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QUALITY OF LIFE RESEARCH

Pilates method in personal autonomy, static balance and quality of life of elderly females

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Pilates;
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Summary *Objective:* The aim of this study was to evaluate the effects of the Pilates method on the personal autonomy, static balance and quality of life in healthy elderly females.
Method: Fifty-two elderly females were selected and submitted to evaluation protocols to assess functional autonomy (GDLAM), static balance (Tinetti) and quality of life (WHOQOL-OLD). The Pilates group (PG: $n = 27$) participated in Pilates exercises twice weekly for eight weeks. Descriptive statistics were compiled using the Shapiro–Wilk test. The level of significance was considered to be $p \leq 0.05$.
Results: The dependent Student-*t* test demonstrated significant post-test differences in the Pilates group in the following areas balance ($\Delta\% = 4.35\%$, $p = 0.0001$) and General Index of GDLAM ($\Delta\% = -13.35\%$, $p = 0.0001$); the Wilcoxon test demonstrated significant post-test differences in the quality of life Index ($\Delta\% = 1.26\%$, $p = 0.0411$).
Conclusion: The Pilates method can offer significant improvement in personal autonomy, static balance and quality of life.

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Introduction

The aging process involves a series of degenerative, gradual and irreversible alterations of body systems culminating in complete loss of function (Matsudo et al., 2000). These alterations can cause losses of strength, flexibility, balance, coordination and memory, leading to considerable losses of personal autonomy and quality of life for elderly people (Heathcote, 2000; Rogatto and Gobbi, 2000).

Loss of balance represents a significant difficulty in the lives of elderly people characterized by reduced postural control in dynamic and static situations and increased risk of falls and injuries (Montes-Castillo, 2006). This deficit has direct consequences for personal and functional autonomy related to individual capacity to complete daily activities, control will and feelings and hide physical and/or mental limitations (Heathcote, 2000; Dantas et al., 2004).

Functional limitations due to age affect the capacity of each individual to carry out their activities and present direct challenges to well-being and quality of life for elderly people (Rebelatto et al., 2006; Siren and Hakamies-Blomqvist, 2009). Quality of life is a subjective concept, although it can be understood as a measure of perfect physical, psychic and social well-being (Minayo et al., 2000).

Several studies have been developed to examine the importance of health quality in old age. Many of them have emphasized the importance of physical activity or mobility as a way of improving organic conditions and slowing physical degeneration. (May, 2003; Kura et al., 2004; Pieron, 2004).

Pilates consists of a physical exercise that uses resources such as gravity and the resistance of springs, either to resist or assist movement execution (Gagnon, 2005). It aims to prevent automatic movements, which are responsible for unwanted muscle activity that can cause injuries (Petrofsky et al., 2005).

According to Anderson and Spector (2000), Pilates encouraged the importance of proprioceptive stimulation for motor learning improvement using the powerhouse exercise (transversus abdominus, obliques, and multifidi muscles) and repetition of correct movement to achieve the training standard, leading to a better motor performance and less risk of injuries.

Pilates practice can be divided in phases: assistive movement (to inhibit improper muscles actions), disassociation, stabilization, mobilization, dynamic stabilization and functional reeducation (Anderson and Spector, 2000).

Pilates method has been studied in relation to its effects on personal autonomy (Johnson et al., 2007), posture (Blum, 2002; Kaesler et al., 2007), pain control (Gladwell et al., 2006), improved muscle strength (Schroeder et al., 2002), flexibility (Segal et al., 2004) and motor skills (Lange et al., 2000); its effects in these areas have been proven.

New research is needed on the Pilates method as a mechanism for the prevention and treatment of geriatric disorders. Thus, the aims of this study are to analyze the effects of the Pilates method on the personal autonomy, static balance and quality of life of healthy elderly females.

Methods and procedures

Samples

Fifty-two volunteer participants were selected by a simple random sampling. They were randomly divided by lottery into two groups: twenty-five in the control group (CG) and twenty-seven in the age-matched Pilates group (PG). They were all women, aged 60—78 years (66 ± 4 years), with a height average of 1.55 (±0.06), weight of 62 (±14.12) and body mass index of 25.8 (±5.64), participants of an Occupational Therapy group (twice weekly), sedentary for at least six months and none had been through a Pilates class before.

