Research Report

Chronic Fatigue Syndrome: Lack of Association Between Pain-Related Fear of Movement and Exercise Capacity and Disability

Background and Purpose. Patients who experience pain, a symptom of chronic fatigue syndrome (CFS), often exhibit kinesiophobia (irrational fear of movement). The purpose of this study was to examine whether pain-related fear of movement is associated with exercise capacity, activity limitations, or participation restrictions in patients with CFS who experience widespread pain. **Subjects and Methods.** Sixty-four subjects met the inclusion criteria. All subjects fulfilled the 1994 Centers for Disease Control and Prevention case definition for CFS and experienced widespread myalgias or arthralgias. The subjects completed the Tampa Scale for Kinesiophobia–Dutch Version (TSK-DV) and the Dutch Chronic Fatigue Syndrome–Activities and Participation Questionnaire (CFS-APQ). They then performed a maximal exercise test on a bicycle ergometer. Heart rate was monitored continuously by use of an electrocardiograph. Ventilatory factors were measured through spirometry. Correlations between the TSK-DV scores and both the exercise capacity data and the CFS-APQ scores were assessed using the Spearman rank correlation coefficient. Using the Mann-Whitney *U* test, the TSK-DV scores were compared between subjects who performed a maximal exercise stress test and those who did not perform the test. **Results.** Forty-seven subjects (73.4%) attained a total score of greater than 37 on the TSK-DV, indicating high fear of movement. Neither the exercise capacity data nor the CFS-APQ scores indicated a correlation with the TSK-DV scores (n=64). Subjects who did not perform a maximal exercise capacity test had more fear of movement (median TSK-DV score=43.0, interquartile range=10.3) compared with those who did perform a maximal exercise capacity test (median TSK-DV score=38.0, interquartile range=13.2; Mann-Whitney *U*-test score=322.5, $z=-1.974$, $P=.048$), but the correlation analysis was unable to reveal an association between exercise capacity and kinesiophobia in either subgroup. **Discussion and Conclusion.** These results indicate a lack of correlation between kinesiophobia and exercise capacity, activity limitations, or participation restrictions, at least in patients with CFS who are experiencing widespread muscle or joint pain. [Nijs J, Vanherberghen K, Duquet W, De Meirleir K. Chronic fatigue syndrome: lack of association between pain-related fear of movement and exercise capacity and disability. *Phys Ther*. 2004;84:696–705.]

Key Words: *Chronic fatigue syndrome, Exercise, Fatigue, Kinesiophobia, Movement, Pain.*

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The main feature of chronic fatigue syndrome (CFS) is debilitating fatigue lasting at least 6 months, accompanied by various other symptoms, such as low-grade fever, pharyngitis, painful lymph nodes, headaches, widespread myalgias and arthralgias, sleep disturbances, neurocognitive complaints, and depression.[1,2] Symptoms are often present at rest, and mild physical exertion can greatly exacerbate the symptoms. The most widely applied criteria for establishing the medical diagnosis of CFS are those generated by the Centers for Disease Control and Prevention in 1994.[1] However, a single diagnostic test for CFS has not yet been established. Based on data reported in the literature, McCully and colleagues[3] concluded that many patients with CFS improve slowly (ie, symptom severity, quality of life), but rarely do they completely recover. The pathogenesis of the illness has not been completely delineated,[4] but CFS is most likely characterized by a combination of both physiologic and psychological impairments.[5] Whiting and colleagues[6] performed a systematic literature review to assess the effectiveness of interventions that have been evaluated for use in the management of patients with CFS. They found that 3 high-quality randomized controlled clinical trials all indicated overall beneficial effects of graded exercise therapy.[6] Because graded exercise regimens require increases in physical activity, this treatment approach focuses on decreasing avoidance behavior toward physical activity.

Many investigators found reduced exercise capacity in patients with CFS,[7–11] whereas others did not.[12–14] Patients with CFS typically experience worsening of symptoms after previously well-tolerated levels of exercise.[1,15] Fischler et al[8] contended that this worsening of symptoms may cause avoidance behavior, especially

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Dr Nijs provided concept/idea/research design and project management. Dr Nijs and Ms Vanherberghen provided writing. Dr Nijs, Ms Vanherberghen, and Dr De Meirleir provided data collection, and Dr Nijs, Ms Vanherberghen, and Dr Duquet provided data analysis. Dr De Meirleir provided fund procurement, subjects, and facilities/equipment. Ms Vanherberghen, Dr Duquet, and Dr De Meirleir provided consultation. The authors thank Lieve De Hauwere, GFN, for her aid during the exercise capacity stress testing and Elke Van Hoof, PhD, Clin Psych, for her critique and input into the final version of the manuscript.

