Revista Brasileira de Fisioterapia
ISSN: 1413-3555
rbfisio@ufscar.br
Associação Brasileira de Pesquisa e Pós-Graduação em Fisioterapia
Brasil

Araujo, Thais B.; Silva, Nélida A.; Costa, Juliana N.; Pereira, Marcio M.; Safons, Marisete P.
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Revista Brasileira de Fisioterapia, vol. 15, núm. 5, septiembre-octubre, 2011, pp. 414-419
Associação Brasileira de Pesquisa e Pós-Graduação em Fisioterapia
São Carlos, Brasil

ISSN 1413-3555
Rev Bras Fisioter, São Carlos, v. 15, n. 5, p. 414-9, Sept./Oct. 2011
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ORIGINAL ARTICLE

Effect of equine-assisted therapy on the postural balance of the elderly

Efeito da equoterapia no equilíbrio postural de idosos

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Abstract

Objective: To determine whether equine-assisted therapy (hippotherapy) produces alterations in the balance of the elderly. **Methods:** The sample included 17 older adults who were divided into experimental (7 subjects) and control (10 subjects) groups. Stabilometry data were acquired with a force platform. The Timed Up and Go test (TUG) was used for clinical analysis of seated balance, transfer from a seated to a standing position, walking stability and changes in gait. Sixteen equine-assisted therapy sessions were carried out. **Results:** Mann-Witney was used to compare the means between groups and no significant differences were found in the analyzed stabilometric parameters. In intragroup comparison with the Wilcoxon test, a significant increase in the variables COPy and Area (p=0.02) was observed. Equine-assisted therapy significantly affected (p=0.04) TUG test means between the experimental and control groups (Mann-Witney). Intragroup TUG test means were also significantly affected (p=0.04) according to the Wilcoxon test. **Conclusions:** Because senescence tends to normalize stabilometric measures, the number of equine-assisted therapy sessions was insufficient to determine any differences. Nevertheless, the significant improvement in TUG test scores demonstrates that this treatment frequency was a predictor of reduced fall risk in the elderly.

Article registered in the Australian New Zealand Clinical Trials Registry (ANZCTR) under number ACTRN12610000534088.

Keywords: equine-assisted therapy; postural balance; elderly; physical therapy; rehabilitation.

Resumo

Objetivo: Verificar se a equoterapia é capaz de produzir alterações no equilíbrio de idosos. **Métodos:** Desenvolveu-se um estudo experimental controlado. A amostra foi composta de 17 idosos, divididos em grupo experimental (GE), sete sujeitos e grupo controle (GC), dez sujeitos. A aquisição dos dados da estabilometria foi realizada por meio da plataforma de força da marca AMTI (*Force Measurement Systems*). Para análise clínica do equilíbrio sentado, transferências de sentado para a posição em pé, estabilidade na deambulação e mudanças do curso da marcha, utilizou-se o teste *Timed Up and Go* (TUG). Foram realizadas 16 sessões de equoterapia. **Resultados:** Na comparação das médias entre os grupos por meio do teste de Mann-Whitney, não houve diferença significativa nos parâmetros estabilométricos analisados. Já na comparação das médias intragrupo por meio do teste de Wilcoxon, verificou-se aumento significante sobre as variáveis COPy e área (p=0,02). Nas médias entre o GE e o GC, por meio do teste de Mann-Whitney para análise do teste TUG, verificou-se efeito significante (p=0,04) da equoterapia. Na comparação das médias intragrupo pelo teste de Wilcoxon, verificou-se efeito significante (p=0,04) sobre a variável TUG. **Conclusões:** A senescência tende a normalizar as medidas estabilométricas, sendo insuficiente, com esse número de sessões de equoterapia, apontar diferenças ligadas a essa intervenção. No entanto, essa frequência de tratamento foi suficiente como preditor de menor risco de quedas em idosos, uma vez que o teste de TUG mostrou diminuição significativa do tempo necessário para executá-lo.

Artigo registrado no Australian New Zealand Clinical Trials Registry (ANZCTR) sob o número ACTRN12610000534088.

Palavras-chave: equoterapia; equilíbrio postural; idosos; fisioterapia; reabilitação.

Received: 04/07/2011 – **Revised:** 04/25/2011 – **Accepted:** 06/17/2011

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Introduction

The Brazilian Ministry of Health states that approximately 30% of elderly people fall every year. Among the institutionalized elderly, this number increases to 38.3%. Of these events, 62.3% occur in the bedroom[1]. About 50% of those who fall and suffer a hip fracture will never again be functional walkers[2-4].