All participants met the inclusion criteria, which included the following: capacity to carry out activities of daily living without physical support, physical aptitude for the practice of Pilates exercises, and no practice of any other type of physical activity during the study period. They also failed to meet the following exclusion criteria: pathologies that could cause physical limitations or that interfered with the functions of attention, understanding and cognition, and use of medication for the treatment of bone, muscle or joint injuries. All participants were required to complete the entire intervention program.

All subjects gave their written consent according to the Regulations Governing Research on Human Subjects of (WMA, 2002), and this study was approved by the Institutional Ethics Committee under protocol number 0050/2008 — UCB/VREPGE/COMEP/PROCIMH. This research does not pose physical or psychological risks to participants, and all of the ethical rules of identity and image confidentiality were respected.

Procedures

For the evaluations, the following equipment was used: a mechanical adult scale with a capacity of 330.7 lb (Instituto São Paulo/SP), a stopwatch with 30-lap memory (SL210 Oregon), a shirt (Hering® size X), two obstacles to turn and one chair without arms (50 cm height).

Both groups were submitted to a general evaluation of personal autonomy, static balance and quality of life. Personal autonomy was evaluated through the Latin American Development Group for Elderly (GDLAM) protocol (GDLAM, 2004), which consists of tests including 10 m walks (C10 m) (Spilá et al., 1996), standing up (LPS) (Guralnik et al., 1994), putting on and to taking off a shirt (VTC) (Vale et al., 2006) rising from the prone position (LPDV) (Alexander et al., 1997) and rising to walk through the house (LCLC) (Andreotti and Okuma, 1999). From the results of these tests, GDLAM (IG) is obtained, which represents the final test scores (Dantas et al., 2004).

Balance was evaluated by the Tinetti test (Tinetti, 1986), wherein a source of mobility guides test performance that is specific for static balance.

Quality of life was evaluated by the WHOQOL-OLD, the version for the elderly of World Health Organization's quality of life questionnaire. It is comprised of twenty-four questions, divided into six domains, as follows: DOM1, sensory abilities; DOM2, autonomy; DOM3, past, present

and future activities; DOM4, social participation; DOM5, death and dying; and DOM6, intimacy (Fleck et al., 2006).

Pilates intervention program

After initial evaluation, the PG began the intervention, which consisted of practicing the Pilates method using a Bobath ball and the Cadillac, Wall Unit, Combo Chair and Reformer devices made by Metacorpus Pilates Studio® (RJ/Brazil). They voluntarily performed Pilates practice in a private clinic (Belém-Pará-Brazil).

The subjects were supervised by a physical therapist certified as a qualified Pilates method instructor (Brazil). An explanation about Pilates and the apparatus was given to the subjects, as well as a practical demonstration of each exercise before they began their intervention. The same instructor taught all sessions, with the assistance of three volunteers at each session ensuring quality of supervision.

The session was divided into the following stages: initial global stretching (10 min), a general conditioning (40 min) and relaxation (10 min), in accordance with protocols used in other studies (Lord et al., 1996; Barnett et al., 2003; Kaesler et al., 2007).

The initial global stretching included two exercises:

1. Hamstring stretch (Combo Chair): standing tall position, feet apart, straight legs. Press through hands to push pedal down. Slowly control pedal return through trunk extension (Figure 1).
2. Mermaid (Reformer): sit tall, legs on table, one hand on foot bar. Pull foot bar and perform an arm arc over head (Figure 2).

For exercise 1 two springs of 81 kilogram force/meter (kgf/m) were used, and for exercise 2 one spring of 24.4 kgf/m and one of 10 kgf/m were used.

The general conditioning phase included eight exercises:

3. Arms up and down (Reformer): supine position, pelvis neutral, hips flexed in 90 degrees. Holding the reformer handles, perform flexion and extension of both shoulders (Figure 3).

Figure 1 Hamstring stretch.

Figure 2 Mermaid.