This research was presented, in part, at the 14th International Congress of the World Confederation for Physical Therapy; June 7–12, 2003; Barcelona, Spain.

This article was received November 24, 2003, and was accepted January 14, 2004.

toward fatiguing physical activities ("fear of movement") such as a maximal exercise stress test.

Kinesiophobia is defined as "an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury"[16(p35)] and has been reported to be a common feature of patients with CFS, fibromyalgia, and chronic low back pain.[17–19] Researchers[18,19] have demonstrated that both patients with CFS and those with chronic low back pain who have high amounts of kinesiophobia are more likely to exhibit avoidance of physical activity. Numerous investigators[20–22] have speculated that avoidance of physical activity may be maladaptive and may cause a greater burden in patients with CFS, providing part of the rationale for incorporating graded exercise therapy into the management of people with CFS. To our knowledge, evidence pointing to the contribution of avoidance behavior toward physical activity to CFS disability is scarce, with only one report by Fischler and colleagues.[8] They used the nonachievement of 85% of age-predicted maximal heart rate during incremental exercise as the sole criterion for avoidance behavior. However, according to the American College of Sports Medicine, the achievement of age-predicted maximal heart rate shows high intersubject variability,[23] and there is no experimental evidence supporting the validity of the failure to achieve 85% of age-predicted maximal heart rate for the assessment of avoidance of physical activity. Thus, further investigation regarding the associations among avoidance of physical activity, exercise capacity, and CFS disability is warranted.

In our cross-sectional study, 64 consecutive patients with CFS were studied to explore the associations between kinesiophobia, exercise capacity, and disability in patients with CFS. We assessed kinesiophobia using the Tampa Scale for Kinesiophobia–Dutch Version (TSK-DV),[24] exercise capacity using a maximal exercise stress test with open-circuit spirometry, and disability using the Dutch Chronic Fatigue Syndrome–Activities and Participation Questionnaire (CFS-APQ).[25] The TSK-DV assesses fear of movement in patients with pain.[16,18] Consequently, we focused on patients with CFS who experienced widespread pain. We hypothesized that, in patients with CFS who experience widespread pain, more kinesiophobia would be associated with impairments in cardiorespiratory fitness, activity limitations, and participation restrictions. Additionally, we hypothesized that patients who did not perform a maximal exercise test would have more kinesiophobia as compared with patients who were able to reach the criteria for a maximal performance.

Method

Subjects

All Dutch-speaking patients attending the outpatient Chronic Fatigue Clinic of the Vrije Universiteit Brussel (VUB) between October 1, 2001, and April 30, 2002, were asked to participate in the study. A letter explaining the nature and purpose of the research and stipulating that patients were not obligated to participate and that anonymity was guaranteed was handed out to the patients. The letter of introduction was followed by use of standardized sheets for the assessment of the demographic features of each patient (age, sex, and illness duration). Next, all patients were asked to complete 2 questionnaires (TSK-DV and CFS-APQ), without providing additional information, even when they asked for additional clarification (approximately 20% of the sample did). This was an attempt to minimize administrator bias. After completing the questionnaires, the patients performed a maximal exercise stress test (until exhaustion).

Patients who did not fulfill the 1994 case definition for CFS[1] were excluded from the sample. To fulfill the CDC criteria for CFS, unexplained, persistent, or relapsing chronic fatigue that is of new or a definite onset should result in a substantial reduction in previous levels of occupational, educational, social, or personal activities.[1] Furthermore, at least 4 of the following symptoms must have persisted during 6 or more consecutive months and must not have predated the fatigue: impairment in short-term memory or concentration, tender cervical or axillary lymph nodes, generalized muscle pain, multijoint pain, headache, unrefreshing sleep, and postexertional malaise for longer than 24 hours.[1] Any active medical condition that may explain the presence of chronic fatigue prohibits the diagnosis of CFS. All patients, therefore, underwent an extensive medical evaluation consisting of a physical examination, a medical history, exercise capacity testing, and routine laboratory tests. The laboratory tests included a complete blood cell count; determination of the erythrocyte sedimentation rate; serum electrolyte panel; measures of renal, hepatic, and thyroid function; and rheumatic and viral screens. If the patient's medical history did not exclude a psychiatric problem at the time of onset of the fatigue syndrome, then a structured psychiatric interview was performed by a physiatrist. In a number of cases, further neurological, gynecological, endocrine, cardiac, or gastrointestinal evaluations were performed by physicians who specialized in these disciplines. The medical records also were reviewed to determine if patients had organic or psychiatric illnesses that could explain their symptoms. Furthermore, if the patients' medical records indicated that they visited the Chronic Fatigue Clinic for

