Research Report

A Comparison of Physical Functional Performance and Strength in Women With Fibromyalgia, Age- and Weight-Matched Controls, and Older Women Who Are Healthy

Background and Purpose. The purpose of this study was to compare functionality and strength among women with fibromyalgia (FM), women without FM, and older women. Subjects. Twenty-nine women with FM (age [$\overline{X}\pm SD$]=46±7 years), 12 age- and weight-matched women without FM (age=44±8 years), and 38 older women who were healthy (age=71±7 years) participated. Methods. The Continuous Scale–Physical Functional Performance Test (CS-PFP) was used to assess functionality. Isokinetic leg strength was measured at 60°/s, and handgrip strength was measured using a handgrip dynamometer. Results. The women without FM had significantly higher functionality scores compared with women with FM and older women. There were no differences in functionality between women with FM and older women. Strength measures for the leg were higher in women without FM compared with women with FM and older women, and both women with and without FM had higher grip strengths compared with older women. Discussion and Conclusion. This study demonstrated that women with FM and older women who are healthy have similar lower-body strength and functionality, potentially enhancing the risk for premature age-associated disability. [Panton LB, Kingsley JD, Toole T, 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;86:1479–1488.]

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Key Words: *Fibromyalgia Impact Questionnaire, Functionality, Strength, Tender point sensitivity.*

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Fibromyalgia (FM) is the second most common rheumatologic disorder in the United States, affecting approximately 4 to 6 million Americans.[1–3] The majority of people with FM are women. Fibromyalgia is characterized not only by chronic pain, but also by a wide array of symptoms.[2,3] These symptoms include sleep disturbance, chronic fatigue, morning stiffness, irritable bowel syndrome, anxiety, depression, mental fogginess, slowness of thought, decreased concentration, paresthesia, and pain upon moderate pressure at various tender points across the body.[2,4–6] According to the American College of Rheumatology, the diagnosis of FM is widespread pain in at least 3 of the 4 body quadrants for at least 3 months and localized pain on palpation in at least 11 of 18 selected muscle-tendon junctions or tender points.[1] The Figure illustrates the tender point locations.

The majority of women with FM have been shown to be aerobically unfit.[6–8] This is due, in part, to the cycle of pain and fatigue that is associated with FM. Research has shown that deconditioned muscles are more susceptible to muscle damage with activity.[9,10] This muscle damage can then result in more pain, thus leading these individuals to become more sedentary and deconditioned. Mannerkorpi et al[11] found that the average 46-year-old woman diagnosed with FM showed a predicted fitness level, measured by the 6-minute walk, similar to that of a 60-year old woman. They also found that one third of the women diagnosed with FM did not have the upper-body strength (force-generating capacity of a muscle) or flexibility to carry out simple routine activities such as reaching high shelves or washing their hair.[11]

The inability to carry out routine activities has significant implications for disability, health care costs, and quality of life in this group of women, especially when problems are occurring at young ages. Studies that have evaluated activities in women with FM have not directly measured their functionality (ability to perform routine activities of daily living [ADL]) in a wide range of tasks, but rather have used questionnaires such as the Fibromyalgia Impact Questionnaire (FIQ). Although the FIQ is a validated instrument that assesses physical function, instrumental ADL, general well-being, and FM-related symptoms,[12] it is based on the respondent's self-reported answers. It has been shown previously that there may be some limitations to self-report ADL questionnaires[13,14] in that these questionnaires may not allow respondents to describe subtle improvements in ADL that may be clinically relevant.[14] Only one study[15] has assessed the functional ability of people with FM using standardized

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Approval of the study was obtained from the Institutional Review Board of Florida State University.

Abstracts of the data in this study have been presented at the national and regional meetings of the American College of Sports Medicine.

This study was funded by grants from Florida State University.

This article was received October 6, 2005, and was accepted July 5, 2006.