Falls are due to the inability to correct for body displacement during movement in space by a lack of coordinated response to control the center of mass[5,6]. Human orthostatic posture is not static, but oscillates idiosyncratically at specific frequencies and amplitudes that result from processing incoming information from the visual, vestibular and proprioceptive systems[5,7]. Liaw et al.[8] compared the characteristics of postural balance in 107 healthy individuals between 16 and 80 years of age and proved that postural sway increases with age. Thus, with advancing age, the propensity to fall becomes more imminent.

The permanent sway present in orthostatic posture can be measured by clinical tests or through stabilometry. The Timed Up and Go (TUG) test measures the time it takes for a person to get up from a chair, walk 2.5 m, return to the chair and sit down again. This test assesses agility and dynamic balance[9]. Stabilometry, which is frequently carried out with a force platform, is a method of analyzing static postural balance by measuring swaying in the anteroposterior and mediolateral axes in terms of displacement of the center of pressure (COP)[10,11].

There is consensus in the literature that the aging process triggers a decline in physical performance and functional independence, which increases the risk of falls. And although neuroplasticity, i.e., the nervous system's ability to reorganize itself, becomes impaired, it is not altogether absent[6]. Physical exercise, acting in conjunction with neuroplasticity, reduces the natural degenerative effects of aging, resulting in a reduced risk of falls[12].

Therefore, proper prevention, even at an advanced age, can affect longevity and promote functional independence and quality of life[13]. Several types of physical exercise have been used to improve postural balance. Physical therapy programs include visual-motor coordination and balance exercises, which consist of repeated visual, vestibular and somatosensory stimulation[14].

Equine-assisted therapy is a multisensory activity in which the rhythmic and three-dimensional sway of horseback riding stimulates the patient's postural reflex mechanism, resulting in balance and coordination training[15]. This activity requires whole body participation and thus contributes to the development of strength, muscle tone, flexibility, relaxation, body awareness and enhanced motor coordination and balance[16,17].

In a database (Pubmed, Medline, PEDro) search of the period 2000 to 2010, only one study was found regarding equine-assisted therapy with the elderly. Toigo, Leal Júnior and Ávila[18] studied the effects of equine-assisted therapy on the postural balance of ten elderly subjects, using a force platform for balance assessment. They found no significant difference in COP displacement speed or in values of COP displacement in the mediolateral direction and significant improvement only in anteroposterior COP. The study design included no control group, and the number of equine-assisted therapy sessions was lower than in similar studies with other populations.

Thus, there was an interest in developing a study with more equine-assisted therapy sessions and a control group in order to investigate the effects of the therapy on postural balance and fall risk among the elderly. The aim of this study was to determine whether equine-assisted therapy can produce changes in static and dynamic postural balance and in fall risk among the elderly.

Methods

Ethics committee

In compliance with Brazilian National Health Council (CNS) Resolution nº 196/96, which regulates research involving human subjects, participation in this study was voluntary and all participants signed an informed consent form. This study was approved by the Research Ethics Committee of the Faculty of Health Sciences of the Universidade de Brasília (UnB), Brasília, DF, Brazil (0079.0.012.000-09).

Selection of study group

The non-random sample in this controlled experimental study, which can be classified as a convenience sample, was selected from among elderly that lived near the equine-assisted therapy center.

The study included subjects from 60 to 84 years of age who were able to perform activities of daily living independently, who had medical clearance to ride, who were willing to participate in the study, and who could fulfill the following criteria: understand simple instructions; remain standing on the force platform for testing; mount the hosre with only with the aid of a platform; obtain their doctor's permission to participate in the activity.

Excluded criteria included the following disorders known to cause balance problems: neurological, ear, nose and throat,

vascular, metabolic, degenerative or neoplastic, osteoporosis and obesity, since excess weight is associated with poorer performance on postural balance tests[19]. Moreover, according to the National Association of Equine-assisted Therapy[20], excess weight interferes with the biomechanical quality of the of the horse's gait.

Thus, the sample consisted of 17 elderly participants, seven in the experimental group (EG) and ten in the control group (CG). The EG included two male and five female subjects while the CG was all female. During the study, equine-assisted therapy was the only regular physical activity that the EG performed; the CG was involved in no regular physical activity.

Stabilometric data collection

Stabilometric data acquisition was conducted at the UnB biomechanics laboratory, which is located in the Faculty of Physical Education. Three 30-second tests were carried out with a 100 Hz data acquisition frequency. A rest period of 60 seconds was given between tests, as suggested by Teixeira et al.[21] and Mann et al.[7].

The subjects stood barefoot on the platform with bipedal support and the feet hip-width apart. They were instructed to keep their eyes open and focus on an eye-level point marked on the opposite wall and keep their arms relaxed at their sides while repeating the three trials. Participants who wore glasses were not required to take them off during the test. Each participant's base of support was marked on the force platform on their first attempt and was repeated in the other trials to ensure uniformity, as suggested by Teixeira et al.[21].