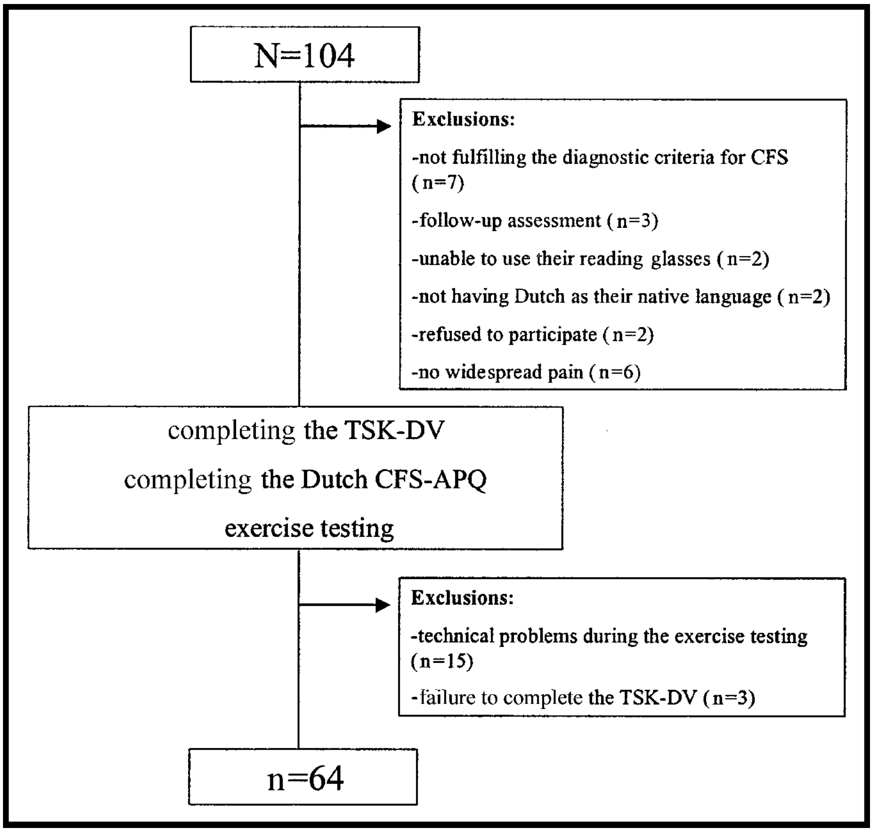

Figure.
Web diagram of the sample. CFS=chronic fatigue syndrome, TSK-DV=Tampa Scale for Kinesiophobia–Dutch Version, CFS-APQ=Dutch Chronic Fatigue Syndrome–Activities and Participation Questionnaire.

a follow-up assessment or if patients were less than 18 years of age, they were excluded from the sample.

We focused on the baseline assessment of adults with CFS. We believe that underaged patients (<18 years of age) demonstrate different activity limitations and participation restrictions when compared with adults. Patients whose native language was not Dutch or who were unable to use their reading glasses were deemed unable to complete the questionnaires properly and were excluded from the sample. Finally, because the Tampa Scale for Kinesiophobia (TSK) was constructed to measure fear of movement in patients with pain,[16,18] patients without widespread myalgias or arthralgias also were excluded. The definition of "widespread pain," as stated in the American College of Rheumatology 1990 criteria for the classification of fibromyalgia,[26] was applied to examine whether it was present in the patients with CFS. Pain, according to this definition, is considered widespread when all of the following are present: pain in both the left and right sides of the body, pain both above and below the waist, and axial skeletal pain.[26]

A total of 104 consecutive patients with chronic fatigue (88 female, 16 male) were asked to participate in this study (Figure). Seven patients did not fulfill the 1994 CDC case definition for CFS,[1] 3 patients with CFS visited the Chronic Fatigue Clinic for a follow-up assessment, 2 patients were unable to use their reading glasses, and 2 patients were excluded because their native language was not Dutch. Two patients refused to participate (one patient reported being too fatigued to complete the questionnaires, and the other patient was unable to perform the exercise stress test). Data could not be collected during exercise testing for 15 patients due to technical problems (eg, problems with the printer, patients being unable to wear the mask). Three patients were excluded because they did not complete the TSK-DV. Six of the remaining 70 patients did not experience widespread pain, as defined in the American College of Rheumatology 1990 criteria for the classification of fibromyalgia,[26] and therefore were excluded.

