Original Article

Effects of resistance training, tai chi chuan and mat pilates on multiple health variables in postmenopausal women

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ABSTRACT

Objective: To compare the effect of two concurrent training methods on the muscle strength, functional autonomy, cardiorespiratory capacity and quality of life (QoL) of postmenopausal women. Material and methods: Thirty-eight volunteers were allocated to two groups: Resistance Training (RT)+Tai Chi Chuan (TC) (n=16), and RT+Mat Pilates (MP) (n=12). For the RT+TC group, RT was linearly periodized twice a week, alternating weekly with TC. In the RT+MP group, RT was non-linearly periodized and alternated with MP in five sessions a week over a period of 16 weeks. Results: Intragroup improvement in QoL was observed for the physical health of RT+MP. The Cooper test showed improvement in the prediction test for both groups. Functional autonomy improved in the following: rising from a ventral decubitus position, rising from a sitting position, walking 10 meters, putting on and taking off a t-shirt (PTTs) and the GDLAM index (GI) in the RT+MP group. For RT+TC, PTTs and GI improved. With respect to strength, there was intragroup improvement in the RT+MP group for all upper limb exercises, knee flexion and 45º leg press. On the other hand, the RT+TC group showed improvements in high shoulder adduction, elbow extension, low shoulder adduction, pec deck pectorals and 45º leg press. Intergroup analysis showed better results in the 10mW test for RT+MP.

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Conclusion: Both methods showed significant improvements in functional autonomy and muscle strength, as well as maintenance of QoL and cardiorespiratory capacity. Intergroup analysis indicated better results with the RT+MP program. **Keywords:** Women, Health, Postmenopausal, Functional autonomy, Physical exercise.

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INTRODUCTION

The world's population is aging (Romo-Pérez et al., 2011), evidenced in the age pyramid, which demonstrates a decline in fertility and mortality rates (World Health Organization, 2015). In Brazil, the Brazilian Institute of Geography and Statistics (Brazilian Institute of Geography and Statistics, 2013) estimates that by 2060, people aged 65 years or older will account for 26.7% of the total population. As such, the number of elderly who are physically inactive and/or suffering from chronic non-communicable diseases will also increase, placing a considerable burden on the world's health economy, due to a rise in the number of medical procedures, drug therapy and hospitalizations (Bueno et al., 2016).

Aging is characterized by a decrease in physical abilities and physiological functions, including sex hormones, flexibility, functional autonomy, joint mobility, aerobic capacity, quality of life (QoL), body balance, bone mass and muscle mass (Farias et al., 2014). In this regard, to prevent and/or reduce menopause-related functional loss and climacteric symptoms, physical exercise programs aimed at the multiple variables of health are essential (Borba-Pinheiro et al., 2010; Romo-Pérez et al., 2011; Tairova & Lorenzi, 2011).

Progressive hypoestrogenism, which interrupts the menstrual cycle, is the primary cause of the climacteric period. This phase is characterized by unpleasant symptoms such as weight gain, hot flashes, cold sweats, insomnia and psycho-emotional disorders, in addition to reduced skin elasticity, vaginal atrophy, urinary disorders, osteoporosis and cardiovascular diseases (Tairova & Lorenzi, 2011).

Based on official health documents (World Health Organization, 2012) and the scientific literature, different methods of supervised physical exercises are recommended and have proven effective for people at an advanced age and the elderly (Borba-Pinheiro et al., 2013; Farias et al., 2014). However, there are gaps in the knowledge of concurrent methods that, in addition to improving health variables, performance and QoL, may provide a healthier and happier lifestyle, be more motivating, and broaden the social environment, especially for elderly submitted to two or more methods in order to maintain and develop these variables (Romo-Pérez et al., 2011; Borba-Pinheiro et al., 2013; Farias et al., 2014).

In this regard, physical exercises with two associated methods may be an effective way of preventing and treating physiological, physical and cognitive decline caused by menopause and consequently maintaining the health and QoL of elderly women. Thus, taking into account the methodological details related to the type of exercise, method, volume and intensity, it is possible to determine which type of concurrent training is most effective in improving and maintaining the health variables. It is important to highlight that alternate exercise programs should combine strength and aerobic resistance exercises (Farias et al., 2014; Silva & Borba-Pinheiro, 2015). In addition, functional and flexibility exercises must also be included in programs for older people and seniors, in order to improve the QoL components of mental health. These methods have proved to be effective in multiple health variables (Farias et al., 2014; Guedes et al., 2016; Gambassi et al., 2017). However, the effects of linear resistance training (RT) associated with Tai Chi Chuan (TC) and non-linear RT associated with Mat Pilates (MP) remain unclear and poorly described in the literature. In this respect, the present study may help fill this gap by introducing an intervention with associated exercise methods. To that end, the following hypothesis was formulated: there is a statistical difference ($p<0.05$) between two exercise methods with different training volumes that associate RT with TC and MP in terms of their effect on the muscle strength, functional autonomy, cardiorespiratory capacity and QoL of postmenopausal women.

As such, the present research aimed to compare the effect of two concurrent training methods (RT + TC and the RT + MP) on the muscle strength, functional autonomy, cardiorespiratory capacity and QoL of postmenopausal women.

MATERIAL AND METHODS

Study Design

This semi-experimental intervention study used a quantitative design, consisting of two groups submitted to different physical exercise methods, assessed in pre- and post-intervention tests in February and June 2017.

Volunteers

The study population was composed of postmenopausal women of advanced age and seniors. The subjects were part of an extension project aimed at disease prevention, in addition to maintaining and enhancing health, using different types of exercises, including resistance training (RT), Tai Chi Chuan (TC) and mat Pilates (MP), conducted in the morning at the Tucuruí Campus of Pará State University (UEPA) in Pará state (PA), Brazil.