DOI: 10.2522/ptj.20050320

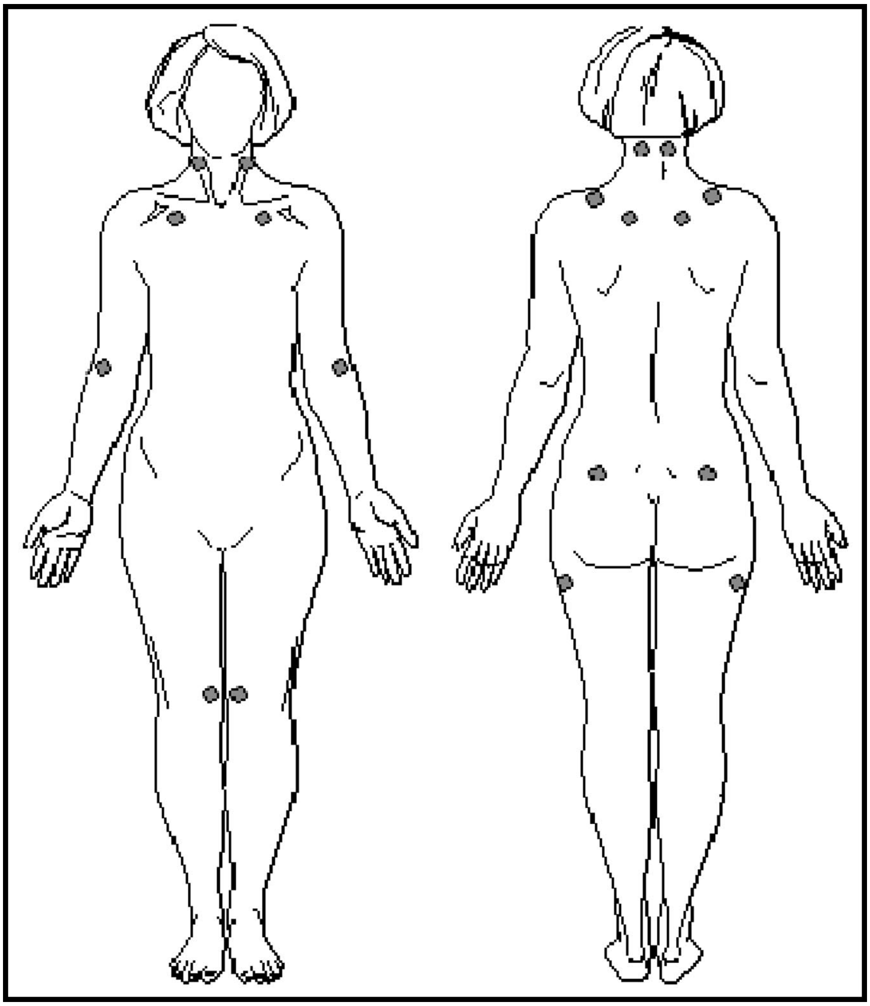

Figure.
Tender points for women with fibromyalgia.

work tasks. The selected tasks were designed to test common workday activities such as twisting knobs or turning screwdrivers, pushing and pulling at the level of the sternum, vacuuming and mopping, working above the shoulder and head level as in placing objects in cabinets, and lifting heavy objects from the floor. Cathey et al[15] found that women with FM performed only 58.6% of the work completed by individuals who did not have FM. The authors concluded that functional loss is present in people with FM and that dysfunction is a part of this syndrome.

Another performance measure that has been validated with data from older adults is the Continuous Scale–Physical Functional Performance Test (CS-PFP). The CS-PFP has been found to be a valid and reliable comprehensive test of physical functional performance.[16] This test is able to measure higher levels of function without having ceiling effects as well as being able to test individuals who cannot perform a task, thus eliminating floor effects.[16] The test is given under standard conditions, which ultimately minimizes variance and enhances the ability to detect changes from intervention programs or even drug therapy.[13,14,17] Functional performance is measured by the CS-PFP by simulating routine activities that consist of common household and community tasks. Tasks range from low functional demand (eg, pouring water into a cup) to high functional demand (eg, climbing simulated bus steps while carrying groceries). The CS-PFP consists of 5 domains (upper-body strength, upper-body flexibility, lower-body strength, balance and coordination, and endurance) and a total functionality score.

Because many women with FM complain of problems with simple routine activities, the present study was designed to measure functionality in this group of women with a validated physical function test. This test not only gives a score of total function, but also can give information on the specific areas of upper- and lower-body strength, endurance, flexibility, and balance and coordination with respect to function. This information can be important when developing intervention programs. A second purpose of the study was to compare the functionality of women with FM with age- and weight-matched women without FM and older women who are healthy to determine whether women with FM are actually functioning at levels similar to those of older adults and not at levels of women of similar age and body weight. Based on previous research,[11,15] we hypothesized that the age- and weight-matched controls would have higher functional scores than the women with FM and the older women. We also hypothesized, based on the research of poorer function[11,15] and fitness levels[11] in women with FM, that there would be no differences in functionality and strength between women with FM and older women who are healthy.

Method

Subjects

Twenty-nine women with FM (aged 18–54 years), 12 women (aged 28–54 years) who were healthy and matched, based on the means of age and weight, with the women with FM, and 38 older, community-dwelling

Table 1.
Characteristics of Women With Fibromyalgia (FM Group), Age- and Weight-Matched Controls (AWM Group), and Older Women (OW Group)[a]

Variable	FM Group (n=29)	AWM Group (n=12)	OW Group (n=38)
Age (y)	46±7 (18–54)	44±8 (28–54)	71±7[b] (59–91)
Height (cm)	164.5±5.5 (155.0–174.0)	162.9±5.3 (153.0–172.0)	159.9±6.4[c] (137.2–172.5)
Weight (kg)	84.2±21.6 (55.0–132.2)	84.2±21.6 (59.9–120.9)	66.2±14.4[c] (42.9–111.4)
BMI[d] (kg/m²)	31.1±7.0 (19.7–44.2)	30.6±6.3 (23.4–44.7)	25.9±5.4[c] (19.6–42.2)

[a] Values are means±SD (with ranges in parentheses).
[b] $P\leq.025$, significantly different from FM and AWM groups.
[c] $P\leq.025$, significantly different from FM group.
[d] BMI=body mass index.

