**Journal of Exercise Physiologyonline**

**June 2013**

**Volume 16 Number 3**



**JEPonline**

**Editor-in-Chief**

Tommy Boone, PhD, MBA

**Review Board**

Todd Astorino, PhD

Julien Baker, PhD

Steve Brock, PhD

Lance Dalleck, PhD

Eric Goulet, PhD

Robert Gotshall, PhD

Alexander Hutchison, PhD

M. Knight-Maloney, PhD

Len Kravitz, PhD

James Laskin, PhD

Yit Aun Lim, PhD

Lonnie Lowery, PhD

Derek Marks, PhD

Cristine Mermier, PhD

Robert Robergs, PhD

Chantal Vella, PhD

Dale Wagner, PhD

Frank Wyatt, PhD

Ben Zhou, PhD

Official Research Journal of the American Society of Exercise Physiologists

ISSN 1097-9751

**Official Research Journal of the American Society of Exercise Physiologists**

ISSN 1097-9751

**Muscle and Functional Parameters of Mid-Age Women with Fibromyalgia and Healthy Elderly**

Suelen Meira Goes1,2, Paulo César Barauce Bento1,2,Joice Mara Facco Stefanello1,2, Khaled Omar Mohamad El Tassa2, Diogo Homann2, Neiva Leite2, André Luiz Félix Rodacki1

1Federal University of Parana – Brazil, Sector of Biological Sciences – Center for Motor Behaviour Studies, 2Federal University of Paraná – Brazil, Sector of Biological Sciences – Center of Quality of Life

##### ABSTRACT

**Goes SM, Bento PCB, Stefanello JMF, El Tassa KOM, Homann D, Leite N, Rodacki ALF.** Muscle and Functional Parameters of Mid-Age Women with Fibromyalgia and Healthy Elderly. **JEPonline**2013;16(3):20-29. Mid-age subjects with fibromyalgia show reduced ability to perform daily-life activities, which is also seen in the elderly. The impairment force generation may be a factor that influences the functional performance. Fifty women (16 mid-age with fibromyalgia syndrome – FS, 16 healthy mid-age – CG, and 18 healthy elderly – HE) were assessed. The 8 ft up and go, sit and reach, and the 30 sec chair stand tests were used to assess functional performance. The peak torque was determined by maximal voluntary isometric contraction- MIVC (hip, knee, and ankle joints) using a load cell. FS and HE groups showed lower performance (P<0.05) than the HC group in the 30 sec chair stand test. The HE group presented lower maximal torque in each MIVC test when compared to HC group (P<0.05). There were no differences between the FS and HE groups in ankle plantar flexors, hip flexors, and extensor muscles (P>0.05), although FS group did not show differences in comparison to the HC group (P>0.05). Both FS and HE groups showed lower knee extensor torque when compared to HC group (P<0.05). Women with fibromyalgia showed similar physical ability performance to the elderly women, especially in static and dynamic lower limb muscle strength. When added to the aging process, FS impairs functional performance.

**Key Words**: Chronic Pain, Ageing, Muscle Strength, Functionality

# 

# INTRODUCTION

Fibromyalgia (FM) – also called 'fibromyalgia syndrome' (FS) – is a multifactorial chronic painful condition of unknown etiology. Its diagnostic label is based on several symptoms that include pain, fatigue, sleep disturb, and cognitive problems (33). In addition, patients with FS show reduced ability to perform daily-life activities when compared to their healthy counterparts (1,9,16).

A number of FM symptoms and a reduced level of physical activities may lead to a pronounced decline in the ability to perform functional tasks (3,21,22). Patients with FS show difficulties to perform everyday ordinary tasks. They also present similar physical ability to the elderly (24). In fact, the FM patients’ changes in physical ability are prone to additional difficulties, given the frequent coexisting condition of ageing that aggravates and perpetuates symptoms.

The physical abilities and the capacity to generate torque (i.e., muscle strength) are essential to performing a number of daily tasks that influence functionality. Women with FS experience a reduction in their fitness level compared (9,16,22). It has also been shown that patients with FM are characterized by a remarkable change in their ability to produce force when compared to a paired group of healthy subjects (9,15), specifically when maximal strength of the lower limbs is measured. This premature deficit in physical capacity may lead to an early loss in the ability to generate muscle force that may compromise an independent lifestyle. However, the number of studies designed to determine and compare physical ability between patients with FM and a group of elderly subjects is small. It is therefore of interest to determine the function of muscles around the ankle, knee, and hip joints, especially since these joints are at the risk of falls. Since FM patients are prone to falls (9) it would be useful to understand how FM influences performance of these muscles.