The inclusion criteria were postmenopausal women aged ≥50 years, of any ethnicity (Caucasian, afro-descendants or indigenous). Excluded were those with chronic musculoskeletal problems, neurological disorders that would make it impossible to comply with the rules and commands, and surgery in the previous six months. Subjects that did not complete at least 75% of the protocol were excluded from analysis.

The result was a simple random sample selected by convenience. The initial sample was composed of 32 volunteers (16 in each group), but there was a sampling loss of four participants in the RT + MP group due to medical procedures. Thus, the final sample consisted of 28 volunteers in two groups: RT + TC (n = 16; age = 60.18±5.93 years; menopause age = 48.4±4.8 years) and RT + MP (n = 12; age = 59.83±5.0 years; menopause age = 45.3±6.63 years). All the subjects gave their informed consent before submitting to any procedure and underwent anamnesis.

Evaluation protocols

Anamnesis Questionnaire

The questionnaire contains general information about the participants, including: name; age; age at menopause onset; amount of time spent engaging in physical exercises, physical limitations, chronic diseases, surgeries and therapeutic drug use. All information was collected during interviews conducted by evaluators.

Anthropometric Evaluation

Body composition was evaluated by measuring the subjects' body weight, height and BMI ((Body Weight in kilograms)/ (Height in meters) ²) using a Welmy®CH110 (Brazil) anthropometric scale, certified by INMETRO (Brazilian regulatory body), with a capacity of 150kg and 100g intervals, with the volunteer barefoot, wearing light clothing, standing with heels together, and head positioned horizontally. Height was measured using a vertical anthropometer attached to the scale. The waist-hip ratio (WHR) was obtained by dividing waist circumference by hip circumference, both in centimeters (World Health Organization, 1995).

Functional Autonomy Assessment

The evaluation protocol of the Latin-American Group for Maturity Development (GDLAM), which assesses common daily activities (Dantas et al., 2014) was used. The tests include a 10-meter walk (10mW) to assess

walking speed; rising from a sitting position (RSP) to evaluate the functional capacity of the lower limbs; rising from a ventral decubitus position (RVDP) to assess the capacity of the individual to rise from the ground; sitting in, rising from, and walking around a chair (SRWC) to evaluate the elderly individual's agility and balance in everyday situations; and putting on and taking off a t-shirt (PTTs) to assess flexibility for everyday tasks. The test times were measured in seconds. The GDLAM index (GI) was calculated as follows:

$$GI: \frac{[\ (10mW+RSP+RVDP+PTTs)\ *2]\ +SRWC}{4}$$

Muscle Strength Assessment
The one-repetition maximum (1RM) prediction test was used for high shoulder adduction, elbow extension, low shoulder adduction, peck deck pectorals, elbow flexion, knee extension, knee flexion, 45º leg press, and horizontal leg press exercises on Physicus® equipment (Brazil). The number of repetitions varied between one and 10, and the "prediction factor" was used to calculate the 1RM result (Baechle & Groves, 1992).

Quality of Life Assessment
The Brazilian version of the QoL Short Form/SF-36 protocol was applied, which collects data on the subjects' daily routine. Three variables are scored; physical health, mental health and total QoL (Ciconelli et al., 1999).

Cardiorespiratory Capacity Assessment
A six-minute adapted version of the Cooper test was applied in a closed environment. The objective of the test is for subjects to walk as far as possible for six minutes on an even surface at their own pace (Rikli & Jones, 2008). In addition, the distance traveled was predicted according to body weight, height, age and reference value for sex: six-minute test distance prediction = 720.50 - (160*(women=1) - (5.14*age in years) - (2.23*weight in kg) + (2.72*height in cm) (Saad et al., 2009).

EXPERIMENTAL INTERVENTION

Concurrent Training (CT1): Linear Resistance Training (RT) and Tai Chi Chuan (TC)

Concurrent training 1 was carried out in the Resistance Training and Health Laboratory (LERES) and a sports facility at Para State University (UEPA), between 6:30 and 7:30 a.m. Before initial evaluations, the subjects were submitted to two weeks' adaptation to RT. The exercises were performed twice a week (Wednesday and Friday) for 16 weeks, alternating between one week of RT and one of TC.
Linear Resistance Training - CT1

Subjects were adapted to RT in the first two weeks and initial assessments took place in the third. Following the 1RM prediction test, exercise intensities in the three RT cycles were established linearly. Final assessments were conducted in the last week. A single series of 10-second stretches was used at the beginning and end of training. The periodization procedure is described in Figure 1, following the recommendations of ACSM (2014).

Tai Chi Chuan (TC) - CT1
The meetings were held twice a week (Wednesdays and Fridays) at the sports facility between 06:30 and 07:30 a.m. A Tai Chi Chuan master, experienced with older adults, conducted the training.

<table>
<tr><th colspan="16">LINEAR PERIODIZATION OF RT (RT+ TAI CHI)</th></tr>
<tr><th colspan="2">ADAPTATION</th><th>PRE TEST</th><th colspan="12">EXPERIMENTAL INTERVENTION</th><th>POST TEST</th></tr>
<tr><th>W1</th><th>W2</th><th>W3</th><th>W4</th><th>W5</th><th>W6</th><th>W7</th><th>W8</th><th>W9</th><th>W10</th><th>W11</th><th>W12</th><th>W13</th><th>W14</th><th>W15</th><th>W16</th></tr>
<tr><td colspan="2" rowspan="11">Learning exercises

Breath orientation

Progressive increase weight</td><td rowspan="11">1MR prediction

GDLAM tests

SF -36 Questionnaire

Cooper test (6min)</td><td colspan="4">1st cycle</td><td colspan="4">2nd cycle</td><td colspan="4">3rd cycle</td><td rowspan="11">1MR prediction