The remaining 64 patients (58 female, 6 male) ranged in age from 23 to 65 years ($\bar{X}$=39.63, SD=8.82). The mean illness duration was 64 months (SD=46.5, range=9–240, median=48). The patients who completed the data collection (n=64) did not differ from the patients whose data collection was confounded by technical problems (n=15) in TSK-DV scores (Mann-Whitney U-test score=465.0, $z=-0.188$, $P=.851$), age ($t=1.102$, $df=77$, $P=.274$), or illness duration ($t=1.302$, $df=77$, $P=.197$). The former group, however, had fewer male patients (6/64) compared with the latter group (6/15) ($P=.008$). The data for each of the variables in the Student t-test analysis were normally distributed (based on the outcome of the Kolmogorov-Smirnov goodness-of-fit test).

Questionnaires

The TSK, a 17-item questionnaire developed by Kori et al,[16] was used for the assessment of kinesiophobia in the patients with CFS who experienced widespread pain. Each of the items of the TSK consists of a 4-point Likert scale with scoring alternatives ranging from "strongly agree" to "strongly disagree." This measure was constructed to measure pain-related fear of movement in patients with pain.[16,18] Indeed, 11 of the 17 questions focus on pain (for instance, item 12 states: "Although my condition is painful, I would be better off if I were physically active."), and the TSK-DV scores showed small correlations with measurements of pain intensity (Pearson r=.25, P<.01).[24] Because Blakely and colleagues[27] concluded that patients with CFS do not differ from patients with chronic pain regarding either ways of coping or self-reported psychiatric symptoms, we deemed this questionnaire to be appropriate for the former population as well, even though it very weakly correlates with pain. A total score is calculated (1–4 for each item) after inversion of the individual scores of items 4, 8, 12, and 16. Total scores for the TSK range between 17 and 68, with scores of 37 or less suggestive of low fear of movement and scores of greater than 37 indicating high fear of movement.[24] Vlaeyen et al[24] used the median score of a sample of patients with chronic low back pain as the cutoff; this cutoff has been used for categorizing patients with CFS as well.[19]

In 1995, the original TSK was translated into Dutch.[18,24] Using a maximum time interval of 24 hours in a sample of patients with acute low back pain, the test-retest correlation coefficient (Pearson r) was .78.[28] The scores obtained with the TSK-DV showed a correlation with scores obtained with other measures of fear (Pearson r=.27–.33 between TSK-DV scores and subscale scores of the Fear Survey Schedule; r=.52 between TSK-DV scores and measurements of fear intensity obtained using a visual analog scale).[24] Furthermore, a negative correlation was demonstrated between TSK-DV scores and scores on the Behavioral Approach Test (the time during which the patients were able to lift a 5.5-kg bag; Pearson r=−.44) (criterion validity).[24] Although many of these correlations are very weak, they offered us statistics that we could use.

In accordance with the World Health Organization's taxonomy, the International Classification of Functioning, Disability and Health,[29] the CFS-APQ is designed to monitor activity limitations and participation restrictions in patients with CFS.[25] Its construction was based on self-reported activity limitations and participation restrictions in a large sample of patients with CFS.[25] The scoring system of the CFS-APQ, as described elsewhere,[25,30] generates 2 overall scores. The first total score (CFS-APQ1) uses an importance verification to acknowledge that people value things differently, while the second total score (CFS-APQ2) does not take this importance verification into account. The importance verification system is based on the assumption that a patient with disability in activities that are important to him or her has a lower quality of life than a patient with disability in activities that are less important to him or her.[31] Twenty-six items compose the questionnaire. A CFS-APQ1 score of 1 indicates no activity limitations or participation restrictions, whereas the maximum score of 16 represents very severe activity limitations and participation restrictions; for the CFS-APQ2, the scores range between 1 and 4.