4. Arms by the side (Cadillac/Wall Unit): standing tall position, pelvis neutral. Holding the spring handle, perform abduction and adduction of a shoulder (Figure 4).
5. Arms up and pull down (Cadillac/Wall Unit): supine position, straight legs, pelvis neutral. Holding the bar, perform flexion and extension of both elbows (Figure 5).
6. Supine lower leg series (Cadillac/Wall Unit): with foot caught in the handle, pelvis neutral, lift the leg up and down (flexion and extension of hip) (Figure 6).
7. Leg series on side, up and down (Cadillac/Wall Unit): lying on side, pelvis neutral, under leg in hip and knee flexion. With foot caught in the handle, lift the leg up and down (abduction and adduction of hip) (Figure 7).
8. Footwork toes and heels (Reformer): supine position, pelvis neutral. Firstly toes in foot bar, than heels in foot bar. Perform knees flexion and extension (Figure 8).
9. Sit ups (Cadillac/Wall Unit): supine position, pelvis neutral, straight legs. Pull the Cadillac/Wall Unit tower bar up and sitting using abdominal muscles (Figure 9).
10. Gluteus and trunk raises (Cadillac/Wall Unit): supine position, neutral pelvis, arms besides body, legs above a Bobath Ball (55 cm). Perform gluteus and trunk raises from table (Figure 10).

For exercises 3, 4, 6 and 7 springs of 8.3 kgf/m were used; for exercise 5 two springs of 10 kgf/m were used; for

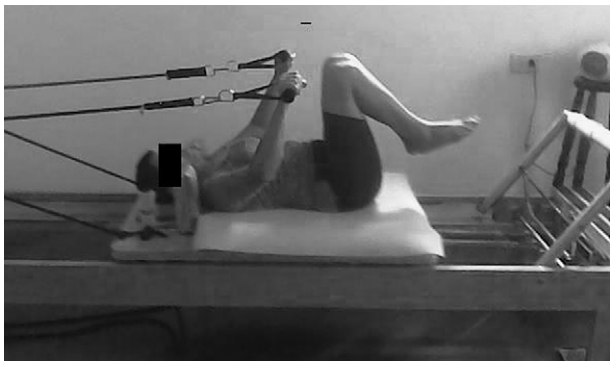


Figure 3 Arms up and down.

Figure 4 Arms by the side.

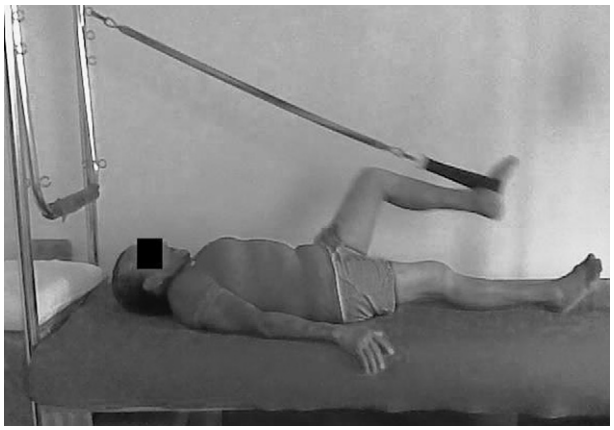


Figure 6 Supine lower leg series.

exercise 8 springs of 29.8 kgf/m were used; for exercise 9 and 10 only gravity was employed.

The springs used were the same for all the volunteers, however, to work on individual needs, adjustments were made to the angle in which they were inserted in the apparatus, in order to provide greater or lesser resistance, according to the physical capacity of each subject. The maximum angle chosen was the one that allowed the subject to achieve total range of motion.

The implementation of exercise followed the principles of Pilates. The subjects were taught by the instructor to inhale through their nose during relaxation and gently exhale through the mouth during the movement. Thus, the movements were performed slowly, at the individual's own pace. Each exercise was performed for a maximum of ten repetitions.

The intervention occurred during a period of eight consecutive weeks, with frequency of two weekly and each session lasted 1 h, according to the protocol used by Kaesler et al. (2007).

After the intervention, all the participants (PG and CG) were re-evaluated and the tests were compared. The control group was not submitted to any kind of intervention.

Statistical treatment

The descriptive analysis was carried out by calculating mean, median, standard error and standard deviation. For the normal distribution analysis, the sample Shapiro—Wilk test was used. The statistical comparison method for variables was the paired Student-*t* test or the Wilcoxon test (intragroup) and ANOVA 2×2 or Kruskal—Wallis (intergroup), followed by the Post Hoc de Shefeé or Mann—Whitney tests, respectively. For all hypothesis tests, the alpha level for significance was 0.05 for rejection of the null hypothesis, as previously defined. Microsoft Excel 2007 and the BioEstat 5.0 statistical package (Ayres et al., 2008) were used to analyze data.

