middle Eastern origin) and berimbau (a musical bow of African origin), the latter specific to capoeira (24).

A plastic chair (®Tramontina Atalaia, Brazil) with arms was adapted to enable the subjects to perform some of the movements in a sitting position before executing them while standing, using ginga. Ginga is a set of body movements that gives capoeira the false appearance of being a dance (24).

The training sessions consisted of 6 stages: 1. Warm-up (10 min); 2. Basic Movements (10 min): gingas and esquivas (sideways movements and dodges), and movements involving the arms and legs; 3. Esquivas (10 min): lateral (side dodge); low (low dodge); pêndulo (slipping and bobbing), and parallel (a type of low squat); 4. Kicks (10 min): "ponteira" (straight kick using the ball of the foot to hit the target at waist level; "benção" (another straight kick with the sole of the foot using ginga); "queixada", spinning kick with the outer part of the foot); "meia lua de frente" (similar to the previous using the inner part of the foot); 5. Variations (10 min): "parado na base" (initial stance of the ginga, moving forward, moving backward); 6. Capoeira Circle (10 min): the capoeira circle ('roda' in Portuguese) is a form of expression that makes it possible to learn and expand the game. In the circle, kicks, movements, and chants are enacted (32). The elderly remained seated in a chair, responding to the chorus of the song, clapping their hands while a pair of "capoeiristas" performs the capoeira movements.

Walking Training

Walking training was performed 2 times·wk^{-1} at 60-min sessions for 6 months. The sessions were subdivided into 3 stages, as follows: 1. Warm-up (10 min) with stretching and joint mobility exercises (2, 10 to 15-sec series); 2. Main Part (40 min): walking with exertion control between scores 3 and 5 on the perceived exertion scale (Borg CR-10) (9); 3. Cool-down (10 min): muscle relaxation and stretching exercises (2, 10 to 15-sec series).

Statistical Analyses

The data were analyzed using the ®IBM SPSS Statistics program, Version 20.0 for Windows and presented as means ± SD and minimum and maximum values. The Shapiro-Wilk and the Levene tests were used to check normality and homogeneity of variance of sample data, respectively. The Student's *t* test for independent samples was applied in the pre-test to verify whether the groups exhibited differences in their characteristics. For intra and intergroup assessment, ANOVA (2x2) with repeated measures was applied to the factors group (ACT and WT) and time (pre- and post-test), followed by the Tukey's *post hoc* test to identify differences in the study variables. The power of the study and effect size (d) were calculated to analyze the magnitude of the results. A P-value of P<0.05 was set for statistical significance. Deltas were calculated for the % intragroup difference with the following formula: [Δ% = (Post – Pre) *100 ÷ Pre] and for % intergroup difference with [Δ% = (Post ACT – Post WT)].

RESULTS

Table 1 shows mean ± SD values at baseline that describe the groups and demonstrates, in all the variables, that there was no statistical difference between the groups at the start of the study.

Table 1. Descriptive Characteristics of the Groups.

Variables	Groups				
	ACT (n=14)		WT (n=14)		
	Mean	SD	Mean	SD	P-value
Age (yrs)	70.07	5.08	69.14	4.17	0.601
Age of Menopause (yrs)	47.93	5.90	50.00	5.70	0.353
Weight (kg)	58.14	7.20	56.57	4.93	0.506
Height (cm)	1.51	0.06	1.51	0.06	0.846
BMI ($kg \cdot m^{-2}$)	25.58	2.98	24.79	2.40	0.444
Session Frequency ($class \cdot wk^{-1}$)	1.61	0.14	1.56	0.11	0.311
T-Score L_1-L_3 (SD)	-1.79	0.85	-1.77	0.72	1.000
T-Score Femoral Neck (SD)	-1.70	0.52	-1.60	0.43	0.951
T-Score Total Femur (SD)	-1.17	0.7	-1.16	0.56	1.000
BMD L_1-L_3 ($g \cdot cm^{-2}$)	0.861	0.14	0.858	0.15	1.000
BMD Femoral Neck ($g \cdot cm^{-2}$)	0.713	0.09	0.690	0.13	0.929
BMD Total Femur ($g \cdot cm^{-2}$)	0.770	0.09	0.747	0.09	0.883
Functional Autonomy Index (GI-Score)	36.82	3.29	36.34	2.72	0.969