women who were healthy (aged 59–91 years) were recruited for the study. The women with FM and the age- and weight-matched controls were significantly younger than the older women, and the women with FM had higher body mass index (BMI) values compared with the older women. The subject characteristics are presented in Table 1. The women with FM and the older women were convenience samples taken from 2 intervention studies. Baseline data were collected on these women before they started their respective intervention programs. Based on a power analysis using the total score of the CS-PFP from data in the study by Brochu et al,[18] 26 subjects would be needed per group to see a significant difference in scores with an effect size (ES) of 0.55 (61.2−52.0/16.5; ES=$[\mu_1-\mu_0]/S_0$), with an alpha level of .05 and a power of 0.80. Twelve women who were healthy were recruited from available faculty and staff in the college of Human Sciences at Florida State University with the goal of matching these women by the mean of their age and weight with the women diagnosed with FM. Because these women were a homogenous group and the variability was small, we were able to detect differences with a sample of 12 women.

The women with FM were previously diagnosed by their rheumatologist or primary care physician. Documentation on diagnosis of FM was received from all physicians. Potential subjects were excluded from the study if they had uncontrolled hypertension, uncontrolled diabetes, or active heart disease or were currently exercising or participating in an exercise program. Informed consent was obtained from all subjects prior to testing.

Data Collection

Data were collected over a 2-week period. Subjects came to the laboratory on 2 or 3 different occasions. Testing of functionality and strength measures were completed on separate days with at least 72 hours between tests. This was done in order to prevent fatigue and flare-ups (acute exacerbation of symptoms) in the women with FM. Tender-point evaluations and questionnaires on the effects of FM were completed on the third visit in only the women with FM.

Tender-point sensitivity. The number of tender points (Figure) and tender-point sensitivity were assessed by a board-certified rheumatologist only in the women who were diagnosed with FM. The rheumatologist determined the number of active tender points and rated the sensitivity of the pain on a scale of 0 (no pain) to 3 (withdrawal of the patient from the examiner) of each tender point to determine a myalgic score.[19] Each of the 18 tender points was evaluated, with the highest possible myalgic score being 54. The myalgic score is a rating given by the physician to describe the sensitivity of a tender point when pressure is applied. Test-retest correlations (r) for tender-point evaluations and myalgic scores of the 12 women with FM in the present study were .80 and .60, respectively.

Fibromyalgia Impact Questionnaire. The FIQ was used to assess the effects of FM on a week-to-week basis[12] only in the FM group. The FIQ consists of 20 questions pertaining to morning stiffness, mood, pain, and the ability to perform ADL. Scores range from 0 to 100 units; the higher the FIQ score, the greater the effects of the disease. On average people with FM score about 50 units, and an individual with severe effects of FM may score above 70 units. Construct validity for the FIQ has been demonstrated through correlations of FIQ scores for physical impairment, pain, depression, and anxiety with the Arthritis Impact Management Scale (r=.67–.76). Test-retest correlations have ranged from .56 for the pain scale to .95 for the physical function scale.[7]

Lower-body and upper-body strength measurements. Peak isokinetic knee extensor torque was measured at 60°/s using gravity correction on the Biodex Isokinetic Machine*. This measurement was chosen to compare

* Biodex Medical Systems, 20 Ramsay Rd, Shirley, NY 11967-4704.

the results the results of our study with those of previous studies of women with FM[20] and older adults.[21] The force generated by the quadriceps femoris muscle also is important in routine ADL. The dominant lower extremity, determined by asking the subjects whether they were right- or left-handed, was tested for peak force production. Subjects were seated in an upright position with the hips flexed to 90 degrees. The subjects' upper body, hips, and lower extremities were stabilized with shoulder, pelvic, thigh, and ankle straps.[22] After 3 practice trials, 3 maximal efforts at generating maximal force were recorded. The peak force (in newton-meters) from the 3 trials was used as the dependent measure. Peak force also was adjusted for body weight (in newton-meters per body weight in kilograms) to compare with results from other studies[21,23] and to control for differences in body weight among the 3 groups that may have an effect on absolute strength. The test-retest reliability of isokinetic test measurements of peak force of the right leg range from good to high, with reported *r* values of .85 to .97.[24,25]

On completion of the isokinetic testing, handgrip strength was measured using a handheld dynamometer (Jamar)† following published procedures.[26] Briefly, the subjects stood with the handgrip dynamometer parallel to the side of the body at about waist level. The grip bar was adjusted to fit comfortably in the subjects' hand with the middle phalanges under the grip handle. Subjects were requested to squeeze as hard as they could while exhaling. Each hand was tested, alternating back and forth for 3 trials. The highest force production (in kilograms) for each hand then was totaled for the dependent variable. This procedure was selected so that comparisons could be made with the results of previous research.[23,27] The reliability coefficients for handgrip testing are usually .90 or higher.[22] The test-retest correlations (*r*) for the handgrip and isokinetic measurements of the women with FM in the present study were .90 and .80, respectively, taken within a 2-week period.