Results

Table 1 presents the descriptive and inferential analysis of the sample's static balance (Tinetti) using Shapiro—Wilk test. Notably, the PG shows a heterogeneous distribution of data ($p < 0.05$).

The Graph 1 presents the absolute Δ values. The Wilcoxon test demonstrated significant difference ($p < 0.05$) in the PG's balance ($p = 0.0001$). According to Mann—Whitney test in the intergroup comparison, a difference in baseline was found of $p = 0.0626$. The PG had significant improvement in post-test relation ($p = 0.0002$).

The descriptive and inferential Shapiro—Wilk analysis of the sample's personal autonomy is displayed in Table 2. PG shows a heterogeneous data distribution ($p < 0.05$) in the

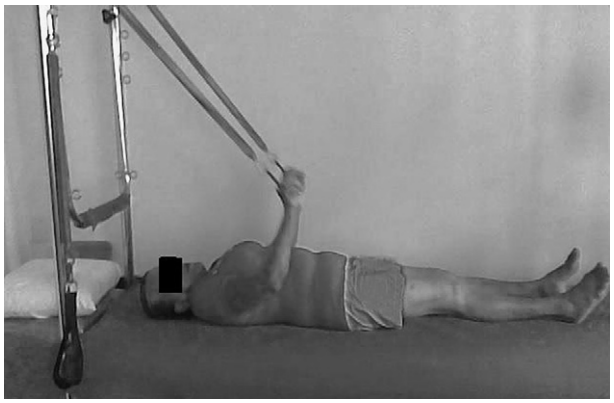


Figure 5 Arms pull up and down.

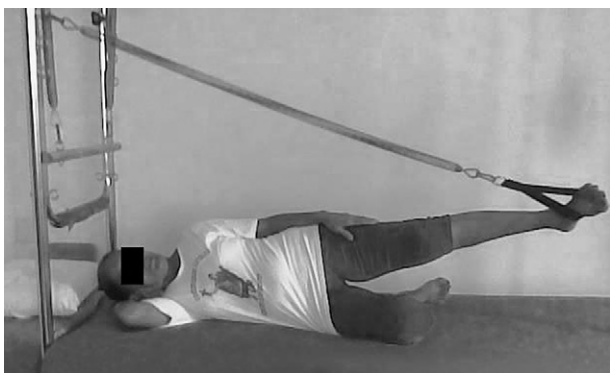


Figure 7 Leg series on side, up and down.

Figure 8 Footwork for toes and heels.

C10M, LPDV, and LCLC variables and in IG score; whereas in the CG the only heterogeneously distributed variable was VTC.

Graph 2 shows absolute Δ values of the PG and CG in relation to IG. In the intergroup comparison the baseline equivalence was observed and the post-PG × post-CG significant differences were observed in all tests, namely: C10m ($p = 0.0103$); LPS ($p = 0.0164$); LPDV ($p = 0.0001$); VTC ($p = 0.0401$); LCLC ($p = 0.0011$) e IG ($p = 0.0003$).

Table 3 shows the descriptive and inferential Shapiro–Wilk analysis of quality of life (WHOQOL-OLD). PG has a heterogeneous data distribution ($p < 0.05$) in the following domains: DOM1, DOM4, DOM6 and QVG; whereas CG shows heterogeneous data distribution only in domain DOM6.

Graph 3 shows absolute Δ values of QVG for PG and CG. The Wilcoxon test showed significant improvement in QVG of PG ($p = 0.0411$). In the intergroup comparison, Student-*t* test showed a baseline difference in DOM5 ($p = 0.0483$) and DOM6 ($p = 0.0108$). The Mann–Whitney test showed significant post-test improvement in the PG following domains: DOM4 ($p = 0.0428$), DOM5 ($p = 0.0349$) and DOM6 ($p = 0.0286$); and Student-*t* test in QVG ($p = 0.0378$).