Panton and colleagues (24) compared the performance of daily task activities and knee muscle strength in women with the diagnostic label ‘fibromyalgia' to a control age-matched and an elderly group. Women without FM have significantly higher functionality scores compared with women with FM and older women. In fact, often there are no differences in functionality between women with FM and older women. Assessment of a single muscle group is relatively limited as other muscles groups play an essential role in the daily activities (4,18,19). The understanding of how FM influences these muscles is relevant to the development of physical activity programs to help reduce the risk of falls (2,4,25).

The decrease in physical ability and capacity to produce force can lead to negative implications on functionality, which can then lead to disability and a reduction in the quality of life of younger women (<65 yrs old). Obtaining information regarding the decrease in muscle strength and physical performance in the FS population is important to understanding how FM clinically impacts ageing and health. Thus, the purpose of this study was to compare physical abilities and the capacity to generate force in lower limbs between mid-aged women with and without FS and a group of healthy female elderly subjects.

# METHODS

# Subjects

Fifty women aged between 30 and 79 yrs old agreed to participate. They were assigned to one of three groups. The first group was formed by patients recruited from the Rheumatology Ambulatory of the University’s Hospital with FS (FS; n = 16; 41.5 ± 5.9 yrs old; 159.8 ± 5.3 m; 71.9 ± 9.9 kg, and 28.2 ± 3.9 kg·m-2). The patients were diagnosed by physicians who applied the American College of Rheumatology criteria (33). The second group included healthy control women (HC; n = 16; 40.4 ± 6.4 yrs old; 159.4 ± 5.8 m; 68.7 ± 13.8 kg, and 26.7 ± 5.6 kg·m-2) who were recruited from University staff. The third group consisted of healthy elderly women (HE; n = 18; 65.7 ± 4.9 yrs old; 153.8 ± 4.4 m; 70.5 ± 10.4 kg, and 29.7 ± 3.4 kg·m-2). The HE subjects were recruited from the local community and from different groups with an interest in physical activity (via flyers and personal contacts). Subjects with untreated and/or uncontrolled cardiac, respiratory, and/or orthopaedic conditions that impeded the performance of the functional tests or daily tasks were not included in the study.

# Procedures

All subjects signed an informed consent form that was approved by the University Ethics Committee (CEP/HC: 1469.137/2007-06). The experimental design of the study is shown in Figure 1.



# 

**Figure 1. Study design. FS: Fibromyalgia Syndrome Group; HC: Health Control Group;**

**HE: Health Elderly Group.**

# Physical Ability Tests

Three physical ability tests were applied: (a) the 8 ft up and go test to determine balance and agility (27); (b) the sit and reach test to evaluate flexibility (32); and (c) the 30-sec chair stand test was used to assess lower muscle strength (27). Each test was performed twice with a minimal interval between trials of 10 min and the best performance was chosen for analysis purposes.

# Lower Limb Muscle Strength Assessment

The maximal voluntary isometric contraction (MVIC) for hip, knee, and ankle flexion and extension, and hip abduction and adduction were assessed by a load cell (Kratos, Modelo CZC500) that was firmly attached to an adjustable pole that permitted alignment perpendicular to the tested (dominant limb) segment. An adjustable cuff was used to attach the cable to the participant.

The MIVC for lower limb flexion and extension tests were performed in a recumbent posture with joints positioned at approximately 90°. The hip abduction and adduction tests were performed with the subjects in a standing posture. To ensure that additional movements did not improve the subjects’ performance, the proximal segments were firmly secured and stabilized by velcro straps. The perpendicular distance between the load cell and the joint center was determined and used to calculate net joint torques (N·m) (4).

The subjects were instructed to produce torque as fast and hard as possible. Each subject sustained the contraction for approximately 2 to 3 sec. To minimize fatigue effects, short periods of contraction were applied with 1 min rest between trials. All subjects were allowed 3 to 5 trials to familiarize themselves with the test demands.

The force-time signals were sampled with a frequency of 1 KHz, amplified (Kratos, model IK-1C, São Paulo, SP, Brazil) and converted to digital signals with the aid of a 16 bit A/D card (National Instruments, model NI USB 6218, Austin, TX, USA) and, then, stored on a personal computer. Raw torque data were low pass filtered with a Butterworth second order recursive filter set at 20 Hz. Peak torque was determined as the highest torque value obtained after the onset of the voluntary contraction.