Continuous Scale–Physical Functional Performance Test. The CS-PFP was developed using data collected on older adults with a broad range of physical abilities.[16] In previously published research, this test has been shown to have convergent, construct, and face validity for 16 everyday household tasks.[16] The CS-PFP has high reproducibility (r=.97)[16] and is sensitive to change induced by exercise, with an effect size of 0.80.[13] The test-retest correlation (*r*) for the total functionality scores of the women with FM in the present study was .90. The CS-PFP is specific for physical function and is not related to emotional or mental health or depression.[13] A detailed description of the procedures for the administration of the CS-PFP is published elsewhere.[13,28] The CS-PFP is based on routine tasks, performed at maximal effort within the bounds of safety and comfort. Sixteen tasks are administered, and a combination of time, distance, and weight is used to quantify performance. Tasks quantified using both weight and time include: (1) carrying of weight, (2) pouring water from a jug into a cup, (3) carrying weight up and down a simulated bus platform, and (4) carrying groceries. Tasks quantified by time alone include: (1) transferring laundry from a washer to a dryer, (2) putting on and removing a jacket, (3) floor sweeping, (4) vacuuming, (5) making a bed, (6) climbing stairs, (7) getting down and up from the floor, (8) pulling open a fire door, (9) putting a Velcro strap‡ over a shoe, and (10) picking up 4 scarves from the floor. Tasks that are quantified by distance alone include: (1) a 6-minute walk and (2) highest reach. Each task is scored from 0 to 100, based on an empirically derived range from data gathered on older adults with a broad range of individual functional abilities.[16]

Time was used to calculate speed (1/t), so that higher numbers reflected higher function for each unit of measure (weight, distance, and speed). Each task is scaled 1 to 100 according to the following formula:

$$\text{Corrected score} = (\text{observed score} - \text{lower limit}) / (\text{upper limit} - \text{lower limit}) \times 100$$

The total physical functional performance score (CS-PFP total) is the average corrected score of all tasks. The CS-PFP total can be broken down into 5 domains representing upper-body strength, upper-body flexibility, lower-body strength, balance and coordination, and endurance.

The laboratory for the administration of the CS-PFP was set up to adhere to the published dimensions,[16] and the CS-PFP was administered using the published protocol[13] and a scripted dialogue with minor changes tailored to this laboratory. Performance data were scored using the Web-based data reduction program.[28]

Before the start of the CS-PFP, all women had the procedures for testing explained to them. They were told to "perform each task safely, working as fast as you can." All women were fitted with transfer belts to protect them in case they slipped or stumbled when performing a task. At the completion of testing, subjects were asked to rate their perceived effort for the entire testing procedures of the CS-PFP from 6 to 20 on the Borg Rating of Perceived Exertion Scale.[26]

† Sammons Preston Rolyan, 4 Sammons Ct, Bolingbrook, IL 60440.

‡ Velcro USA Inc, 406 Brown Ave, Manchester, NH 03103.

Table 2.
Tender-Point Sensitivity, Myalgic Score, Fibromyalgia Impact Questionnaire (FIQ) Scores, and Activities of Daily Living (ADL) Score Derived From FIQ for Women With Fibromyalgia

Variable	$\overline{X}$	SD	Range
Fibromyalgia duration (y)	8	6	1–24
Total tender points	12	5	1–18
Myalgic score	15	7	1–33
FIQ (units)	59	17	16–86
ADL score from FIQ	8	6	1–24

Data Analysis

The independent variable was group (women with FM, age- and weight-matched controls, older women), and the dependent variables were the primary outcome categories of function (CS-PFP total) and strength. A Bonferroni test was used to correct for multiple primary outcomes with significance level set at P=.025 (.05/2). One-way analyses of variance (ANOVAs) were used to determine whether there were differences among the 3 groups of women. When significant differences were detected, Tukey *post hoc* tests were used to determine where the differences were located. Data are presented as means ± standard deviations. All statistical analyses were carried out using the SPSS (version 13.0) statistical package.[§]

Results

Table 2 presents the data for the women with FM in regard to duration since diagnosis, tender-point sensitivity, myalgic score, and effects of FM as measured by the FIQ. The women with FM had been diagnosed with the syndrome for an average of 8 years and were currently being treated by a primary care physician or a rheumatologist. The women had an average of 12 active tender points with a myalgic score of 15 units. The average FIQ score in the present study was 59 units. Sixty-two percent of the women with FM were taking pain medications, 41% were taking blood pressure medications, 41% were taking antidepressants, 14% were taking anti-anxiety medications, and 17% were taking cholesterol medications. None of the age- and weight-matched controls were taking medications for cholesterol or hypertension. One control subject was taking an antidepressant medication. Of the older women, 23% were taking pain medications, 44% were taking blood pressure medications, 13% were taking antidepressant medications, and 15% were taking cholesterol medications. The disease profile of the women with FM was similar to that of the older women.

Table 3 presents the strength measurements. There were no differences in handgrip strength between the women with FM and the age- and weight-matched controls. The older women were significantly weaker in handgrip strength compared with the other 2 groups. In the isokinetic knee extension strength measures, the age- and weight-matched controls were significantly stronger than both the women with FM and the older women and the women with FM were significantly stronger than the older women. However, when the isokinetic extension strength measure was taken relative to body weight, there were no strength differences between the women with FM and the older women. When evaluating the isokinetic flexion measures for both absolute and relative values, the age- and weight-matched controls were significantly stronger than the women with FM and the older women.