According to Sigmound (1964), the Pearson correlation coefficient (r) was significant in: Tinetti × C10m ($r = -0.384$); Tinetti × DOM2 ($r = 0.428$); IG × LPS ($r = 0.679$); IG × LCLC ($r = 0.676$); IG × LPDV ($r = 0.579$); IG × VTC ($r = 0.854$); IG × DOM3 ($r = 0.396$); VTC × LPS ($r = 0.481$); VTC × LPDV ($r = 0.459$); LCLC × VTC ($r = 0.382$); DOM5 × LPS ($r = -0.438$); QVG × DOM2 ($r = 0.566$); QVG × DOM3 ($r = 0.566$); QVG × DOM4 ($r = 0.614$); QVG × DOM6 ($r = 0.614$); DOM2 × DOM6 ($r = 0.387$); DOM3 × DOM4 ($r = 0.029$); DOM6 × DOM3 ($r = 0.501$); DOM3 × VTC ($r = 0.399$) and DOM6 × VTC ($r = 0.434$).

Figure 9 Sit ups.

Figure 10 Gluteus and trunk raises.

The β error calculated in this paper was of 0.18. This result corresponds to a power experiment of 82%, remaining above the minimum acceptable that is 80% to control the type II error.

Discussion

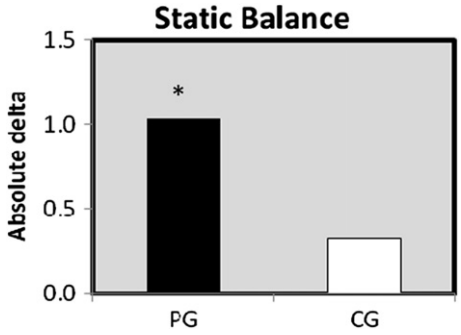
The maintenance of physical, psychic and social independence, often impacted by aging, is important in the preservation of personal autonomy and quality of life for elderly people. This preservation, according to studies, can be obtained by regularly practicing physical activity, which functions as an important factor for maintaining motor skills, preventing falls and improving quality of life for geriatric populations (Rogatto and Gobbi, 2001; Reeves et al., 2004), as has been observed in this research.

The Pilates method is a mode of physical activity that offers resistance work, either using the subject's own body weight or the springs that are applied in the method, supported by a philosophy of body consciousness that searches for harmony between body and mind. The principles of the Pilates methods include: centralization, control, concentration, fluidity of movement, precision and breathing (Anderson and Spector, 2000), offering its practitioner a global practice in stability and flexibility. As

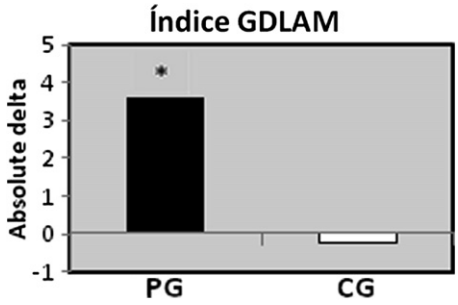
Table 1 Descriptive and inferential analysis using Shapiro–Wilk tests of PG and CG for static balance, in pre- and post-test conditions.

		Average ± SD	SE	Median	SW *p*-value
PG	Pre	23.85 ± 1.49	0.29	24	0.009
	Post	24.88 ± 1.07	0.21	25	
CG	Pre	22.04 ± 2.89	0.58	23	0.084
	Post	22.36 ± 2.63	0.53	22	

PG: Pilates group; CG: Control group; SW: Shapiro–Wilk; SE: standard error; SD: standard deviation; the unit of measure was: score (Tinetti).



Graph 1 Comparative analysis of absolute Δ of PG's and CG's static balance. * $p < 0.05$ (PG-post × CG-post).



Graph 2 Comparative analysis of absolute Δ of PG's and CG's IG. *$p < 0.0001$ (PG-post × CG-post).

a result of its known benefits such as improved muscle strength and flexibility, Pilates has come to be studied as a physical activity method for older adults.

This research indicated that the Pilates method can offer positive benefits in relation to static balance in the elderly, since the group that practiced the method showed post-test results that were more significant than CG results. These results can be explained by diverse factors. It is known that loss of balance is related to many factors, including reduced speed of muscular responsiveness (Orr et al., 2006), of strength (Heathcote, 2000) and proprioceptive information (Westlake et al., 2007), characteristic of aging. In previous studies it was demonstrated that Pilates method promotes increased strength (Schroeder et al., 2002), improves resistance (Kloubec, 2005), and that with respect to principles such as concentration, precision and control, it supplies constant proprioceptive stimulation during practice (Lange et al., 2000).