# Statistical Analyses

Descriptive statistics were performed to characterize the subjects’ responses. The Shapiro-Wilk test was used to ensure data normality. In order to compare groups ANOVA one-way and Bonferroni post hoc test were performed for parametric data, and Kruskal-Wallis and Dunns post hoc tests were used for nonparametric data. Statistical procedures were conducted using a standard statistical package (STATISTICA®, Version 7.0, STATSOFT Inc., USA). Statistical significance was set at P<0.05.

# 

# RESULTS

There were no differences between groups in physical features and age (P>0.05), except the HE group, which was older compared to the other groups (P<0.05). There were no differences between groups in the physical abilities tests, except in the 30-sec chair stand test, in which FS and HE groups showed lower performance (P<0.05) than the HC group (see Figure 2).



**Figure 2. Physical Abilities Tests Performance in Each Group.** ANOVA and Kruskal-Wallis Test. \*P<0.05.

The HE group presented lower maximal torque in each MIVC tests when compared to HC group (P<0.05). There were no differences between FS and HE groups in ankle plantiflexors, hip flexors and extensor muscles (P>0.05), although FS group did not show differences in comparison to the HC group in all tests (P>0.05). Furthermore, FS and HC group did not differ in hip abduction and adduction, knee flexion and ankle dorsiflexion (P>0.05). However, both FS and HE groups showed lower knee extensor torque when compared to HC group (P<0.05). The MIVC tests results are shown in Figure 3.

# DISCUSSION

Findings of this study showed that middle-age women with FM present a similar static and dynamic lower limb strength performance that is comparable to healthy elderly women. Both the FM subjects and the elderly women showed a reduced performance in a number of functional parameters, which included the ability to generate torque when compared to the healthy middle-age control group.

The ability to generate torque has been investigated in elderly subjects (17) and in women with FM (9,14,31). The elderly showed the lowest peak torque in all muscle groups when compared to the FM and healthy middle age groups, which is a common finding described in senescent subjects (18,19,29). On the other hand, the group of fibromyalgia was able to produce similar joint torques in comparison to the control group, except around the knee extensor muscles. The causes for the reduced torques around the knee extensor muscles are not clear and a number of mechanisms have been proposed (10,11,13,14,31), but the discussion of such mechanisms is beyond the scope of the present study.



**Figure 3. Peak Torque Values for Hip, Knee, and Ankle Flexion and Extension and Hip Abdution and Addution.** ANOVA and Kruskal-Wallis Test. \*P<0.05.

Women with fibromyalgia have lower knee extensors peak torque in comparison to healthy women (9, 14,24,31), which is in agreement with the findings of the present study. However, it is intriguing to observe the fact that only the knee extensor muscles of the FS group showed a large discrepancy (~40% less) when compared to the CG. It may be argued that the pain in large and bulky muscles is more limiting than when smaller muscles groups are affected (i.e., as a protective mechanism) (20). Indeed, large muscles are more required in almost all daily tasks. Also, the preserved torque around the knee flexor muscles may have decreased the net extensor torque, especially in the FS patients who are described as predisposed to greater agonist-antagonist activation (13,31). The absence of differences in peak torque between the FS group and the elderly group may be also explained due to the fact that the amount of muscle strength reduction varies according to the muscle group assessed (30).

Valkeinen et al. (31) reported larger coactivation in FM patients than in healthy counterparts. Their finding may be rather important since the performance of daily tasks is highly dependent on the ability of the quadriceps to produce large amounts of torque (12), which is comparable to the group of elderly subjects and is in agreement with the findings of Panton et al. (24). This point may have serious implications for women with FM, who may be at risk for premature age-associated disability.

In the present study, women with FM were about 25 yrs younger than the elderly group, but the similar knee extensors peak torque may indicate that these patients are likely to experience premature functional limitations that may become more severe as they age. Therefore, it is anticipated elderly FM patients will present with grater deterioration, especially since they use around 80% of their maximum capacity to produce torque production to perform everyday tasks. These values are much higher than the 50% of maximum capacity to produce torque in younger subjects (17).

The dynamic strength of the lower limb in the FM group and the elderly group was lower than the healthy middle-age group. Although the sit-to-stand test does not only provide a functional measure of the lower limbs daily living tasks, it is related to a higher risk of falls in healthy elderly (28) and in women with FM (9). The reduced strength and ability to resist to fatigue in the elderly have been consistently reported in the literature (5,7,8,26), and has been attributed to changes in the central nervous and muscular systems. Muscle mass loss, muscle architectural changes, modification in the recruitment and synchronism of motor units, and increased co-activation of antagonist muscles are reported in both the FM patients and elderly subjects (6,23). In particular, the increased antagonist muscles co-activation by itself is sufficient to compromise the ability to produce force (31).