GDLAM tests

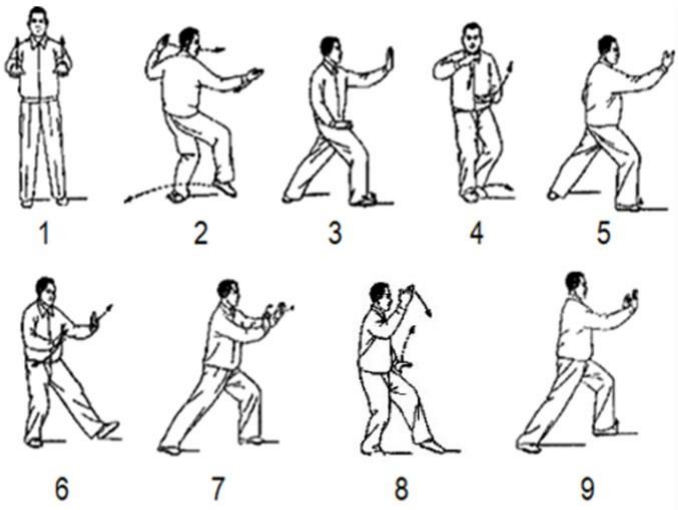
SF -36 Questionnaire

Cooper test (6min)</td></tr>
<tr><td colspan="4">60%-70%</td><td colspan="4">70%-80%</td><td colspan="4">80%-90%</td></tr>
<tr><td colspan="12">3 sets</td></tr>
<tr><td colspan="4">12-15 repetitions</td><td colspan="4">10-12 repetitions</td><td colspan="4">8-9 repetitions</td></tr>
<tr><td colspan="12">30" -40" rest between sets and exercises</td></tr>
<tr><td colspan="12">2/sessions alternating weekly with Tai Chi Chuan</td></tr>
<tr><td colspan="12">1- High Shoulder Adduction
2- Elbow Extension
3- Low Shoulder Adduction
4- Peck Deck Pectorals
5- Elbow Flexion
6- Knee Extension
7- Knee Flexion
8- Leg Press at 45°
9- Horizontal Leg Press</td></tr>
<tr><td colspan="12">Total Session: 60 minutes</td></tr>
</table>

Note: W=Week

Figure 1. Resistance training periodization 1 - Linear

The Beijing 24 form, derived from the Yang style, was the TC routine used. It is characterized by slow smooth movements whose primary focus is the harmonious cultivation of mind, body and spirit (Wang et al., 2004). This style was adapted and only nine forms were used. A subjective effort face scale varying from light to exhausting was applied to control intensity (Costa et al., 2004). The classes were divided into three periods: 1- start: five minutes of breathing exercises; 10 minutes of “holding-the-tree”; 10 minutes of “tiger stepping”; 2- middle: 30 minutes to develop forms (movements), and 3- end: five minutes of breathing exercises. TC periodization is explained in Figure 2.



EXPERIMENTAL INTERVENTION OF TAI CHI											
W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
1st cycle				2nd cycle				3rd cycle			
Low				Low				Moderate			
one set											
The movements were coordinated according to the breath											
2/sessions alternating weekly with RT											
1-Starting 2- Repulse monkey 3- Brush knee 4- Hold the ball 5- Parting the wild horse's mane 6- Grasp the bird's tail 7- Press 8- White crane spreads it's wings 9- Open up and push											
Total Time Session: 60 minutes											

(A) **(B)**

Note: W=Week

Figure 2. (A) - The nine TC forms used in the study, adapted from the 24 forms. (B) - Periodization cycles with the nomenclature of Beijing style movements

Concurrent Training (CT2): Non- Linear Resistance Training (RT) and Mat Pilates (MP)

Concurrent training 2 was also carried out at the LERES and the UEPA multiple activity room from 07:30 to 09:00 a.m. Subjects were also submitted to two weeks of RT adaptation. Training sessions were held five times a week (Monday to Friday), RT on Mondays, Wednesdays and Fridays, and MP on Tuesdays and Thursdays, for a period of 16 weeks.

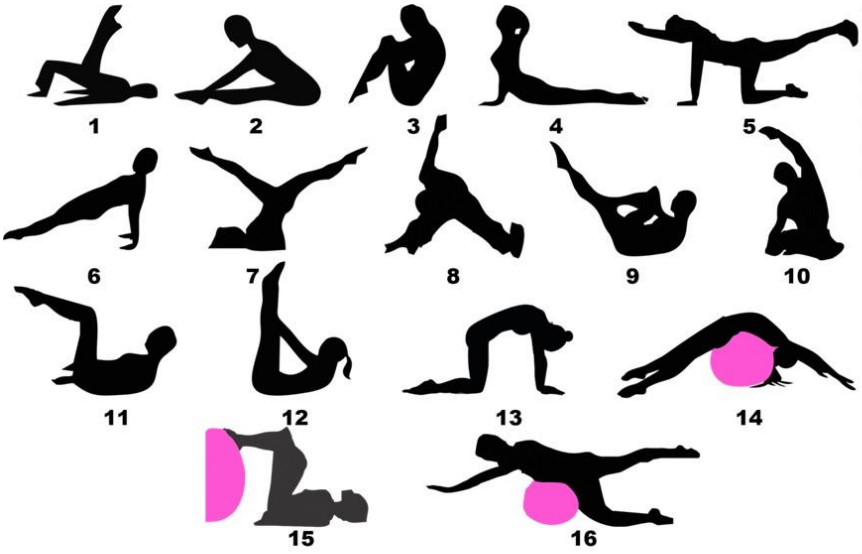
Non- Linear Resistance Training - CT2

Cycle intensities were established after the 1RM prediction test. In this program, RT was non-linear, where intensities were divided into three cycles, since the number of repetitions complied with intensity and volume recommendations (American College of Sports Medicine, 2014). One 10-second series of stretching exercises was used at the beginning and end of training (American College of Sports Medicine, 2014; Matveev, 1991). Figure 3 shows non-linear RT periodization.