Functionality scores derived from the CS-PFP are presented in Table 4. The women with FM and the older women were not significantly different on total functionality or on any of the five domains of upper-body strength, lower-body strength, upper-body flexibility, balance and coordination, or endurance. Even when body weight and body mass index were used as covariates, there were still no differences in functionality between the two groups of women. Women with FM in this study were functioning at levels similar to those of older women with respect to their functionality measured by the CS-PFP. The age- and weight-matched controls had significantly higher scores in all domains of functionality and significantly higher total functionality scores. One of the components in calculating the endurance domain score is the 6 minute walk. The age- and weight-matched controls walked significantly farther (603.5±134.2 m) than the women with FM (486.8±82.5 m) and the older women (507.8±102.1 m) (Tab. 5).

Table 5 presents the raw data that were used to calculate the functionality scores for the domains of upper-body strength, lower-body strength, upper-body flexibility, balance and coordination, and endurance and the total functionality score. As expected, women with FM and older women carried less weight, performed tasks slower, and covered less distance than the age- and weight-matched controls.

Discussion

The present study showed that the women with FM had reduced lower-body strength and functionality compared with age- and weight-matched controls. The women with FM had functionality scores and lower-body strength scores similar to those of women who were on average 25 years older. These findings have serious implications for women with FM, who may be at risk for premature age-associated disability.

[§] SPSS Inc, 233 S Wacker Dr, Chicago, IL 60606.

Table 3.
Isokinetic Strength and Handgrip Measurements for Women With Fibromyalgia (FM Group), Age- and Weight-Matched Controls (AWM Group), and Older Women (OW Group)[a]

Variable	FM Group (n=29)	AWM Group (n=12)	OW Group (n=38)
Handgrip (kg)	39±11 (24–63)	40±12 (22–59)	26±10[b] (8–42)
60°/s isokinetic knee extension (N·m)	102±37 (27–182)	128±35[c] (86–215)	79±19[b] (47–123)
60°/s isokinetic knee extension/body weight (N·m/kg)	1.26±0.48 (0.29–2.23)	1.62±0.45[c] (0.89–2.34)	1.24±0.32 (0.58–1.86)
60°/s isokinetic knee flexion (N·m)	47±22 (8–103)	75±23[c] (45–126)	40±15 (6–78)
60°/s isokinetic knee flexion/body weight (N·m/kg)	0.59±0.26 (0.08–1.05)	0.93±0.27[c] (0.49–1.43)	0.61±0.22 (0.10–1.28)
60°/s isokinetic knee extension/body weight/height (N·m/[kg·m^{-1}])	2.07±0.79 (0.49–3.73)	2.62±0.73[c] (1.47–3.82)	1.98±0.51 (0.87–2.97)

[a] Values are means±SD (with ranges in parentheses).
[b] $P \leq .025$, significantly different from FM and AWM groups.
[c] $P \leq .025$, significantly different from FM and OW groups.

Table 4.
Functionality Scores on the Continuous Scale–Functional Performance Test (CS-PFP) for Women With Fibromyalgia (FM Group), Age- and Weight-Matched Controls (AWM Group), and Older Women (OW Group)[a]

Variable	FM Group (n=29)	AWM Group (n=12)	OW Group (n=38)
UBS domain (units)	47±12 (25–69)	68±9[b] (58–89)	50±14 (25–87)
UBF domain (units)	68±13 (40–88)	83±9[b] (64–95)	72±13 (41–91)
LBS domain (units)	42±16 (13–75)	63±7[b] (49–73)	42±16 (14–78)
BALC domain (units)	48±17 (12–82)	62±9[b] (48–80)	46±12 (20–70)
END domain (units)	52±17 (18–87)	67±8[b] (58–82)	50±13 (19–78)
CS-PFP total (units)	49±15 (19–80)	66±6[b] (57–76)	49±13 (21–78)
RPE	12±2 (6–15)	11±1 (9–13)	11±1 (7–13)

[a] Values are means±SD (with ranges in parentheses). UBS=upper-body strength, UBF=upper-body flexibility, LBS=lower-body strength, BALC=balance and coordination, END=endurance, RPE=rating of perceived exertion for the CS-PFP.
[b] $P \leq .025$, significantly different from FM and OW groups.

Previous research has documented that women with FM have lower muscular strength[15,23] and cardiovascular fitness[6,12] compared with age-and weight-matched controls. In the present study, we found that women with FM did not have decrements in upper-body strength compared with the age- and weight-matched controls. Both the women with FM and the age- and weight-matched controls had significantly higher handgrip values compared with the older women. A reason for the lack of difference in the women with FM may be due to the location of the tender points and the strength assessment tool that we used. Most of the tender points in the upper body are located in the neck and shoulder regions (Figure); therefore, these women may not be compromised in forearm strength due to the pain associated with their tender points. These results may have been different if we had used a measurement of upper-body strength that included more of the musculature in the upper back and shoulder regions. Another possibility is that the hands are used for most activities during the day and perhaps handgrip strength is preserved in women with FM. Therefore, our data do not support the notion that women with FM have lower upper-body strength when measured by the handgrip dynamometer.

