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Is the chronic fatigue syndrome an exercise phobia? A case control study☆

A.M. Gallagher[a], A.R. Coldrick[a], B. Hedge[b], W.R.C. Weir[c], P.D. White[a,*]

[a]Centre for Psychiatry, Institute of Community Health Sciences, Queen Mary School of Medicine and Dentistry, St. Bartholomew's Hospital, EC1A 7BE London, UK
[b]Torbay Hospital, South Devon Healthcare NHS Trust, UK
[c]Coppett's Wood Hospital, Royal Free Hospital Trust, London, UK

Abstract

Objective: The aim of this study was to test whether patients with chronic fatigue syndrome (CFS) have an exercise phobia, by measuring anxiety-related physiological and psychological reactions to ordinary activity and exercise. **Methods:** Patients and healthy but sedentary controls were assessed over 8 h of an ordinary day, and before, during and after an incremental exercise test on a motorised treadmill. To avoid confounding effects, those with a comorbid psychiatric disorder were excluded. Heart rate, galvanic skin resistance (GSR) and the amount of activity undertaken were measured, along with state and trait measures of anxiety. **Results:** Patients with CFS were more fatigued and sleep disturbed than were the controls and noted greater effort during the exercise test. No statistically significant differences were found in either heart rate or GSR both during a normal day and before, during and after the exercise test. Patients with CFS were more symptomatically anxious at all times, but this did not increase with exercise. **Conclusion:** The data suggest that CFS patients without a comorbid psychiatric disorder do not have an exercise phobia.

Keywords: Activity; Avoidance; Chronic fatigue syndrome; Exercise; Galvanic skin resistance; Phobia

Introduction

The cognitive–behavioural model for chronic fatigue syndrome (CFS) suggests that patients become trapped in a vicious cycle perpetuated by maladaptive behaviours, cognitive misinterpretations and illness beliefs that maintain symptoms and disability [1].

Graded exercise therapy (GET) has been advocated for CFS, on the basis that CFS is maintained by both the avoidance of activity and deconditioning [2,3]. Two systematic reviews have concluded that there is high quality evidence of efficacy of GET in adult outpatients [4]. Yet, many patients can drop out of GET or not even start it, and this may be related to a fear of exercise, which is reported by the majority of CFS patients [5]. Fifty percent of 2338 members of an ME self-help charity held the belief that GET was "damaging" [6]. Of 105 patients reporting their experience of exercise, 55% believed that their recovery would be facilitated by limiting their physical activity [7]. Even some doctors have "...deep concerns over the current application of graded exercise programmes..." [8].

Kinesiophobia is the fear of physical movement or activity [9], and the concept is derived from studies of patients with chronic pain syndromes [10,11]. The Tampa Scale of Kinesiophobia (TSK) has been developed in pain patients as a valid and reliable measure of the fear of exercise and has been found to be a predictor of distress and disability [10]. It has been adapted by both Silver et al. [9] and Nijs et al. [12] for use in CFS patients. Using the new TSK-F scale, Silver et al. found that fear of exercise was linked to reduced exercise performance on a bicycle ergometer and explained 15% of the variance in distance cycled. They also found that preexercise anxiety was much

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* Corresponding author. Department of Psychological Medicine, St. Bartholomew's Hospital, EC1A 7BE London, UK. Tel.: +44 020 7601 8108; fax: +44 020 7601 7969.

E-mail address: p.d.white@qmul.ac.uk (P.D. White).

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higher than postexercise anxiety. Nijs et al. found that 47 of 64 CFS patients (72%) had a TSK score for fatigue of over 37, in their view, indicating kinesiophobia [12].