Using the Dutch version of the CFS-APQ in a sample of 47 adults with CFS, intraclass correlation coefficients for test-retest reliability of the overall scores were ≥.95 (P<.001).[30] In the same study, the overall scores on the CFS-APQ showed a small correlation with visual analog scale scores for pain (Spearman rho=.51, P<.001) and fatigue (rho=.50, P<.001), substantiating the convergent validity of the scores obtained with the Dutch CFS-APQ.[30] Data documenting the content validity of scores obtained for this measure in patients with CFS also have been reported.[30]

Exercise Testing

The subjects performed a bicycle ergometric test against a graded increase in workload until exhaustion was reached.[7] The exercise tests were performed at a humidity of 40% to 60% and at a room temperature of 20° to 22°C. The subjects were asked to take a sitting position on the electromagnetically braked ergometer (Jaeger 900*), and, after 3 to 5 minutes of adjustment to the position, the test was started. Heart rate was monitored continuously at rest and during exercise. There was continuous recording of the 12-lead electrocardiogram using an electrocardiograph.† In order to collect pulmonary data during the test, we used an open-circuit spirometer (Mijnhart Oxycon‡) with automatic printout every 30 seconds. Automatic averages were attained for peak oxygen uptake ($\dot{V}O_2$peak) and maximal carbon dioxide production during every 30-second interval for the duration of each stage of the exercise. A 2-way breathing valve attached to a mask, which covered the subjects' nose and mouth, was used to collect the expired air. The air was analyzed continuously for ventilatory and metabolic variables. Prior to each test, the spirometer was calibrated for environmental conditions.

We chose a constant increase of 10 W/min to be used with subjects in order to obtain a total exercise duration between 8 and 12 minutes, the time that has been suggested as being an optimal test period for individuals without known pathology or limitations.[32] In order to avoid early onset of fatigue in the lower extremities due to inadequate physical fitness, the duration of the exercise was kept below 15 minutes. All subjects started the test at 10 W, with an increase of 10 W/min.[7] Regardless whether or not they reached the criteria for a maximal performance, all subjects were instructed to cycle until exhaustion was reached. In a previous study,[7] this exercise capacity stress testing protocol was able to

* Lode BV, Groningen, the Netherlands.
† Marquette Electronics Inc, Milwaukee, WI 53201.
‡ IBM, Bunnik, the Netherlands.

distinguish women with CFS from sedentary controls without CFS.

The following factors were measured and extrapolated: heart rate at rest (HRrest), peak heart rate (HRpeak), exercise duration, maximal work capacity attained, $\dot{V}O_2$peak, O_2peak per kilogram of body weight, peak respiratory quotient (RQpeak), heart rate at respiratory quotient (RQ)=1.0, peak work rate at RQ=1.0, and percentage of target heart rate (%THR). The age-predicted HRpeak was calculated as 220 minus the subject's age in years.[33] The metabolic data analyzed were the means of the last 30 seconds from the final stage of exercise or the highest value attained if a decline in oxygen uptake ($\dot{V}O_2$) occurred at the final workload.[7] The exercise capacity stress test was considered a maximal performance when: (1) the RQpeak reached the value of 1.0 and (2) an HRpeak of at least 85% of the age-predicted target heart rate was achieved (both criteria had to be met in order to be classified into the maximal performance group).[7] Still, subjects and testers were unaware of these criteria during the testing, indicating that the test was not ended when the criteria for performing a maximal effort were achieved.

Data Analysis

All data were analyzed using SPSS 10.0 for Windows.[§] Appropriate descriptive statistics (mean and standard deviation for age, illness duration, and the exercise capacity factors; frequencies and percentages for gender distribution and the prevalence of kinesiophobia; and median and interquartile range for the scores obtained with both questionnaires) were used. The data obtained from subjects whose data collection was confounded by technical problems were compared with the characteristics of the subjects who completed the data collection using the Fisher exact test (gender distribution), the independent-samples nonparametric Mann-Whitney *U* test (2-tailed for the scores obtained with the TSK-DV), and the Student *t* test (independent-samples *t* test, 2-tailed for illness duration and age). The one-sample Kolmogorov-Smirnov goodness-of-fit test was used to examine whether the data of each of the variables, entering the Student *t*-test analysis, were normally distributed. Correlations between the scores obtained with the TSK-DV and both the CFS-APQ and exercise capacity data were assessed using the Spearman rank correlation coefficient.

Next, the sample was divided into 2 groups based on their ability to perform a maximal effort during the exercise testing (defined by 2 endpoints: RQpeak of ≥1.0 and an age-predicted target heart rate of at least 85%[7]), and the correlation analysis was performed for both groups separately. The differences between these 2 groups were assessed using the Student *t* test (independent-samples *t* test, 2-tailed for illness duration and age), the Fisher exact test (gender distribution), and the independent-samples nonparametric Mann-Whitney *U* test (2-tailed for the scores obtained with the TSK-DV). Again, the one-sample Kolmogorov-Smirnov goodness-of-fit test was used to examine whether the data of each of the variables, entering the Student *t*-test analysis, were normally distributed. The level of significance was set at .05, but, for the purpose of the correlation analysis, it was adjusted using the Bonferroni correction[34] to allow for multiple comparisons.