NON-LINEAR PERIODIZATION OF RT (RT+MP)															
ADAPTATION		PRE-TEST		EXPERIMENTAL INTERVENTION										POST TEST	
W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16
Learning exercises Breath orientation Progressive increase weight		1MR prediction GDLAM tests SF -36 Questionnaire Cooper test (6min)		1st cycle				2nd cycle				3rd cycle		1MR prediction GDLAM tests SF -36 Questionnaire Cooper test (6min)	
				65%-55%-70%				70%-60%-70%				80%-75%-85%			
				3 sets				2 sets				2 sets			
				12-18/15-20/10-15 repetitions				10-15/15-20/10-15 repetitions				6-10/10-15/5-7 repetitions			
				30" -40" rest between sets and exercises											
				3 sessions/ week											
				1- High Shoulder Adduction 2- Elbow Extension 3- Low Shoulder Adduction 4- Peck Deck Pectorals 5- Elbow Flexion 6- Knee Extension 7- Knee Flexion 8- Leg Press at 45° 9- Horizontal Leg Press										
				Total Session: 60 minutes											

Note: W=Week

Figure 3. Resistance training periodization 2 - Non-Linear (wavy)



(A)

EXPERIMENTAL INTERVENTION OF MP									
W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
1st cycle				2nd cycle				3rd cycle	
Low				Medium				Moderate	
2 - 4 sets									
8 -16 repetitions or 15 -20 seconds static									
2/sessions alternating weekly with RT									
1-Sholder Bridge 2- Spine Stretch 3- Rolling Back 4- Swan Dive 5- Quadruped 6- Leg Pull Back 7- Scissors 8- The Saw 9- One Leg Stretch 10- Mermaid 11- Hundred 12- The Double Leg Stretch 13- Cat 14- High Bridge 15- Glute Stretch 16- Quadruped on the ball									
Total Session: 45 minutes									

(B)

Note: W=Week

Figure 4. (A) - The 16 MP exercises selected. (B) - Periodization cycles with the nomenclature of Mat Pilates movements

Mat Pilates (MP) - CT2

The subjects were divided into two 45-minute classes, beginning at 07:30 a.m. and 08:15 a.m. respectively. Mat Pilates consisted of stretching and strength exercises, based on Joseph Pilates' principles (Pilates, 2010). In the first two weeks, individuals learned the following six basic principles through the exercises: concentration, breathing, control, accuracy, fluidity of movement and centralization. These principles were reviewed at the end of the two-week period (Pilates, 2010). In addition to the ground exercises, 55-cm Torian All Sports® Swiss balls were used and a subjective effort face scale to control intensity (Costa et al., 2004).

The training classes were divided into three periods: 1- start: five minutes of breathing exercises; 2- middle: 35 minutes for exercise development, and 3- end: a five-minute rest period. Figure 4 illustrates the exercises and periodization of the method used in the present study.

Research ethics

The subjects were informed of the aims, procedures and voluntary nature of their participation in the study, and those who agreed with the terms gave their informed consent, in accordance with resolution 510/16 of the National Health Council for experiments with human beings (World Medical Association, 2008; Brazil, 2016). The research was approved by the ethics committee of the Universidade Federal do Rio de Janeiro (Federal University of Rio de Janeiro) in partnership with UEPA, Tucuruí Campus, under protocol number 0050/2011.

Statistical analysis

Analyses were conducted using BioEstat 5.3® software, and the significance level was set at $p<0.05$. All variables were expressed as means, medians and standard deviations. The Shapiro-Wilk test of normality was carried out and depending on the result, the T-test to analyse baseline data, in addition to repeated measures 2x2 mixed factorial ANOVA and Tukey's post hoc test for intra and intergroup comparisons. The $\Delta\%$ was calculated using the following formula: $\Delta\% = [(\text{post-test} - \text{test}) * 100/\text{test}]$.

RESULTS

Table 1 presents intergroup comparisons of the descriptive data, expressed in average values and standard error at baseline.