Stabilometric data processing

COP displacement amplitude and effective area were the kinetic variables related to body balance. After the data regarding these variables were acquired in a stabilometer (AMTI AccuSway Plus), they were processed using Balance Clinic software. Data were filtered in a low-pass filter at a frequency of 10 Hz.

Collection of the Timed Up and Go test (TUG)

The TUG test evaluates the time (in seconds) that an individual takes to get up from a sitting position in a chair, walk 2.5 meters, return and sit down again in the same chair. An armless chair, a stopwatch and a flag, which indicated a distance of 2.5 meters from the chair, were used for this test.

The subjects were instructed to sit up straight with their back supported by the chair back. The test began with a verbal command (beginning of timing) and ended when the individual arrived back at the starting position (end of timing).

The subjects performed the task as both as quickly and as carefully as possible to avoid possible accidents. All subjects performed the test three times before and after equine-assisted therapy and the mean performance was recorded before and after intervention.

Intervention protocol

Equine-assisted therapy sessions were held at the Basic Center of equine-assisted therapy of the Instituto Cavalo Solidário, located in the Distrito Federal, Brazil. In this study, 30 minute biweekly equine-assisted therapy sessions were held for eight weeks, totaling 16 sessions.

Following the methodology proposed by Araujo et al.[22], each session of equine-assisted therapy consisted of different horse gaits (step and trot), gound surfaces (sand, asphalt and turf), terrains (flat, hilly and steep), movement combinations and changes of direction.

In order to produce more intense three-dimensional stimuli from the horse's hind limbs and pelvic girdle, horses with a long step length and wide steps (i.e., low step frequency) were selected. As well as a saddle, we used low stirrups so that the joints of the head, spine, shoulders, hips, knees and ankles would stay aligned, facilitating, therefore, treatment focused on improved postural balance while standing upright.

Soon after the 16th session of equine-assisted therapy, the stabilometry evaluation was repeated using the same methodology as the pre-intervention measurements.

Statistical analysis

Statistical analysis included the Shapiro-Wilk test for normality and Levene's test of homogeneity of variance. Because the assumptions of normality and homogeneity were not guaranteed, non-parametric statistics were used for data treatment. The Mann-Whitney U-test was used to ensure that EG and CG were from the same population. The Wilcoxon T-test was used to verify the effect of equine-assisted therapy on pre- and post-intervention stabilometric parameters in each group. A significance level of ≤5% was used for all tests.

Results

The pre- and post-intervention results are described in Tables 1 and 2.

Stabilometric data

The results of the Mann-Whitney test revealed that there were no significant post-intervention differences in the analyzed stabilometric parameters.

In the intra-group comparison with the Wilcoxon test, there was a significant increase in the variables COPy and area (p=0.02) after treatment. The EG post-test COPy mean (2.14cm±0.43) was significantly higher than the pre-test mean (1.76cm±0.30). The means for area also followed this pattern (0.86cm^2±0.38 and 0.61cm^2±0.23, pre- and post-intervention, respectively).

TUG

According to the Mann-Whitney test, the treatment had a significant effect (p=0.04) on mean TUG test results between groups, with EG (5.12±0.70) significantly better than the CG (5.98±1.01).

According to the Wilcoxon test, there was significant intra-group treatment effect (p=0.04) on the mean TUG score. The EG's post-test mean (5.12±0.70) was significantly better than its pre-test mean (6.37±2.17). There was no significant difference (p=0.08) between CG pre-and post-test results.

Discussion

Several stabilometric parameters based on COP have been used to quantify balance changes. There is controversy in the literature about which parameter is the most sensitive to sways in COP. Understanding these variables is essential for balance analysis.

Table 1. Average results of pre and post intervention.

Groups		Medium/Standard deviation			
		COPx(cm)	COPy(cm)	Area(cm^2)	TUG(seg)
EG	Pre	1.10±0.34	1.76±0.30	0.61±0.23	6.37±2.19
	Post	1.15±0.43	2.14±0.41	0.86±0.37	5.12±2.12
CG	Pre	0.80±0.22	1.94±0.40	0.56±0.24	6.02±1.41
	Post	0.86±0.32	2.06±0.75	0.72±0.60	5.98±1.01

COPx=center of pressure medio-latera; COPy=center of pressure anterio-posterior; TUG=*timed up and go*.

Table 2. Non-parametric analysis of the data pre and post intervention.