Results

All descriptive data from the questionnaires and the exercise capacity factors are presented in Table 1. The correlation analysis between the scores obtained with the TSK-DV and both the exercise capacity data and the CFS-APQ scores showed no correlations, not even at the .05 level (Tab. 2).

The majority of the subjects attained the required RQ threshold of 1.0 (n=55 [85.9%]). However, only 22 of the 64 patients (34.4%) attained the required percentage of age-predicted target heart rate. Neither the subjects who fulfilled both criteria for a maximal performance (n=22) nor the subjects who did not fulfill both criteria (n=42) showed any associations among the TSK-DV scores, the exercise capacity data, and the CFS-APQ scores (data not shown).

The TSK-DV scores were compared between the subjects who performed a maximal ergometric test (n=22) and those who did not (n=42) (Tab. 3). Subjects who did not perform a maximal exercise capacity test had more fear of movement than did subjects who performed a maximal exercise capacity test. No differences were found for age, gender distribution, or illness duration between the 2 groups.

Discussion

In this study, the mean score (±SD) on the TSK-DV (41.5±7.7) differed slightly from previously reported scores from patients with fibromyalgia (36.2±8.6) and from patients with chronic low back pain (40.6±7.9).[17] Likewise, the mean score on the TSK-DV as observed in our sample differed slightly with a previously reported mean score in patients with CFS (38.5±8.6).[19] Because the total scores on the TSK are ordinal data, we believe that authors should report the appropriate descriptive statistics (median and interquartile range instead of mean scores and standard deviations). Still, the median score in our sample of patients with CFS was higher (42) than the median score in patients with low back pain (37).[24] Silver and colleagues[19] did not report the median

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

Table 1.
Descriptive Data for the Tampa Scale for Kinesiophobia–Dutch Version (TSK-DV), the Dutch Chronic Fatigue Syndrome–Activities and Participation Questionnaire (CFS-APQ), and the Exercise Capacity Variables (n=64)[a]

Questionnaire	Median	Interquartile Range	Range
TSK-DV	42.0	10.0	23.0–62.0
CFS-APQ1	7.9	2.9	4.1–14.2
CFS-APQ2	2.6	0.7	1.6–3.9
Exercise Capacity Variable	$\overline{X}$	**SD**	**Range**
Exercise duration (min)	9.4	2.7	3.4–21.1
HRrest (bpm)	88.6	13.8	58.0–119.0
HRpeak (bpm)	141.0	21.4	102.0–186.0
Workload (W)	90.8	27.4	35.0–200.0
Workload per body weight (W/kg)	1.4	0.4	0.6–2.6
$\dot{V}O_2$peak (L/min)	1,165.8	326.3	505.0–2,392.0
$\dot{V}O_2$peak/body weight (mL·kg^{-1}·min^{-1})	17.6	4.7	7.0–31.0
Workload at RQ=1 (W)	54.5	28.2	5.0–110.0
HR at RQ=1 (bpm)	120.9	20.5	71.0–164.0
RQpeak	1.1	0.2	0.9–2.0
%THR	78.5	11.4	57.3–103.9

[a] Because the scores obtained with the questionnaires are ordinal data, the median and interquartile range are reported. CFS-APQ1=overall score of the CFS-APQ, ranging from 1 to 16; CFS-APQ2=overall score without taking the importance verification into account, ranging from 1 to 4; HRrest=resting heart rate; HRpeak=peak heart rate; RQ=respiratory quotient; RQpeak=peak respiratory quotient; $\dot{V}O_2$peak=peak oxygen uptake; %THR=percentage of target heart rate.

Table 2.
Correlation Analysis Between Tampa Scale for Kinesiophobia–Dutch Version (TSK-DV) Scores and Both the Dutch Chronic Fatigue Syndrome–Activities and Participation Questionnaire (CFS-APQ) Scores and the Exercise Capacity Data (n=64)[a]

Variable	rho for TSK-DV	P^b
CFS-APQ1	.173	.131
CFS-APQ2	.194	.178
Exercise duration (min)	.000	.999
HRrest (bpm)	.126	.320
HRpeak (bpm)	−.232	.065
Workload (W)	.041	.746
Workload per body weight (W/kg)	−.096	.450
$\dot{V}O_2$peak (L/min)	−.003	.983
$\dot{V}O_2$peak/body weight (mL·kg^{-1}·min^{-1})	−.110	.388
Peak workload at RQ=1.0 (W)	.001	.997
Heart rate at RQ=1.0 (bpm)	−.126	.359
RQpeak	−.164	.194
%THR	−.178	.158