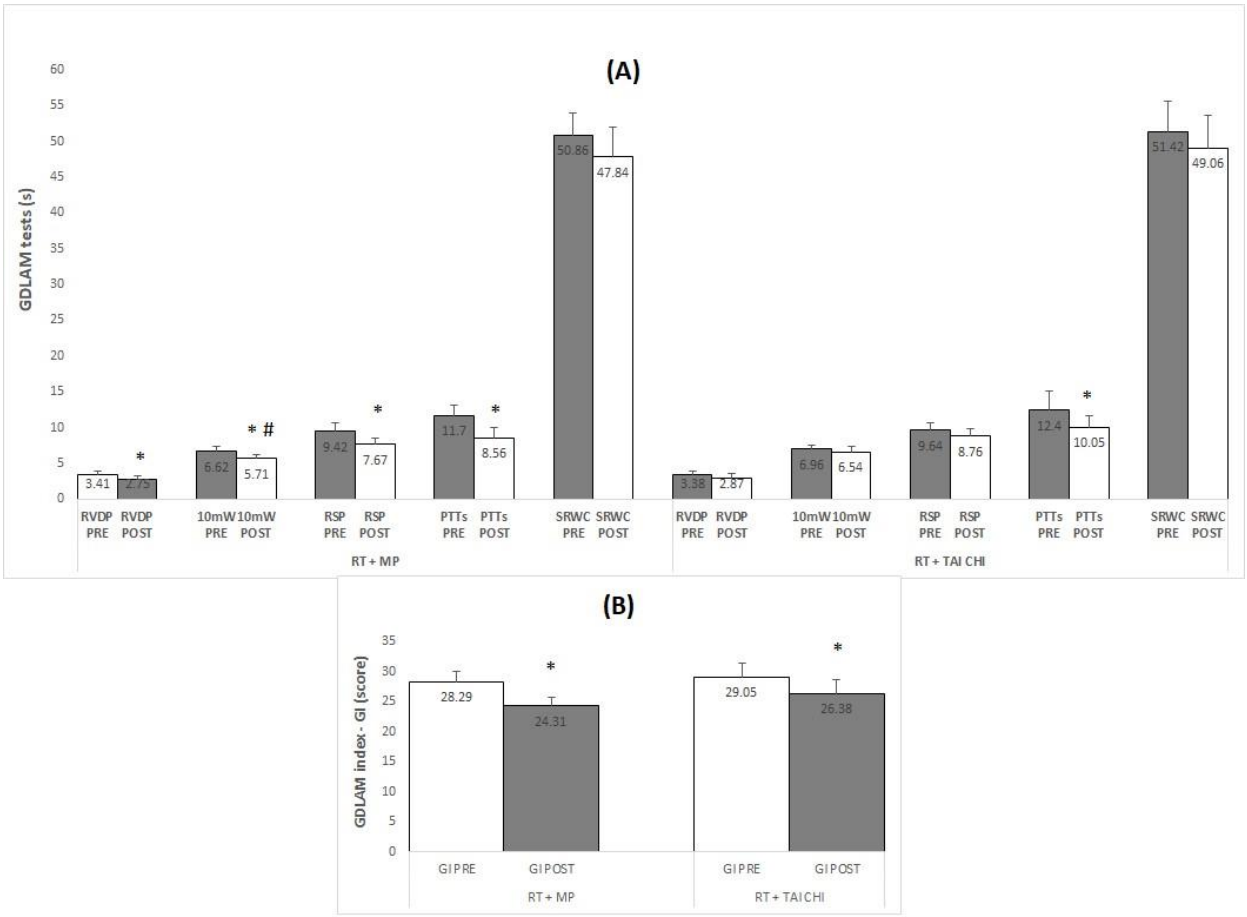
Table 1. Descriptive data compared to baseline

Groups	RT+TC, n=16		RT+MP, n=12		
Variables	Average	Standard error	Average	Standard error	p-value
Age (years)	60.18	1.48	59.83	1.44	0.868
Age of menopause (years)	48.68	1.21	45.75	1.95	0.192
Body mass (kg)	70.62	3.68	68.87	3.2	0.731
Height (m)	1.5	0.01	1.52	0.01	0.503
BMI (score)	30.97	1.35	29.72	1.22	0.514
WHR (score)	0.81	0.02	0.87	0.02	0.175
Cooper test 6min (m)	605.78	15.8	613.68	15.7	0.732
Cooper prediction test (m)	510.28	9.7	513.26	11.4	0.844
RVDP (s)	3.37	0.14	3.41	0.13	0.857
RSP (s)	9.64	0.25	9.41	0.34	0.599

10mW(s)	6.95	0.15	6.61	0.19	0.171
SRWC (s)	51.42	1.05	50.86	0.89	0.700
PTTS (s)	12.4	0.68	11.69	0.39	0.379
GI (score)	29.04	0.56	28.28	0.49	0.340
High Shoulder Adduction (kg)	28.66	1.08	35.01	1.67	**0.002**
Elbow Extension (kg)	28.7	1.43	33.1	1.64	0.055
Low Shoulder Adduction (kg)	34.2	1.6	38.1	1.56	0.102
Peck Deck Pectorals (kg)	22.6	1.88	25.8	1.59	0.225
Elbow Flexion (kg)	27.59	1.19	33.6	1.33	**0.002**
Knee Extension (kg)	41.9	4.03	43.7	3.35	0.750
Knee Flexion (kg)	12.8	1.51	10.7	3.35	0.349
Horizontal Leg Press (kg)	61.35	4.54	60.74	3.8	0.923
45º Leg Press (kg)	109.14	10.57	120.2	9.75	0.463
PH (score)	72.56	2.62	72.83	2.6	0.943
MH (score)	78.68	3.11	79.75	2.57	0.803
Total QoL(score)	77.06	2.65	79.91	2.27	0.441

BMI- body mass index; WHR- waist-hip ratio; RVDP- rising from a ventral decubitus position; RSP- rising from a sitting position; 10mW- 10 meters walk; SRWC- sitting in, rising from, and walking around a chair; PTTS-putting on and taking off a t-shirt; GI-GDLAM index; PH- physical health; MH- mental health; QoL- quality of life. Bold numbers indicate a value of p<0.05.

Figure 5 shows the inter and intragroup comparisons for the functional autonomy and GDLAM index tests. For concurrent training RT+MP intragroup analysis, RVDP, 10mW, RSP, and PTT showed significant improvement in the post-tests, while for RT+TC, only the 10mW test improved. Intergroup analysis revealed that RT+MP obtained better results in the 10mW test. However, the GDLAM Index (GI) results improved significantly for both programs in the post-tests.