Moreover, studies such as Kaesler's (2007) indicate that the effect in relation to static balance can be a consequence of postural stability, reached by the harmony of opposing muscle groups. In this way, the effects related to muscles can be associated with the proprioceptive stimulation and postural stability to analyze the effects of the method in relation to static balance as indicated by this study.

Personal autonomy was evaluated using the GDLAM protocol, which was developed especially for elderly people and is composed of measures of activities of daily living such as walking, standing up, and getting dressed (Dantas et al., 2004). Although previous studies have not used this protocol for evaluating Pilates practice, the results of this research show that through this method it was possible to see significant differences in levels of personal autonomy of the elderly participants, whereas the control group did not present significant results.

According to previously performed studies, personal autonomy is dependent on variables such as strength, flexibility, coordination, balance, interpretation of sensorial stimulations, and cognitive capacity. The preservation or improvement of autonomy demands work that incorporates these variables. It was also demonstrated that physical activities can improve strength (Sekendiz et al., 2007), resistance (Kloubec, 2005), flexibility (Vale et al., 2005), balance and motor abilities Lange et al., 2000, (Silva et al., 2008) since they improve neural function, and strengthen the muscles of posture and the interpretation of sensory stimuli (Orr et al., 2006).

Table 2 Descriptive and inferential analysis using Shapiro–Wilk test of the functional autonomy of PG and CG in pre- and post-test conditions.

		Average ± SD		SE		Median		SW *p*-value	
		PG	CG	PG	CG	PG	CG	PG	CG
C10M	Pre	7.60 ± 1.68	7.56 ± 1.12	1.68	1.12	7.22	7.29	0.001	0.042
	Post	6.89 ± 1.60	7.59 ± 1.21	1.60	1.21	6.49	7.29		
LPS	Pre	10.47 ± 2.22	10.70 ± 1.95	2.22	1.95	10.71	10.19	0.198	0.209
	Post	9.23 ± 2.27	10.58 ± 2.19	2.27	2.19	9.12	10.47		
LPDV	Pre	4.20 ± 0.93	4.44 ± 0.96	0.93	0.96	4.07	4.47	0.001	0.080
	Post	3.11 ± 0.80	4.59 ± 1.10	0.80	1.10	3.02	4.85		
VTC	Pre	14.30 ± 3.31	12.95 ± 1.78	3.32	1.78	14.04	13.09	0.056	0.175
	Post	12.31 ± 2.57	13.21 ± 1.89	2.57	1.89	12.18	13.26		
LCLC	Pre	34.99 ± 4.99	36.65 ± 4.70	4.99	4.70	35.69	37.34	0.070	0.438
	Post	31.07 ± 6.01	36.69 ± 4.89	6.01	4.89	29.8	36.59		
IG	Pre	27.21 ± 3.85	26.96 ± 3.37	3.85	3.37	26.66	26.91	0.035	0.125
	Post	23.58 ± 3.96	27.19 ± 3.58	3.96	3.58	22.47	27.05		

C10m: walked of 10 m; LPS: to rise from a seated position; LPDV: to rise from a ventral decubitus position; VTC: to put on and to take off a shirt; LCLC: to rise out of a chair and to move freely through the house; IG: Index GDLAM; PG: Pilates group; CG: Control group; SW: Shapiro–Wilk; SE: error standard; SD: standard deviation.

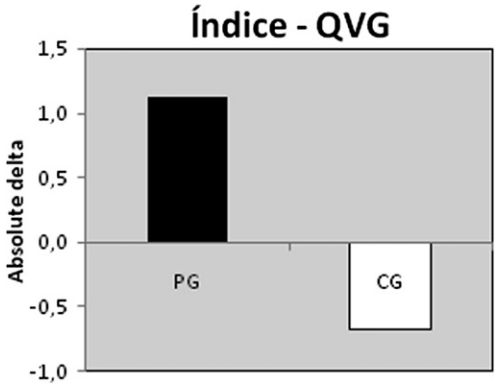
Table 3 Descriptive and inferential analysis of quality of life of PG and CG in pre- and post-test conditions using the Shapiro—Wilk test.