[a] CFS-APQ1=overall score of the CFS-APQ, ranging from 1 to 16; CFS-APQ2=overall score without taking the importance verification into account, ranging from 1 to 4; HRrest=resting heart rate; HRpeak=peak heart rate; RQ=respiratory quotient; RQpeak=peak respiratory quotient; $\dot{V}O_2$peak=peak oxygen uptake; %THR=percentage of target heart rate.
[b] Level of significance=.0038 (Bonferroni corrected).

score on the TSK in their sample of patients with CFS. In comparing the scores on the TSK between populations, it is currently unclear whether a 5-point difference (ie, 42 in our CFS sample versus 37 in patients with chronic low back pain[34]) is relevant. We are unaware of data addressing the issue of relevance in differences in TSK-DV scores in either patients with CFS or patients with chronic low back pain.

Concerning the issue of the cutoff for the identification of patients with CFS who have high pain-related fear of movement, we suggest that physical therapists should remain consistent with the approach of using the median score as the cutoff, as proposed by Vlaeyen et al.[24] Consequently, we suggest using a median score of 42 as the cutoff for classifying patients with CFS who are experiencing widespread pain as having high or low pain-related fear of movement. Using the median of a sample of patients with chronic low back pain for the identification of high fear in a sample of patients with CFS, as done by Silver et al,[19] may be inappropriate. Using the median automatically places 50% of the patients in the high-fear group. Still, there is currently no evidence that having "high fear" has any functional relevance in patients with CFS, especially given that fear of movement has not been shown to be related to either disability (as measured by the CFS-APQ) or exercise

Table 3.
Comparison Between Subjects Who Performed a Maximal Ergometric Test (n=22) and Subjects Who Did Not Perform a Maximal Ergometric Test (n=42)[a]

	Maximal Performance Group	Submaximal Performance Group	t	df	P[b]
Age (y)	39.2±8.8	39.8±8.9	.230	62	.819
Illness duration (mo)	65.9±57.6	58.4±41.7	−.602	62	.549
No. of female subjects	20 (91%)	38 (90%)			1.000
	Maximal Performance Group	**Submaximal Performance Group**	**Mann-Whitney U Test**	**z**	**P[b]**
TSK-DV	38.0 (13.2)	43.0 (10.3)	322.5	−1.974	.048

[a] TSK-DV=Tampa Scale for Kinesiophobia–Dutch Version; because this questionnaire generates ordinal data, the median and interquartile range (in parentheses) are reported. For age and illness duration, both the mean and standard deviation are provided. Age and illness duration were normally distributed in both groups (submaximal performance group: Kolmogorov-Smirnov z=0.368 and P=.879 for age, Kolmogorov-Smirnov z=1.32 and P=.063 for illness duration; maximal performance group: Kolmogorov-Smirnov z=0.368 and P=.999 for age, Kolmogorov-Smirnov z=0.740 and P=.643 for illness duration).
[b] Level of significance=.05.

capacity in the types of patients we studied. A better option for determining a cutoff score would be to compare TSK scores with an external reference standard.

We found lower total scores on the TSK-DV among subjects who performed a maximal stress test than among those who did not. This finding suggests that the inability to achieve a maximal performance may be related to kinesiophobia in people with CFS who experience widespread pain. This observation confirms the assumption made by Fischler et al,[8] who used the nonachievement of 85% of age-predicted maximal heart rate during incremental exercise for the assessment of avoidance behavior.

In our study, however, the correlation analysis was unable to confirm that the inability to perform a maximal stress test is related to kinesiophobia. If pain-related kinesiophobia did prevent the subjects from performing a maximal stress test, then we believe there should have been a correlation between the TSK-DV scores and the exercise capacity data at least in the subjects who did not perform a maximal stress test. No associations were found between exercise capacity and kinesiophobia, either in the subjects who fulfilled the criteria for a maximal performance or in the subjects who did not. Likewise, no correlations were found between measurements obtained for any of the exercise capacity variables and scores for pain-related fear of movement in the overall sample (n=64). We did not question the subjects about their reasons for stopping the exercise test. This information might have explained our contradictory findings (the lack of correlation between exercise capacity data and TSK-DV scores together with the increased TSK-DV scores among the subjects with a submaximal performance on the stress test). We do, however, contend that caution is warranted in the interpretation of the findings concerning the difference between the 2 groups of subjects. Because the primary aim of our study was to examine possible associations among variables (ie, pain-related fear of movement and exercise capacity in patients with CFS who are experiencing pain), a correlation analysis provides the strongest information. Additionally, the criteria used for categorizing the exercise performance as maximal or submaximal may account for these contradictory observations.