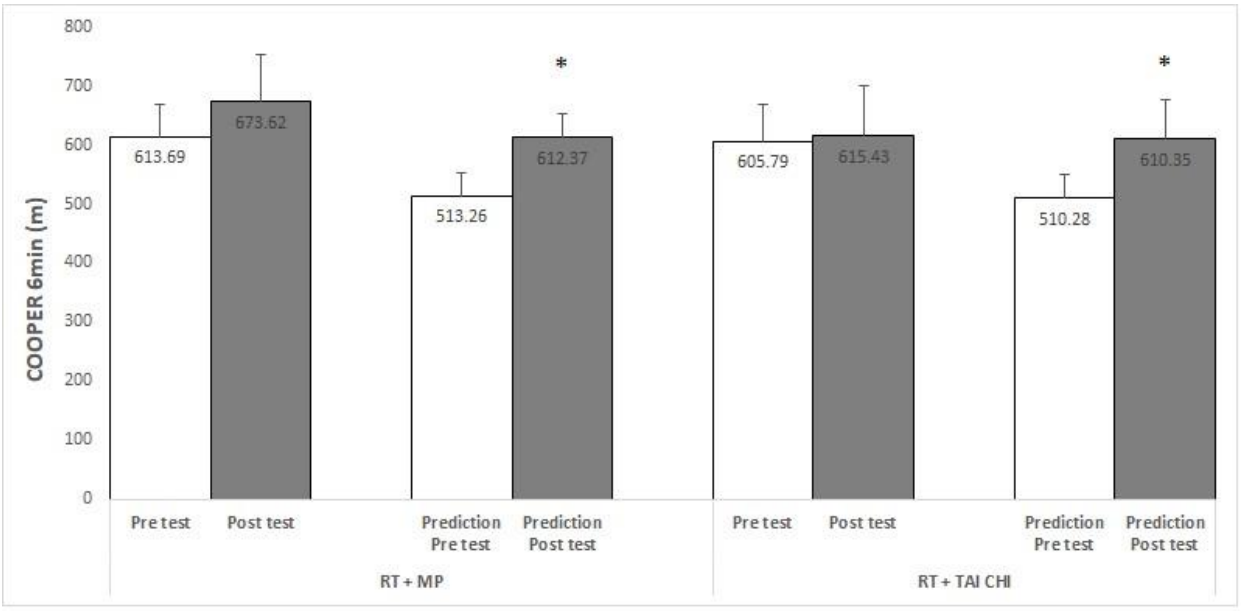
*Note: * p<0.05 for pre vs. post; # p<0.05 for post RT + MP vs. post RT + TC*

Figure 5. Functional Autonomy. (A) GDLAM protocol tests. (B) GDLAM index

With respect to walking performance, a pre and post 6-minute Cooper test was applied, in addition to the prediction test (Figure 6). This test considers the variables age, weight, height and sex in the prediction. RT+MP and RT+TC showed statistical improvement only for the predictions, although the subjects performed better on the test compared to predicted values.

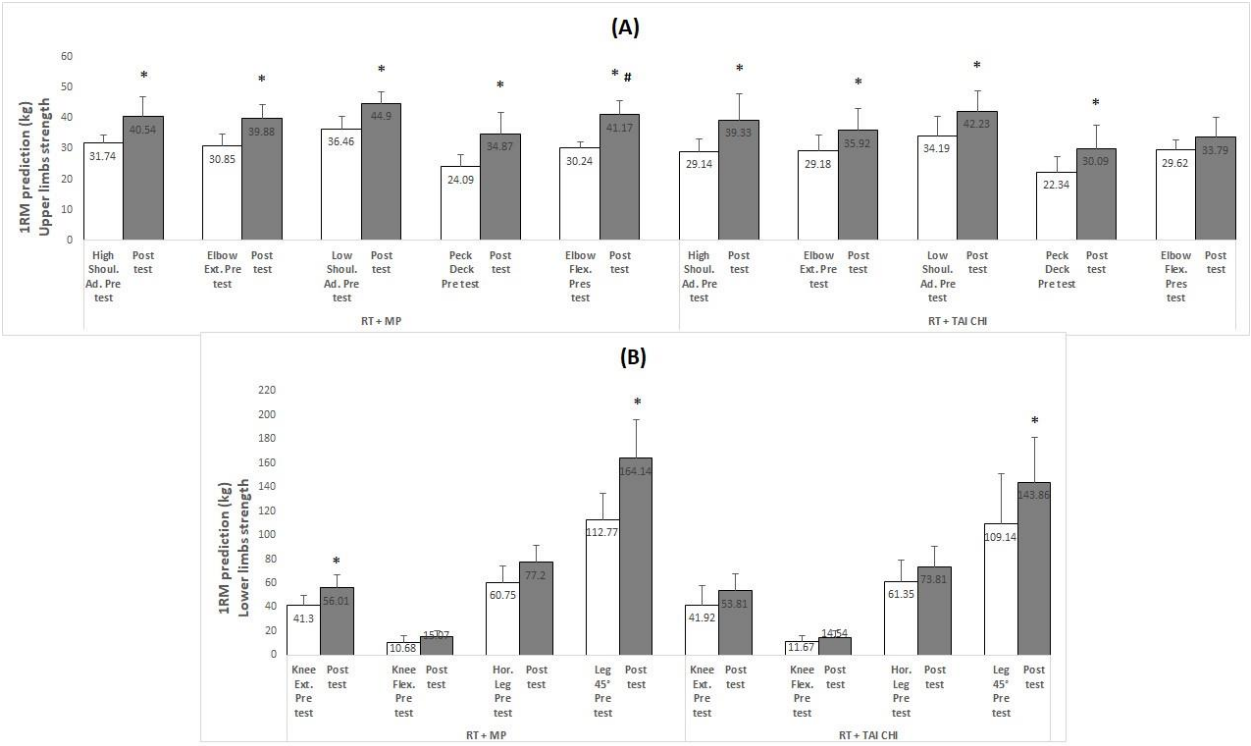
Intragroup upper limb strength was significantly better for all RT+MP and RT+TC exercises, except for elbow flexion in the latter. In relation to lower limb strength, RT+MP showed improvements for knee extension and 45° leg press exercises and RT+TC only for 45º leg press. Intergroup analysis showed an improvement in the elbow flexion exercise for RT+MP (Figure 7).