The age- and weight-matched controls had significantly higher absolute and relative isokinetic values compared with the women with FM and the older women. The women with FM had significantly higher absolute strength values for isokinetic knee extension compared with the older women. However, when the lower-body strength measurements were adjusted for body weight, there were no differences in strength between the women with FM and the older women.

Our isokinetic knee extension and flexion measurements at 60°/s relative to body weight for the women with FM were very similar to the isokinetic extension and flexion values reported by Maquet et al[23] in women with FM (1.27±0.35 and 0.70±0.21 N·m/kg, respectively) of a similar age group (43±9 years). In the present study, the age- and weight-matched controls had greater isokinetic knee extension and flexion at 60°/s relative to body weight compared with the women with FM. Our data, therefore, are in agreement with the findings of other studies that women with FM have a reduction in lower-body strength values.

Table 5.
Raw Scores for the Continuous Scale–Physical Functional Performance Test (CS-PFP) for Women With Fibromyalgia (FM Group), Age- and Weight-Matched Controls (AWM Group), and Older Women (OW Group)[a]

Task	Variable	FM Group (n=29)	AWM Group (n=12)	OW Group (n=38)
Low effort				
Pot carry	Time (s)	3.9±1.3	3.6±0.6	3.8±0.8
	Weight (kg)	8.3±3.5	18.8±7.5[b]	10.7±3.7
Water pour	Time (s)	9.3±3.4	7.1±1.1	8.7±1.9
Jacket	Time (s)	13.0±3.9	11.6±3.1	12.8±3.5
Shoe strap	Time (s)	7.8±2.6	6.6±2.2	7.6±1.9
Scarves pickup	Time (s)	8.9±4.4[c]	5.1±1.0	6.6±2.0
Reach	Height (cm)	213.8±9.4	221.2±8.5[b]	211.2±7.0
	Height/body height	1.30±0.03[c]	1.36±0.01[b]	1.32±0.03
Medium effort				
Sweep	Time (s)	33.7±14.0	28.5±9.2	35.5±13.3
Laundry 1	Time (s)	29.2±9.0	23.2±2.9	29.2±7.7
Laundry 2	Time (s)	20.7±5.1	14.9±2.3[b]	19.3±4.4
Bed making	Time (s)	83.2±27.8	66.9±16.0[b]	98.6±40.8
Vacuum	Time (s)	53.6±16.6[c]	36.8±11.7	42.2±12.6
Floor sit	Time (s)	11.2±4.6	6.5±1.4[b]	12.7±5.3
Fire door	Time (s)	3.0±1.1	2.7±0.5	3.7±1.0[d]
High effort				
Bus stop	Time (s)	20.1±5.9	20.3±7.4	22.6±5.6
	Weight (kg)	8.3±3.4[c]	15.5±6.1[b]	10.9±4.4[d]
Grocery	Time (s)	53.2±10.3	53.0±17.9	55.6±10.6
	Weight (kg)	7.4±4.5	14.9±5.5[b]	9.3±4.9
6-min walk	Distance (m)	486.8±82.5	603.5±134.2[b]	507.8±102.1
Stair climb	Time (s)	7.1±2.8	5.0±1.3[b]	6.6±1.6

[a] Values are means±SD. Height/body height=ratio of the height that was reached divided by the body height of subject.
[b] $P \leq .025$, significantly different from FM and OW groups.
[c] $P \leq .025$, significantly different from AWM and OW groups.
[d] $P < .05$, significantly different from FM and AWM groups.

Although we did not directly measure cardiovascular fitness in the 3 groups, we did measure the 6-minute walk as part of the measure of total functionality and of functionality in the endurance domain. Pankoff et al[29] have shown the reliability of measurements for the 6-minute walk to be excellent in women with FM. Their intraclass correlation coefficient was .91, which was similar to the value of .93 that we obtained in the present study. Again, the data were not significantly different between the women with FM and the older women. The older women walked an average distance of 507.8±102.1 m in 6 minutes, and the women with FM walked an average of 486.8±82.5 m. The age- and weight-matched controls walked significantly farther than the women with FM and the older women, with a mean distance of 603.5±134.2 m. Our data are in agreement with the data published by Mannerkorpi et al[11] for women with FM (mean age=46 years). Mannerkorpi et al[11] reported that the women with FM in their study walked 489.0±96.4 m in 6 minutes, with a range of 200 to 703 m. Pankoff et al[29] also found women with FM (27–59 years of age) walked 478±61 m, 492±57 m, and 495±60 m over 3 days of reliability testing for the 6-minute walk test. Our data are very similar to data collected by Mannerkorpi et al[11] and Pankoff et al[29] and support the notion that women with FM have a reduced cardiovascular fitness much like that of older women.

We are the first group of researchers to utilize the CS-PFP, a valid and reliable tool, to evaluate functionality of routine activities in women diagnosed with FM. What is unique about the CS-PFP is the information that is given on the specific areas of upper- and lower-body strength, endurance, flexibility, and balance and coordination with respect to total function. In the present study, we found that the age- and weight-matched controls had a significantly higher total functionality score than the other 2 groups of women as well as higher scores for the domains of upper- and lower-body strength, endurance, upper-body flexibility, and balance and coordination. The women with FM and the older women were not different from each other in total functionality or in the domains of functionality.