A variety of criteria have been used by investigators to determine the achievement of maximal oxygen uptake ($\dot{V}O_2max$). The criteria used in our study are one set out of many combinations, as reviewed by Howley et al.[35] The criteria for confirmation that maximal effort during graded exercise testing was used have been questioned.[23] There appears to be considerable interindividual variability in the RQ, and the achievement of age-predicted maximal heart rate shows high intersubject variability and therefore should not be used as an indication that maximal effort has been achieved.[23] Nevertheless, the criteria we used are consistent with the criteria in an earlier report on exercise capacity in patients with CFS.[7] In addition, when people with disease are incapable of achieving the criteria for performing a maximal exercise stress test due to symptoms, deconditioning, or unwillingness to tolerate fatigue, then $\dot{V}O_2peak$ can be used instead of $\dot{V}O_2max$.[36]

At least a subset of patients with CFS can be characterized by avoidance of physical activity as a coping strategy.[20,37] Our data do not support the view that kinesiophobia is associated with disability (ie, activity limitations and participation restrictions) in patients with CFS who experience pain. Our results, therefore, bring into question the clinical importance of kinesiophobia.

Fear of movement, according to our results, is not associated with impairments in cardiorespiratory fitness in patients with CFS who experience widespread pain. These results are in accordance with those of Silver et al,[19] who found no associations between fear of movement and maximal heart rate, HRrest, level of tiredness, or symptom severity in patients with CFS. They did, however, find that their beliefs about activity correlate with the distance traveled on an exercise bike.[19] Silver et al[19] modified the existing TSK to the Tampa Scale of Kinesiophobia–Fatigue (TSK-F) by changing 11 of the 17 items ("pain" was replaced by "fatigue"). Because the main focus of CFS has been on the primary symptom of fatigue, we believe this modified TSK might be more appropriate for people with CFS. Fatigue has been claimed to be the most predominant and overpowering symptom of CFS,[1] yet we believe patients might attribute an equal amount of discomfort to pain as they do to fatigue. One may be just as important as the other. This assumption is supported by the finding that measurements of both pain and fatigue intensity showed a correlation to the CFS-APQ scores in a sample of 47 patients with CFS (rho=.51 and .50, respectively).[30] This, we believe, brings into question the appropriateness of the TSK-F questionnaire for people with CFS. Future research, we contend, should address the clinical relevance of fear of movement in patients with CFS using a TSK questionnaire that has been modified by replacing "my pain" by "my symptoms."

We excluded all patients who did not experience widespread myalgias or arthralgias. Consequently, our data cannot be extrapolated to all people with CFS. Nishikai et al[38] found that 85 (74.6%) of the 114 patients with CFS in their study reported muscle pain, and 74 patients (64.9%) had multijoint pain. There is a growing international consensus that people with CFS should be subclassified, because more homogeneous subgroups are less likely to reveal conflicting data among investigators.[39] Chronic fatigue with musculoskeletal system disorders such as muscle pain and joint pain has been suggested as an important subclass of CFS.[39]

Both the lack of data because some subjects failed to complete the maximal exercise test and the questionable validity of the criteria for confirmation of maximal effort during graded exercise testing are limitations of this study. Another limitation is that the small sample size may lack strength, especially when comparing different groups within the sample. The variation in the TSK-DV scores (and data obtained for some of the exercise capacity factors) was limited, which could have reduced the correlation coefficients. In addition, all patients were recruited from a specialized fatigue clinic and are therefore unlikely to be representative of patients with CFS in general. Finally, because it is well established that women have a lower $\dot{V}O_2max$ compared with men,[40] pooling of gender data, as we did, may have biased the results.[12] The results, however, indicate that the same percentage of men in the overall sample (~10%) was represented in both the group of subjects who had a maximal performance on the stress test and the group of subjects who had a submaximal performance on the stress test. Reanalyzing the data by excluding all men was consequently deemed unnecessary.

Conclusion

In a subgroup of patients with CFS, namely those who were experiencing widespread pain as defined by the 1990 American College of Rheumatology criteria for fibromyalgia,[26] measurements of pain-related fear of movement were neither correlated with exercise capacity data nor correlated with data obtained for activity limitations and participation restrictions. Future studies regarding these associations are needed in different subgroups of people with CFS or in a sample that is more likely to reflect people with CFS in general.

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