SD = Standard Deviation; **BMI** = Body Mass Index; **ACT** = Adapted Capoeira Training; **WT** = Walking Group; **BMD** = Bone Mineral Density

Figure 1 shows the results of BMD variables in the study groups. ANOVA with repeated measures showed an interaction between the study variables (Wilk's Lambda = 0.357; F = 3.250; P<0.001). The power of the experiment for L1-L3 BMD ($g \cdot cm^{-2}$) Femoral Neck BMD ($g \cdot cm^{-2}$) and Total Femur BMD ($g \cdot cm^{-2}$) was 80%, 78%, and 96%, respectively, increasing the magnitude of the results. Intragroup analysis showed that the ACT group had greater significance for L_1-L_3 BMD (Δ% = 14.9, P=0.042, d = 0.95) and total femur (Δ% = 11.2, P=0.039, d = 0.98), which did not occur with WT. In intergroup analysis, the ACT group performed better in all BMD values (L_1-L_3: Δ% = 0.14%, P=0.029; femoral neck: Δ% = 0.12%, P=0.017; and total femur: Δ% = 0.13% P=0.001) when compared to WT.

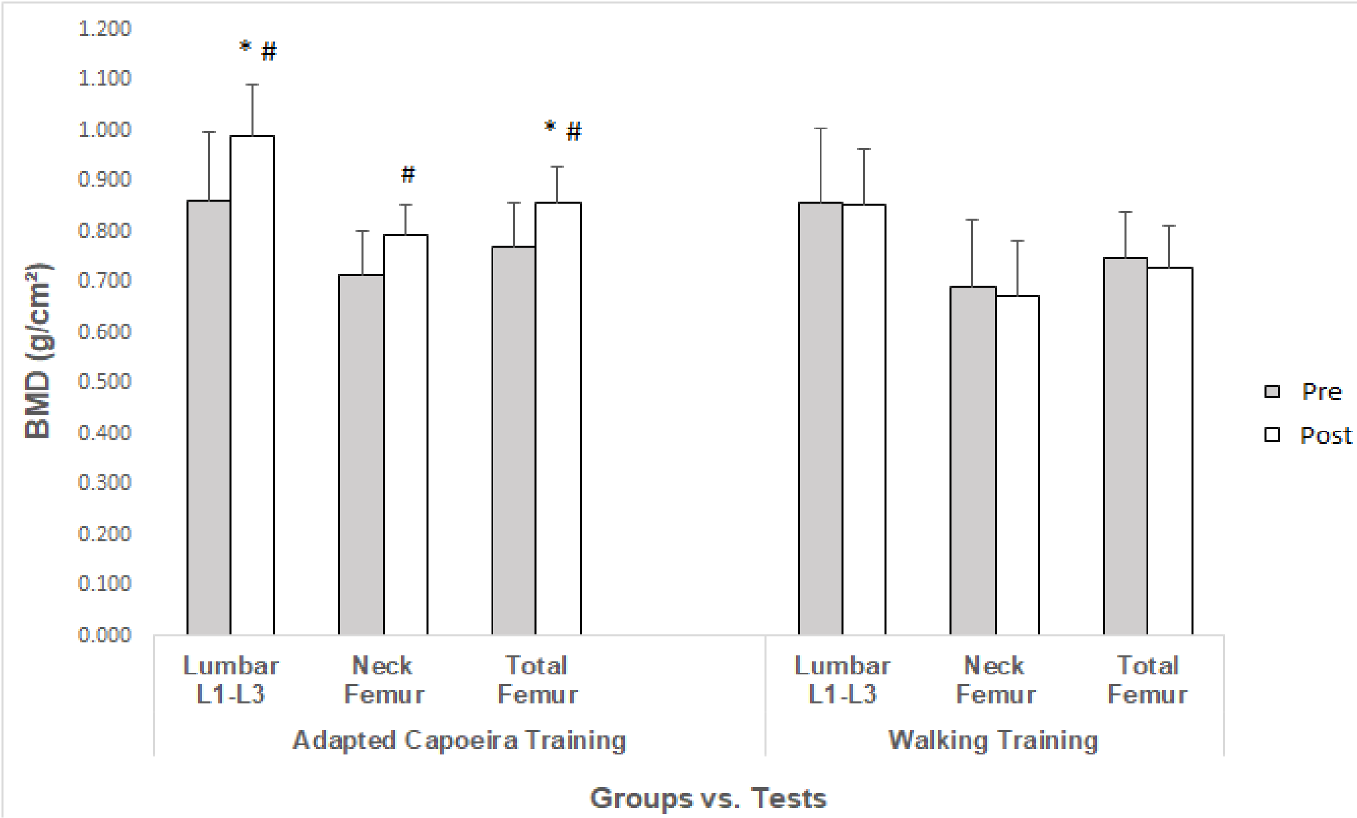

Figure 1. Results of BMD Variables. *P<0.05 intragroup; #P<0.05 intergroup.

Figure 2 shows the results of functional autonomy variables according to GDLAM protocol tests of the groups assessed. ANOVA with repeated measures showed an interaction between the study variables (Wilk's Lambda = 0.329; F = 3.574; P<0.001). The power of the study for 10 mW, RSP, LPS, RVDP, PRTS, RCMH, and functional autonomy index (GI-score) was 92%, 99%, 88%, 92%, 97%, and 99%, respectively, increasing the magnitude of the results obtained. Intragroup analysis showed a decline in execution time in all the tests for ACT: 10mW (Δ% = 11.6%, P=0.037, d = 1.17); RSP (Δ% = 23.2%, P<0.0001, d = 2.09); RVDP (Δ% = 25.2%, P=0.008, d = 1.01); PRTS (Δ% = 21.1%, P=0.002, d = 1.48) and RCMH (Δ% = 13.8%, P=0.008, d = 1.36), which did not occur with WT. In intergroup analysis, ACT performed better in the following tests: 10 mW, (Δ% = 1.04%, P=0.041); RVDP (Δ% = 1.36%, P=0.013) and PRTS (Δ% = 2.65% P=0.031) when compared to WT.