From a purely statistical interpretation, the finding of no difference between the women with FM and the older women could simply mean that the between-group variance and the within-group variance are unbiased estimates of the same value, the population error variance.[30] This could suggest that there are large variances in both groups (high variation within each group) that would essentially eliminate any between-group differences. When the functional means and standard deviations (eg, CS-PFP total of 49±15 the women with FM and 49±13 for the older women) are compared, the means are exactly the same and the standard deviations are similar and not extremely high. This suggests that there are no true differences between the women with FM and the older women.

Examination of the raw scores of the women with FM and the older women shows that both groups of women had difficulty with similar tasks. The lower scores for both groups of women were for tasks that required greater strength (grocery and pot carry), endurance (6-minute walk and stair climb), and flexibility (scarf pickup and reach). The lower scores in these areas also were associated with longer times to complete the given tasks (bed making and floor sit). In some instances, the women with FM performed poorer than the older women (bus stop weight carry and scarf pickup). Although 5 of the 17 tasks were not significantly different across the 3 groups, in most of these tasks, the women with FM performed similar to the older women. The CS-PFP consecutive task performance yields cumulative information that is often missed in simple task evaluation. However, the summary scores of the CS-PFP and its domains can capture these subtle differences.

The decrements in functionality in the women with FM could have been due, in part, to their chronic pain. However, the women were instructed to take their regular medications before coming to the laboratory for testing. Many of the women verbally expressed soreness during the different tasks, but they did not believe that their soreness limited their performance except in the overhead reach task. Many of the tender points are clustered around the neck area, making it difficult to lift the arms over the head. This was the only task that required subjects to reach with their arms above their shoulders. We also found the retest reliability to be high in the women with FM (r=.90). Because values were so similar between the women with FM and the older women and the retest reliability was high, we believe that the decrements in functionality were due to reductions in strength, cardiovascular fitness, and flexibility.

The CS-PFP has been used to test individuals with a broad range of abilities. Cress et al[16] reported that older individuals (>70 years of age) living in the community at large had a CS-PFP score of 54±11 units, whereas residents of a retirement community with a continuum of care scored 42±15 units if they did not have self-reported functional limitations and 24±9 units if they had self-reported functional deficits. Twenty-one (72%) of the women with FM were functioning below a CS-PFP score of 54, and 29 (76%) of the older women were functioning below this score. These findings do not bode well for the women with FM, who—in some cases—were 25 years younger than the older women and had similar strength and functional ability. When talking to both groups of women, many of them reported that they had made modifications in their routine activities. Some of the women with FM had made alterations in their kitchens so that they did not have to reach above their shoulders to get items from cabinets. Household members also were helping many of these women with housework and with the shopping. The women with FM in the present study were scoring similar to the older individuals in the study by Cress et al[16] who are living independently in a retirement community. Yet their FIQ scores indicate that their disease is having significant effects on their quality of life. Therefore, these women with FM may be at greater risk of disability, especially as they continue to age.

The FIQ has been used in a number of intervention studies as a primary outcome variable to assess the effects of FM on ADL.[2–4,6,20] However, there has been some concern that there may be some limitations to self-report ADL questionnaires.[13,14] Activities of daily living questionnaires may not allow respondents to describe subtle improvements that may be clinically relevant after intervention studies, especially if they do not perform the questioned activity as part of their daily routine.[14] The CS-PFP would be an ideal tool to use in combination with the FIQ because the CS-PFP may pick up changes that occur with intervention programs that the FIQ may miss. The CS-PFP also gives information on specific areas of impairments (strength, endurance, flexibility) so that intervention programs can be tailored to the individual's needs.

There are a few limitations of the study that need to be addressed. When we assessed the tender-point sensitivity of the women, we did not ask them to refrain from taking their pain medications; therefore, some of the women did not have 11 of the 18 tender points. However, their physicians did have to sign a physician form stating the women had been previously diagnosed with FM. For a true diagnosis of the number of tender points and their sensitivity, the women should have been off their medications for at least 24 hours. The women also took their regular pain medications the day of the functional testing, which may have improved their ability to perform these routine tasks of daily living. Although the CS-PFP was validated in older adults with a broad range of abilities, these tasks also are commonly performed by individuals with varying conditions, including FM. The routine activities that are included in this test are not specific to an older population but are activities used in independent living regardless of age.

Conclusions

The results of this study suggest that women with FM have reduced lower-body strength and functionality, as measured by the CS-PFP, compared with age- and weight-matched controls. The women with FM had functionality scores similar to those of the older women; therefore, women with FM may be at a greater risk for premature disability. Ultimately, the inability to perform routine tasks of daily living may significantly lower the quality of life in women with FM. Therefore, it is important to develop future studies that evaluate intervention programs to address functionality and its domains in women with FM.

References

1 Wolfe F, Smythe HA, Yunus MB, et al. The American College of Rheumatology 1990 criteria for classification of fibromyalgia: report of the Multicenter Criteria Committee. *Arthritis Rheum.* 1990;33:160–172.