Statistical Tests	Stabilometric Datas			Test data
	COPx(cm)	COPy(cm)	Area(cm^2)	TUG(seg)
Mann-Whitney	0.13	0.81	0.27	0.04
Wilcoxon for EG	1.00	0.02	0.02	0.04
Wilcoxon for CG	0.96	0.58	0.58	0.08

Significance level: p≤0.05. COPx=center of pressure medio-latera; COPy=center of pressure anterio-posterior; TUG=*timed up and go*.

Fujimoto et al.[23] assessed the accuracy of posturography for diagnosing peripheral vestibular disease, emphasizing visual and somatosensory dependence. To this end, they analyzed 80 patients with peripheral vestibular disorders and 66 healthy controls. Their results indicated that area was significantly higher in subjects with vestibular disorder. Area may, indirectly, reflect the role of the Central and Peripheral Vestibular System due to a reduction of visual and somatosensory input.

In light of this information, we chose to analyze COP in the X (mediolateral sway) and Y (anteroposterior sway) axes and, as a derived measure, the area. However, there was no significant decrease in intergroup stabilometric parameters after 16 sessions of equine-assisted therapy. These results are consistent with those of Toigo, Leal Júnior and Ávila[18], who analyzed the static balance of ten elderly subjects after eight sessions of equine-assisted therapy and found a significant improvement in COPy values. However, there was no significant improvement in COPx results in their study and area was not assessed.

When comparing stabilometric data among healthy elderly subjects, performance is assessed in terms of age and intergroup differences are not expected. However, such differences are expected when comparing young adults with the elderly[22]. This also serves to confirm our findings, since no difference was found between groups. This may be due to the fact that the EG and CG consisted of healthy subjects of the same age. Thus, the idea that senescence tends to normalize the stabilometric measures among healthy elderly is reinforced.

Moreover, the implications of body inclination, with all mass concentrated on the force platform, may not be always valid; so the resulting COP measures may not be reliable for this type of analysis[24]. This reinforces the need for postural balance assessment with healthy subjects of the same age with other validated tests.

The TUG test, although it assesses few aspects of balance (standing, sitting and turning), is a predictor of fall risk[9]. The intra-test and inter-test reliability has been described as high (ICC=0.98) with elderly subjects. Nevertheless, the test-retest reliability in groups without cognitive impairment is moderate (ICC=0.56)[25]. Shumway-Cook, Brauer and Woollacott[26] analyzed the sensitivity and specificity of the TUG test in 15 elderly subjects with no previous history of falls and 15 elderly with a history of two or more falls in the previous six months. The TUG test had a sensitivity of 87% and specificity of 87% for identifying elderly adults prone to falls.

Wall et al.[27] compared the results of the TUG test between three groups (healthy young people, healthy elderly people and elderly people at risk of falling) of ten subjects each. The

young and the healthy elderly had a mean performance time of less than 10 seconds, while the at-risk elderly had a mean time of 18.14±4.604 seconds. These authors concluded that a TUG test performance time of less than 10 seconds means a low risk of falls and that this assessment is a sensitive and objective method for assessing postural balance.

In the present study, equine-assisted therapy significantly affected the TUG variable. The mean performance time on this test was below 10 seconds and, thus, the subjects had a low risk of falls[5] even before the intervention. However, three of seven subjects had suffered at least one fall in the previous year, which is very close to the rate found by Caterino et al.[28] in emergency rooms, whose analysis of clinical histories revealed that 40% of elderly patients have suffered falls.

With respect to age and daily activity, a positive and independent association with TUG has been observed[29]. This is consistent with the findings of the present study, in which an increase in daily activity, i.e., equine-assisted therapy, caused an increase in the agility of the elderly participants.

In studies assessing the kinesiotherapeutic effects of this technique, no consensus can has been reached concerning the optimal number of sessions. Significant changes have been reported in children after 13 sessions[17]. We found only one intervention with the elderly in the literature, in which eight equine-assisted therapy sessions were carried out[18]. Thus, to date, no method has been defined regarding the number of sessions appropriate for this type of activity in the elderly population. In this study, 16 sessions of equine-assisted therapy, despite being higher than the average of previous interventions, showed no significant results regarding the stabilometric data.

The force platform could not detect significant changes in postural balance. However, the TUG test showed significant decrease in performance time and 16 sessions of equine-assisted therapy were sufficient as a predictor of lower risk of falls in the elderly. Therefore, further studies with longer intervention times are needed both to assess the effects of equine-assisted therapy on stabilometric parameters in the elderly and to determine the number of sessions necessary for improving balance in this population.

This study was limited in that it did not control for overall health aspects such as nutritional status or the use of drugs that could affect balance. Moreover, detailed histories of previous falls were not required, which could be an important variable to analyze in this population. Furthermore, the fact that neither group presented changes in postural balance in the pre-test can be considered a limiting factor.

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