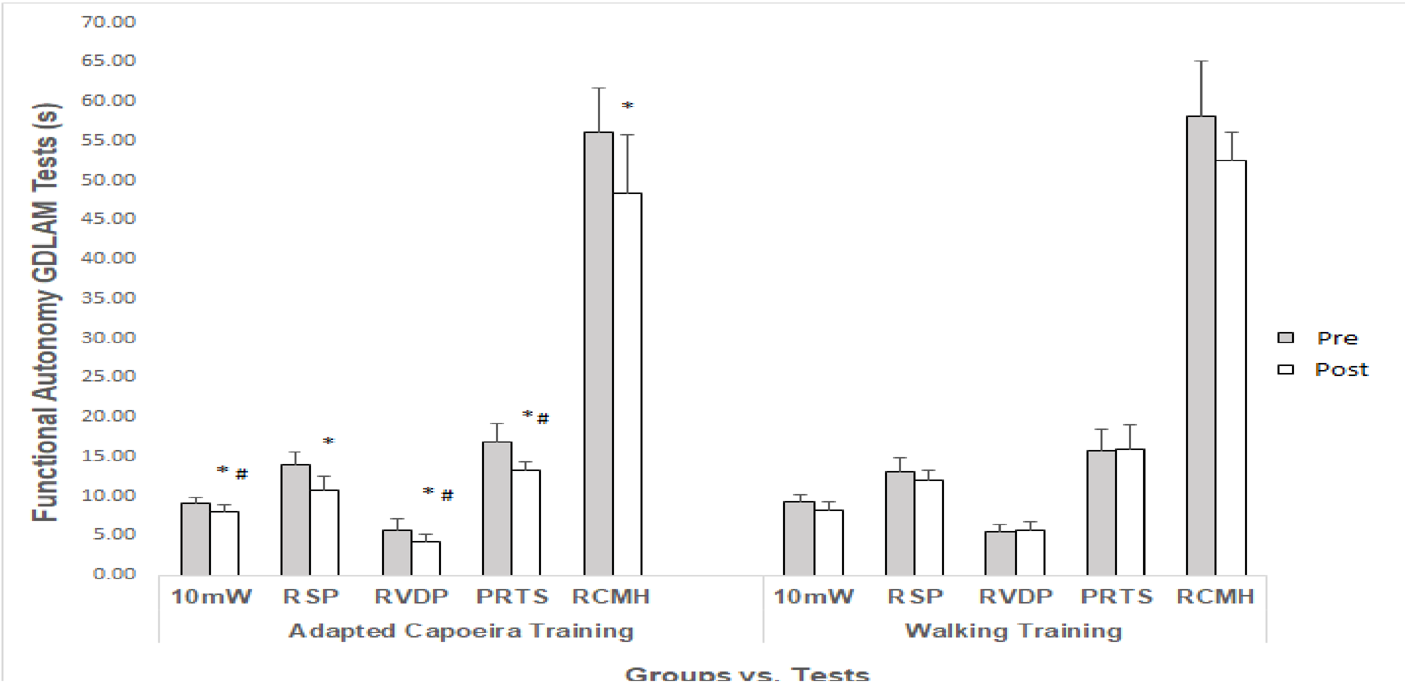

Figure 2. Results of GDLAM Functional Autonomy Tests. *P<0.05 intragroup; #P<0.05 intergroup

Figure 3 shows the functional autonomy index results of the GDLAM protocol. Intra and intergroup analyses exhibited favorable results in ACT, intra GI (Δ% = 17.9%, P<0.0001, d = 2.01) and inter GI (Δ% = 3.87%, P=0.003) when compared to WT.

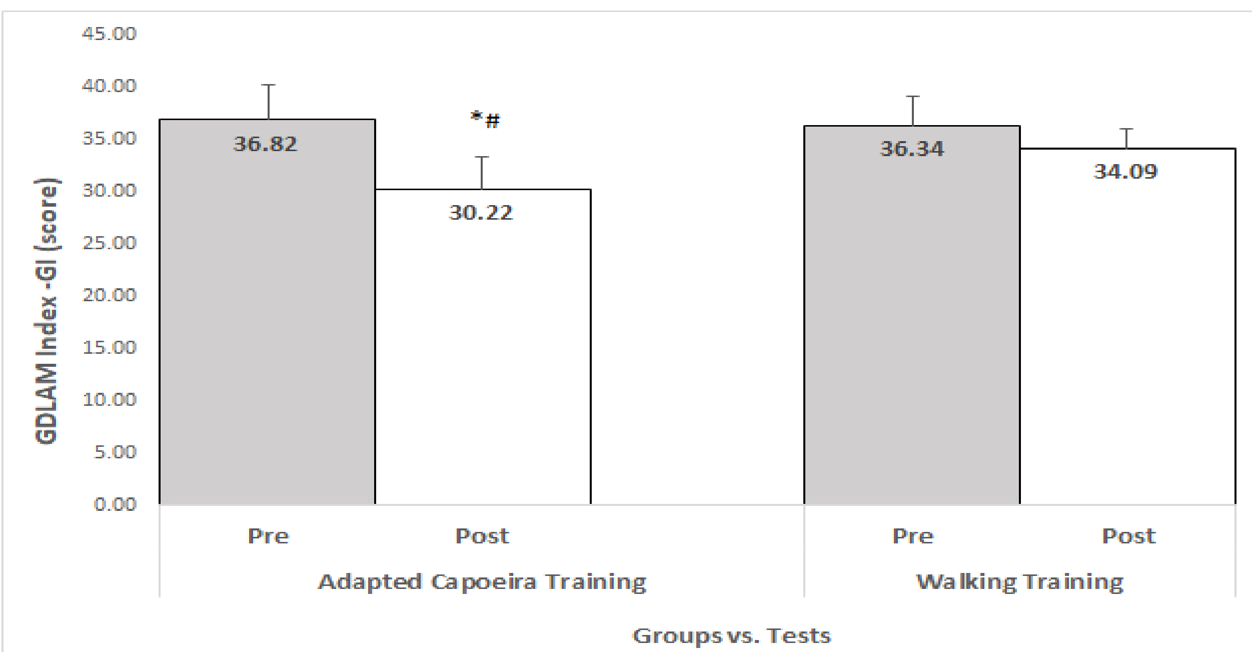

Figure 3. Results of the GDLAM Functional Autonomy Index. *P<0.05 intragroup; #P<0.05 intergroup

DISCUSSION

This study presents an innovative exercise for elderly women based on a methodological adaptation of a Brazilian martial art called Capoeira, demonstrating positive results after 6 months. The findings indicate there was an improvement in the BMD measures and functional autonomy of subjects from the ACT group when compared to their WT counterparts. For the present study, methodological adaptations were needed to apply adapted capoeira. Other studies with different fighting styles have also used methodological adaptations to enable middle-aged and elderly women to participate (5,7).