The sit and reach test (flexibility) and the 8 ft up and go test (balance and agility) measures showed no significant differences across the groups. The performance of the group with FM (7 ± 1.8 sec) in the 8 ft up and go test was comparable to that found in the group of elderly women (50th percentile) (28). These findings indicate that the physical ability of the middle-age women is comparable to the physical ability of the FM and elderly subjects.

# CONCLUSIONS

Women with FM showed static and dynamic muscle strength similar to their elderly counterparts who were 25 yrs older. Women with FM showed similar physical ability performance to the elderly subjects, especially in lower limb muscle strength. Elderly and fibromyalgia groups presented lower performance when compared to the subjects in the control (healthy) group. The reduced lower limb muscle strength emphasizes the negative impact that FM symptoms play in these patients. Strategies to preserve the integrity of the muscles to generate strength, power, and functionality are required to minimize the ageing effects in the FM subjects.

ACKNOWLEDGMENTS

The authors wish to acknowledge the financial support of CAPES (Coordination of improvement for graduated personnel), an agency of the Brazilian Government which allowed the training and preparation of human resources. In addition, also to the participants and all research staff from the institutions involved in this paper.

Address for correspondence: Góes SM, Universidade Federal do Paraná - Departamento de Educação Física R. Coração de Maria, 92, Jardim Botânico – Curitiba–PR–Brazil – Zip code: 80215-370 Phone 00 55 41 3360-4333; FAX 00 55 41 3360-4336; Email: [su.goes@gmail.com](mailto:su.goes@gmail.com)