		Average ± SD		SE		MEDIANA		SW *p*-value	
		PG	CG	PG	CG	PG	CG	PG	CG
DOM1	Pre	04.23 ± 2.87	13.44 ± 4.34	0.56	0.87	15	13	0.001	0.225
	Post	14.69 ± 2.43	13.24 ± 4.85	0.78	0.97	15	14		
DOM2	Pre	13.74 ± 2.82	13.88 ± 2.49	0.54	0.50	14	14	0.466	0.293
	Post	14.18 ± 3.21	13.64 ± 2.81	0.62	0.56	15	13		
DOM3	Pre	15.70 ± 1.61	15.00 ± 2.52	0.31	0.50	16	15	0.026	0.272
	Post	15.85 ± 2.82	15.00 ± 2.35	0.54	0.47	16	15		
DOM4	Pre	15.88 ± 1.77	14.52 ± 3.51	0.35	0.70	16	14	0.009	0.277
	Post	16.35 ± 2.17	14.20 ± 3.90	0.42	0.78	16	15		
DOM5	Pre	12.92 ± 4.06	10.84 ± 4.81	0.78	0.96	12	10	0.254	0.224
	Post	12.96 ± 3.49	10.88 ± 4.90	0.67	0.98	12	10		
DOM6	Pre	15.18 ± 2.99	17.16 ± 2.32	0.57	0.46	15	17	0.070	0.044
	Post	14.96 ± 3.80	17.16 ± 2.52	0.73	0.50	15	17		
QVG	Pre	88.23 ± 6.19	84.84 ± 10.6	1.21	2.11	89	85	0.010	0.910
	Post	89.35 ± 9.38	84.16 ± 11.0	1.84	2.20	89	86		

PG: Pilates group; CG: Control group; SW: Shapiro—Wilk; SE: standard error; SD:standard deviation; DOM1: sensorial abilities; DOM2: autonomy; DOM3: past, present and future activities; DOM4: social participation; DOM5: death and dying; DOM6: privacy; QVG: quality of life index.

The Pilates method has already had proven results related to variables such as strength (Sekendiz et al., 2007), flexibility (Segal et al., 2004), balance (Johnson et al., 2007) and postural stability (Kaesler et al., 2007). So, the positive results found in this research, from the improvement in daily activities to the improvement of measured variables as a whole, can be attributed to the Pilates method, which is important for the development of necessary motor control.

Concerning quality of life, we observed that there was a meaningful improvement in ratings of quality of life in the Pilates group but no meaningful difference in the control group, which comprises the evaluation of this variable. Several factors could explain this result. One issue is that quality of life is a subjective concept that is not exclusively associated with physical performance, but also associated with emotional and social conditions, although these are not essential objectives in the practice of Pilates. Moreover, it is possible to find correlations between the evaluation instruments, the short period of time for re-evaluation, the evaluation modality and objectives of exercises, as well as the participant's self-esteem (Velchia et al., 2005).



Graph 3 Comparative analysis of absolute Δ in PG's and CG's QGV index. *$p < 0.0001$ (PG-post × CG-post).

Relevance of findings of this study.

The aging of the world's population suggests there is a need to reduce the functional limitations arising from the degeneration of the systems of older people, in order to attempt to preserve physical, psychological and social independence. Therefore, any scientifically validated techniques and procedures, that positively influence the lives of elderly people, have undeniable relevance. The results of this study offer reliable data suggesting that Pilates exercise can be used to promote an improvement in functional capacity, offering a positive influence on static balance and, consequently, an improved quality of life for elderly females. These results reflect the scientific evidence that Pilates improves the motor performance of aging people, reducing the time required to perform activities of daily living and, therefore, suggests a resource that can improve function and quality of life for older individuals.

Conclusion

Based on this study it is possible to conclude that the practice of the Pilates method can improve the functional autonomy and static balance of elderly individuals. However, in relation to quality of life, we suggest that further studies be carried out using a more representative sample, and a longer period of intervention, to more precisely evaluate the results of the method with respect to this variable.

Conflict of interest

The authors have no conflict of interest.

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