The American College of Sports Medicine (2) states that physical exercises are one of the most recommended health promotion strategies, providing benefits to the musculoskeletal system, among others, thereby contributing to preventing diseases such as osteoporosis. Santos and Borges (33) report that the most important physical exercises for preventing osteoporosis are high-intensity resistance and high-impact aerobic exercises.

The results illustrated in Table 1 show that the age and age of menopause of ACT and WT subjects correspond to the mean reported by the National Osteoporosis Foundation (NOF) (29). These results corroborate those of Lang (20), who demonstrated that advanced age, in addition to the rapid decline in estrogen levels, shows the greater need for physical exercises.

The T-scores depicted in Table 1 revealed that the bone sites of the study groups displayed losses in L1-L3 BMD, with a densitometric diagnosis of osteopenia (41). For the femoral neck, both groups also showed a loss of BMD, but the losses were similar and the groups were classified as having osteopenia of the femoral trochanter.

The results of the present study for L1-L3 BMD presented in Figure 1 show that the ACT group obtained an increase in lumbar and total femur BMD. In intergroup analysis, ACT also produced better lumbar, femoral head and total femur BMD. Borba-Pinheiro et al. (5,7), using different methodologies in their research on judo, reported similar results for lumbar BMD and an increase for L2-L4 in the group submitted to adapted judo training for 2 yrs when compared to the control group, with the best results obtained after the first 12 months of intervention.

Cabral et al. (12), Navega and Aveiro (26), and Shirazi et al. (34) found that walking also resulted in multiple benefits, such as decreasing bone loss, in contrast to the findings of the present study. Santos and Borges (33) reported that walking has little effect on improving BMD, since this type of exercise does not stimulate the bones enough to increase their mass.

Functional autonomy showed favorable results after ACT in relation to WT (Figure 2). ACT exhibited lower execution time in all the GDLAM protocol tests. In intergroup analysis, ACT was better than WT in 10 mW, RVDP, and PTT tests. With respect to the functional autonomy index, intragroup analyses also exhibited favorable results after ACT. These findings agree with those of Vale et al. (38), who concluded that physical exercise provides benefits to the elderly, such as muscle strength and endurance, mobility for the activities of daily living (ADL), and balance to prevent falls. Civinski (14) reports that a decline in regular physical activity contributes to decreased physical aptitude, loss of functional capacity, and the emergence of a number of pathologies. In this regard, Tairova and De Lorenzi (36) showed that physical exercises help increase the mobility of elderly individuals. Borba-Pinheiro et al. (6,8) demonstrated that exercise is one of the best ways to preserve BMD and functional capacity during the aging process, especially since it exerts a positive influence on the functional capacity and performance of the elderly. Another study (13) used the GDLAM functional autonomy index (GI) to show that active elderly women display better functional capacity than their sedentary counterparts.

The findings of the present study demonstrate that capoeira training with an adapted methodology can have positive effects on BMD and functional capacity of post-menopausal women over a 6-month period. This may favor functional capacity and the activities of daily living (ADL). However, the present investigation did not control eating habits or hormone levels related to bone remodeling, which may be a limitation of this study.

CONCLUSIONS

The adapted capoeira training program for post-menopausal women was more effective for lumbar spine and total femur BMD and for functional autonomy tests aimed at ADL when compared to the group submitted to walking training. As such, adapted capoeira may be an effective physical activity strategy for preserving the BMD and functional capacity of post-menopausal women. More studies should help analyze the relationship between capoeira training, BMD, and secretion levels of hormones such as IGF-1, estrogen, and progesterone, which decline post-menopause.

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Corresponding address: Schneyder Rodrigues Jati, Centro Universitário Estácio da Amazônia, Rua Jornalista Humberto Silva, 308 – Bairro União, Roraima/RR, Brazil CEP: 69313-792, E-mail: schneyder7@hotmail.com

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