**REFERENCES**

1. Aparicio VA, Ortega FB, Carbonell-Baeza A, Camiletti D, Ruiz JR, Delgado-Fernández M. Relationship of weight status with mental and physical health in female fibromyalgia patients. *Obesity Facts.* 2011;4(6):443-448.
2. Bennett PN, Breugelmans L, Chan D, Calo M, Ockerby C. A combined strength and balance exercise program to decrease falls risk in dialysis patients: A feasibility study. *J Exer Physiol.* 2012;15(4):26-39.
3. Bennett RM, Jones J, Turk DC, Russell IJ, Matallana L. An internet survey of 2,596 people with fibromyalgia. *BMC Musculoskelet Disord.* 2007;8. doi:10.1186/1471-2474-8-27
4. Bento PCB, Pereira G, Ugrinowitsch C, Rodacki ALF. Peak torque and rate of torque development in elderly with and without fall history. *Clin Biomech.* 2010;25(5):450-454.
5. Candow DG, Chilibeck PD. Differences in size, strength, and power of upper and lower body muscle groups in young and older men. *J Gerontol.* - Series A Biological Sciences and Medical Sciences. 2005;60(2):148-156.
6. Clark BC, Manini TM. Functional consequences of sarcopenia and dynapenia in the elderly. *Curr Opin Clin Nutr Metab Care.* 2010;13(3):271-276.
7. Delmonico MJ, Harris TB, Visser M, Park SW, Conroy MB, Velasquez-Mieyer P, et al. Longitudinal study of muscle strength, quality, and adipose tissue infiltration. *Am J Clin Nutr.* 2009;90(6):1579-1585.
8. Frontera WR, Hughes VA, Fielding RA, Fiatarone MA, Evans WJ, Roubenoff R. Aging of skeletal muscle: A 12-yr longitudinal study. *J Appl Physiol.* 2000;88(4):1321-1326.
9. Goes SM, Leite N, Shay BL, Homann D, Stefanello JM, Rodacki AL. Functional capacity, muscle strength and falls in women with fibromyalgia. *Clin Biomech. (Bristol, Avon).* 2012;Jan 7.
10. Graven-Nielsen T, Lund H, Arendt-Nielsen L, Danneskiold-Samsøe B, Bliddal H. Inhibition of maximal voluntary contraction force by experimental muscle pain: A centrally mediated mechanism. *Muscle and Nerve.* 2002;26(5):708-712.
11. Graven-Nielsen T, Svensson P, Arendt-Nielsen L. Effects of experimental muscle pain on muscle activity and co-ordination during static and dynamic motor function. *Electroencephalogr Clin Neurophysiol.* 1997;105(2):156-164.
12. Gür H, Çakin N. Muscle mass, isokinetic torque, and functional capacity in women with osteoarthritis of the knee. *Arch Phys Med Rehabil.* 2003;84(10):1534-1541.
13. Häkkinen K, Pakarinen A, Hannonen P, Häkkinen A, Airaksinen O, Valkeinen H, et al. Effects of strength training on muscle strength, cross-sectional area, maximal electromyographic activity, and serum hormones in premenopausal women with fibromyalgia. *J Rheumatol.* 2002;29(6):1287-1295.
14. Henriksen M, Lund H, Christensen R, Jespersen A, Dreyer L, Bennett RM, et al. Relationships between the fibromyalgia impact questionnaire, tender point count, and muscle strength in female patients with fibromyalgia: A cohort study. *Arthritis Care Res.* 2009;61(6):732-739.
15. Henriksson KG. The fibromyalgia syndrome: Translating science into clinical practice. *J Musculoskeletal Pain.* 2009;17(2):189-194.
16. Homann D, Stefanello JM, Goes SM, Leite N. Impaired functional capacity and exacerbation of pain and exertion during the 6-minute walk test in women with fibromyalgia. *Rev Bras Fisioter.* 2011;15(6):474-480.
17. Hortobágyi T, Mizelle C, Beam S, DeVita P. Old adults perform activities of daily living near their maximal capabilities. *J Gerontol* - Series A Biological Sciences and Medical Sciences. 2003;58(5):453-460.
18. Kerrigan DC, Lee LW, Collins JJ, Riley PO, Lipsitz LA. Reduced hip extension during walking: Healthy elderly and fallers versus young adults. *Arch Phys Med Rehabil.* 2001;82(1):26-30.
19. Kerrigan DC, Xenopoulos-Oddsson A, Sullivan MJ, Lelas JJ, Riley PO. Effect of a hip flexor - stretching program on gait in the elderly. *Arch Phys Med Rehabil.* 2003;84(1):1-6.
20. Lamontagne M, Beaulieu ML, Beaulé PE. Comparison of joint mechanics of both lower limbs of THA patients with healthy participants during stair ascent and descent. *J Orth Res.* 2011;29(3):305-311.
21. Lund N, Bengtsson A, Thorborg P. Muscle tissue oxygen pressure in primary fibromyalgia. *Scandinavian J Rheumat.* 1986;15(2):165-173.
22. Mannerkorpi K, Svantesson U, Broberg C. Relationships between performance-based tests and patients' ratings of activity limitations, self-efficacy, and pain in fibromyalgia. *Arch Phys Med Rehabil.* 2006;87(2):259-264.
23. Narici MV, Maganaris CN, Reeves ND, Capodaglio P. Effect of aging on human muscle architecture. *J Appl Physiol.* 2003;95(6):2229-2234.
24. Panton LB, Kingsley JD, Toole T, Cress ME, Abboud G, Sirithienthad P, et al. A comparison of physical functional performance and strength in women with fibromyalgia, age- and weight-matched controls, and older women who are healthy. *Phys Ther.* 2006;86(11):1479-1488.
25. Persch LN, Ugrinowitsch C, Pereira G, Rodacki AL. Strength training improves fall-related gait kinematics in the elderly: A randomized controlled trial. *Clin Biomech (Bristol, Avon).* 2009;24(10):819-825.
26. Petrella JK, Kim JS, Tuggle SC, Hall SR, Bamman MM. Age differences in knee extension power, contractile velocity, and fatigability. *J Appl Physiol.* 2005;98(1):211-220.
27. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community- residing older adults. *J Aging Physical Act.* 1999;7(2):129-161.
28. Rikli RE, Jones CJ. Functional fitness normative scores for community-residing older adults, ages 60-94. *J Aging Phys Act.* 1999;7(2):162-181.
29. Taekema DG, Maier AB, Westendorp RGJ, De Craen AJM. Higher blood pressure is associated with higher handgrip strength in the oldest old. *Am J Hypertens.* 2011;24(1):83-89.
30. Trudelle-Jackson E, Jackson AW, Morrow JR. Relations of meeting national public health recommendations for muscular strengthening activities with strength, body composition, and obesity: The women's injury study. *Am J Public Health.* 2011;101(10):1930-1935.
31. Valkeinen H, Alen M, Hannonen P, Hakkinen A, Airaksinen O, Hakkinen K. Changes in knee extension and flexion force, EMG and functional capacity during strength training in older females with fibromyalgia and healthy controls. *Rheumatology (Oxford).* 2004;43(2):225-228.
32. Wells KF, Dillon EK. The sit and reach - A test of back and leg flexibility. *Res Q Exerc Sport.* 1952;23:115-118.
33. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Katz RS, Mease P, et al. The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care Res.* 2010;62(5):600-610.

# Disclaimer

The opinions expressed in **JEPonline** are those of the authors and are not attributable to **JEPonline**, the editorial staff or the ASEP organization.