The SF-36 QoL questionnaire (Figure 8) shows the results of three variables: physical health (PH), mental health (MH), and total QoL. Only RT+MP obtained statistically significant intragroup improvements in physical health.



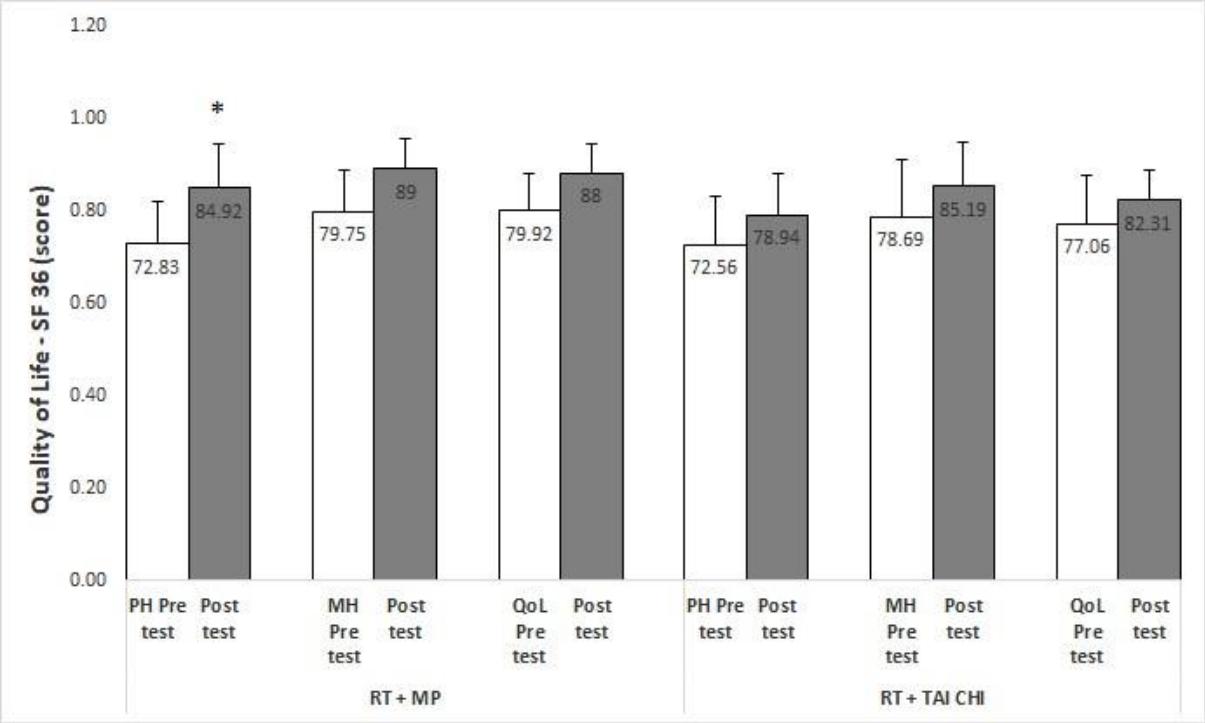
Note: (*) indicates statistical intragroup improvement

Figure 6. Cardiorespiratory capacity. Cooper and prediction tests



*Note: *p<0.05 for pre vs. post; # p<0.05 for post RT + MP vs. Post RT + TC*

Figure 7. Muscle Strength. (A) Upper limb strength results (B) Lower limb strength results



Note: (*) indicates statistical intragroup improvement

Figure 8. Quality of Life. Quality of life assessment

DISCUSSION

Maintaining and improving the variables evaluated in this study is important for older women since they help repair and/or delay declining performance due to menopause and aging, in terms of flexibility, dynamic and recovered balance, gait speed, muscle power, agility, muscle strength, among other variables that contribute to good QoL with independence (Romo-Pérez et al., 2011; Tairova & Lorenzi, 2011). They provide an increase in muscle mass, thereby contributing to the management of sarcopenia, maintain bone mass, reduce the risk of falls and cardiovascular disease, and enhance socialization (World Health Organization, 2012; American College of Sports Medicine, 2014). They also reduce uncomfortable menopausal symptoms characterized by progressive hypoestrogenism. As such, there is a need to organize and plan training by applying methods that control volume and intensity, combining different types of exercises that benefit the health of individuals, as shown by the methodology used in the present study (American College of Sports Medicine, 2014).

The results obtained here demonstrated benefits in both groups. With respect to functional autonomy, RVDP, 10mW, RSP, and PTT improved in the RT+MP group ($p<0.05$), while the RT+TC group improved only in the 10mW. RT+MP also performed better than RT+TC in the 10mW test (Figure 5), possibly due to their higher training volume. The results of the present study corroborate those of other research that evaluated this variable, such as the study by Melo et al. (2004), who found improvements in the functional autonomy of seniors who engaged in TC, compared to a sedentary group. Rezende et al. (2015) observed that sensory-motor training improved the results of all the GDLAM protocol tests in elderly women when compared to the control group. A study by Silva & Borba-Pinheiro (2015) found that linear RT was effective for postmenopausal women in all the tests of the same functional autonomy protocol. According to Reche-

Orenes & Carrasco (2016), the Pilates method improves isometric hip strength and balance in the elderly. Mendes et al. (2015) found that MP three times a week for 16 weeks improved the functional autonomy of elderly women. This finding corroborates the results obtained here, which showed improvements in the study variables, especially for the RT+MP group.