2 Gowans SE, deHueck A, Voss S, et al. Effect of a randomized, controlled trial of exercise on mood and physical function in individuals with fibromyalgia. *Arthritis Rheum* 2001;45:519–529.

3 Geel SE, Robergs RA. The effect of graded resistance exercise on fibromyalgia symptoms and muscle bioenergetics: a pilot study. *Arthritis Rheum.* 2002;47:82–86.

4 Martin L, Nutting A, MacIntosh BR, et al. An exercise program in the treatment of fibromyalgia. *J Rheumatol.* 1996;23:1050–1053.

5 Hakkinen K, Pakarinen A, Hannonen P, 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;29:1287–1295.

6 Rooks DS, Silverman CB, Kantrowitz FG. The effects of progressive strength training and aerobic exercise on muscle strength and cardiovascular fitness in women with fibromyalgia: a pilot study. *Arthritis Rheum.* 2002;47:22–28.

7 Burckhardt CS, Clark SR, Nelson DL. Assessing physical fitness of women with rheumatic disease. *Arthritis Care Res.* 1988;1:38–44.

8 Nielens H, Boisset V, Masquelier E. Fitness and perceived exertion in patients with fibromyalgia syndrome. *Clin J Pain.* 2000;16:209–213.

9 Bengtsson A, Henriksson KG, Jorfeldt L, et al. Primary fibromyalgia: a clinical and laboratory study of 55 patients. *Scand J Rheumatol.* 1986;15:340–347.

10 Henriksson KG, Bengtsson A, Larson J, et al. Muscle biopsy findings of possible diagnostic importance in primary fibromyalgia (fibrositis, myofacial syndrome) [letter]. *Lancet.* 1982;2:1395.

11 Mannerkorpi K, Burckhardt CS, Bjelle A. Physical performance characteristics of women with fibromyalgia. *Arthritis Care Res.* 1994;7:123–129.

12 Burckhardt CS, Clark SR, Bennett RM. The Fibromyalgia Impact Questionnaire: development and validation. *J Rheumatol.* 1991;18:728–733.

13 Cress ME, Buchner DM, Questad KA, et al. Exercise: effects on physical functional performance in independent older adults. *J Gerontol A Biol Sci Med Sci.* 1999;54:M242–M248.

14 Ades PA, Savage PD, Cress ME, et al. Resistance training on physical performance in disabled older female cardiac patients. *Med Sci Exerc Sports.* 2003;35:1265–1270.

15 Cathey MA, Wolfe F, Kleinheksel SM. Functional ability and work status in patients with fibromyalgia. *Arthritis Care Res.* 1988;1:85–98.

16 Cress ME, Buchner DM, Questad KA, et al. Continuous-scale physical functional performance in healthy older adults: a validation study. *Arch Phys Med Rehabil.* 1996;77:1243–1250.

17 Miszko TA, Cress ME, Slade JM, et al. Effect of strength and power training on physical function in community-dwelling older adults. *J Gerontol A Biol Sci Med Sci.* 2003;58:171–175.

18 Brochu M, Savage P, Lee M, et al. Effects of resistance training on physical function in older disabled women with coronary heart disease. *J Appl Physiol.* 2002;92:672–678.

19 Inanici F, Yunus MB. History of fibromyalgia: past to present. *Curr Pain Headache Rep.* 2004;8:369–378.

20 Mannerkorpi K, Nyberg B, Ahlmen M, Ekdahl C. Pool exercise combined with an education program for patients with fibromyalgia syndrome: a prospective, randomized study. *J Rheumatol.* 2000;27:2473–2481.

21 Cress ME, Meyer M. Maximal voluntary performance levels needed for independence in adults aged 65 to 97 years. *Phys Ther.* 2003;83:37–48.

22 Adams GM, *Exercise Physiology Laboratory Manual.* 3rd ed. Boston, Mass: WCB McGraw-Hill; 1998.

23 Maquet D, Croisier J, Renard C, Crielaard JM. Muscle performance in patients with fibromyalgia. *Joint Bone Spine.* 2002;69:293–299.

24 Clarkson PM, Johnson J, Dextradeur D, et al. The relationships among isokinetic endurance, initial strength level, and fiber type. *Res Q.* 1982;53:15–19.

25 Perrin DH. Reliability of isokinetic measures. *Athletic Training.* 1986;21:319–321.

26 *ACSM's Health-Related Physical Fitness Assessment Manual.* Philadelphia, Pa: Lippincott Williams & Wilkins; 2005.

27 Sahin G, Ulubas B, Calikoglu M, Erdogan C. Handgrip strength, pulmonary function tests, and pulmonary muscle strength in fibromyalgia syndrome: Is there any relationship? *South Med J.* 2004;97:25–29.

28 Continuous Scale–Physical Functional Performance Test (CS-PFP). Available at: http://www.coe.uga.edu/CS-PFP/.

29 Pankoff BA, Overend TJ, Lucy SD, White KP. Reliability of the six-minute walk test in people with fibromyalgia. *Arthritis Care Res.* 2000;13:291–295.

30 Hayes WL, *Statistics for Psychologists.* New York, NY: Holt, Rinehart and Winston; 1963.