Although the cardiorespiratory capacity results, as measured by the six-min Cooper test, were not statistically significant, there average of both groups showed an increasing trend. Moreover, the protocol prediction showed statistically significant results ($p<0.05$) for both training programs (Figure 6). Pestana et al. (2013) found a significant improvement in walking and balance for the MP and RT groups. The study by Sukson et al. (2011) reinforces the importance of developing aerobic capacity, given the positive effects on overall fitness observed in an aerobic endurance and muscle strength group and another that engaged in TC 24 forms for 12 weeks, showing better results for the former. In the present study, both the walking and prediction tests exhibited statistically significant improvements (Figure 6).

In regard to muscle strength, the RT+MP group improved ($p<0.05$) in all of the upper and lower limb exercises. Similar results were obtained by the RT+TC group, where only the elbow flexion exercise did not statistically improve. The fact that intergroup analysis showed better results in the elbow flexion exercise for the RT+MP group ($p<0.05$) than those of their RT+TC counterparts (Figure 7) is not significant because this exercise already exhibited a difference at baseline (Table 1). Other research has also demonstrated improved strength in seniors who exercised regularly (Pereira et al., 2008; Silva & Borba-Pinheiro, 2015).

Silva & Borba-Pinheiro (2015) reported improvements in the upper and lower limb strength of elderly women submitted to linear RT for six months. According to Pereira et al. (2008), lower limb strength, balance and flexibility improved in elderly individuals who engaged in TC 24 form three times a week, for 12 weeks compared to the control group. In another study that combined two RT and one swimming session per week for nine months, lower and upper limb strength also improved ($p<0.01$) (Cepero-González et al., 2012). It is important to underscore that the adapted TC nice forms used here also improved muscle strength. Both exercise programs (RT+MP and RT+TC) increased the muscle strength of elderly women. Other training programs involving aerobic exercise, RT and TC also reported positive results (Takeshima, 2004; Lopes et al., 2014; Concha-Cisternas et al., 2017) over the same period as that used in the present study.

In relation to QoL, although both groups showed improvement, only the physical health variable of the RT+MP group was statistically significant (Figure 8), which may be explained by the fact that this group underwent a higher training volume. In studies with alternative exercise programs, QoL also improved, as shown by Wang et al. (2008), who assessed knee osteoarthritis-related pain, finding improvements in all variables after 12 weeks of TC 10 form adapted from the Yang style. Another study Tozim et al. (2014) evaluated the influence of eight weeks of MP on flexibility, pain, and the QoL of seniors. The results showed improved flexibility, reduced pain intensity and maintenance of QoL in the MP group when compared to controls.

In addition to the aforementioned improvements, menopause symptoms also benefitted (Lopes et al., 2014) in terms of the following: pain, overall health, mental health and perceived QoL of postmenopausal women who engaged in aerobic and resistance exercise three times a week. Tairova & Lorenzi (2011) assessed the influence of physical activity on the menopause symptoms and QoL of two groups, one sedentary and the other engaged in aerobic exercises, the latter exhibiting improvements in psychological, genitourinary and sexual symptoms, as well as cardiorespiratory capacity. Although the present study did not evaluate menopause symptoms, the fact that subjects were at the age of menopause (Table 1) and the positive health

results, particularly in the RT+MP group (Figure 8), suggest that physical exercise helps control the unpleasant symptoms of the climacteric period (Tairova & Lorenzi, 2011).

The present study presented innovative exercise methods (Figures 1 and 3). In method 1, RT had a lower volume and linear intensity in association with TC. In method 2, RT had a higher volume and non-linear intensity in association with MP, both conducted over a 16-week period. Resistance training, which controls volume and intensity, and has proven to be highly effective in improving health variables, was associated with methods that do not provide effective control because they feature subjective aspects of volume and intensity. However, the latter methods can increase motivation and adherence to exercise programs in older adults. Moreover, our study demonstrated that different exercise methods can be combined to improve physical and mental health, in addition to increasing motivation and adherence to exercise programs.

The scientific literature reinforces the need to consider combined exercise programs, given the demonstrated improvements in the overall physical aptitude, functional autonomy and QoL of seniors (Farias et al., 2014; Gambassi et al., 2017; Guedes et al., 2016), similar to those of the present research, even though training volumes were different. The findings suggest that new strategies be adopted to improve the multiple variables of postmenopausal women's health, using methods with alternative exercises that can generate more interest and motivation for people to initiate or continue engaging in physical exercises.

Primary elderly health care is a priority of the Brazilian federal government, which seeks to promote an active lifestyle, functional autonomy and QoL through physical activities in order to achieve the independence needed for healthy aging (American College of Sports Medicine, 2014; Brazil, 2012). The recommendations proposed by World Health Organization (2012) involve at least 150 minutes of moderate or 75 minutes of vigorous aerobic activity a week, or a combination of both. For elderly with mobility problems, a minimum of three days of physical activity a week is indicated for balance and fall prevention, and at least two days of strength exercises for the large muscle groups (World Health Organization, 2012).

The results presented here reinforce the scientific evidence and official health guidelines with respect to mitigating the effects of declining health in the climacteric period. In addition, methodologies should consider a training program involving both physical and mental health variables that also improve social interaction and cardiorespiratory function, and reduce the risk of falls, depression and chronic non-communicable diseases (Romo-Pérez et al., 2011; World Health Organization, 2012; American College of Sports Medicine, 2014).

CONCLUSION

We were unable to confirm that RT+MP with a higher exercise volume is superior to RT+TC for the health variables evaluated. However, both methods obtained good results and can be recommended as alternative exercise for training programs emphasizing the health of postmenopausal women. The RT+MP group with a higher volume tended to perform better, especially in relation to intergroup results. These findings suggest possible benefits for sarcopenia management with an increase in the Insulin Growth Factor (IGF-1), thereby improving flexibility and the endothelial metabolism that protects against cardiovascular diseases, in addition to favoring brain neuroplasticity as a protective factor for mental health. New studies with larger samples, different performance and health variables and the inclusion of a control group are recommended.

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