A phobia is a "marked and persistent fear that is excessive or unreasonable, cued by the presence or anticipation of a specific object or situation" [13]. Exposure to the stimulus provokes an immediate anxiety response, with consequent avoidance or intense anxiety [13]. We tested the hypothesis that CFS patients have a phobic avoidance of exercise (kinesiophobia) [9] that related both to the activities of everyday living and to a specific exercise challenge. We expected that if these patients do suffer from such a phobia, then they would show an associated abnormal physiological arousal in anticipation of and/or during exposure to their feared stimulus: an exercise challenge [14,15]. We also expected the CFS patients to be less active (more avoidant) than the controls and to have higher anxiety scores, both before and after the exercise [9,13].

To test for the presence of an exercise phobia, we hypothesized the following concerning CFS in comparison to controls: (a) they would be generally more anxious; (b) they would have an increase in state anxiety in both anticipation and response to exercise; (c) they would have physiological evidence of greater arousal, as measured by a greater increased heart rate, and a greater decrease in galvanic skin resistance (GSR) during routine daily activities and in response to exercise; and (d) they would be more likely to avoid physical activity in general and exercise in particular. If a phobia of either exercise or activity were present, then we would expect to see both increased symptomatic anxiety in anticipation of the feared stimulus and a physiological reaction in the face of the stimulus [13–15].

Method

Participants

Forty-two CFS patients were selected from consecutive attenders at two secondary care teaching hospital chronic fatigue clinics, one a psychiatry clinic and the other an infectious diseases (ID) clinic. All of the patients met the Oxford criteria for CFS [16]; 24 patients (57%) met the international criteria for CFS and a further 16 patients (38%) met the criteria for idiopathic chronic fatigue (ICF) [17]. Two cases (5%) had missing data for this variable. Each patient had a psychiatric screening interview [Structured Clinical Interview for DSM-IV (SCID) patient edition with psychotic screening; [18,19]]. Patients with a current comorbid psychiatric disorder (such as mood disorders and somatisation disorder) were excluded from the study, because comorbid psychiatric disorders could have confounded the measures of anxiety and arousal [20,21]. By excluding these patients, we can conclude that any differences found are not due to comorbid psychiatric disorders. We did not exclude participants if they had a phobia, because by excluding such patients, we might be excluding just those patients who also had kinesiophobia [22]. Other exclusions were those aged under 18, those on psychoactive or cardiac drugs and those unable to walk.

The 42 healthy controls were matched to the CFS patients by age, sex, social class and body mass index (BMI). Because pair matching on so many variables was very difficult, group matching was undertaken in batches of approximately five. The controls were healthy but sedentary hospital staff responding to advertisements about the study. The criteria for sedentary controls were that they thought they ought to take more exercise, they performed moderate exercise of 20 min less often than once per week, and they never/rarely engaged in exercise long enough to work up a sweat, get the heart pumping or get out of breath [23].

Study design

All participants were studied on two separate days. Day 1 provided baseline measures and ambulatory physiological measures on an ordinary day. On the next day (Day 2), all participants attended for a treadmill exercise test. Physiological measures were continuously taken before, during and after the exercise test. The state measure of anxiety was measured before and immediately after the exercise test. The study was considered ethically satisfactory by the research ethics committees of both St. Bartholomew's and the Royal Free hospitals.

Measures

To describe the samples, the following measures were taken. Details on occupation were used to assign socioeconomic class [24]. The physical function subscale of the short form Health Status Survey (SF-36) was used to self-rate physical function [25]. Fatigue was measured using the Chalder Fatigue Scale [26]. This is an 11-item questionnaire using categorical (0, 0, 1, 1) scoring. Sleep disturbance was self-rated with the Pittsburgh Sleep Quality Index (PSQI; [27]). Measures of symptomatic anxiety included the Hospital Anxiety and Depression Scale (HADS; [28]). Spielberger's State-Trait anxiety questionnaire was used to measure the level of anxiety at the time of assessment (state) and the general tendency to respond to events with anxiety (trait) [29]. The somatic amplification questionnaire measured perceptual amplification of bodily symptoms, in case anxiety was perceived somatically [30].

An ambulatory monitor was used to collect physiological measures of arousal over time [31]. The monitor recorded heart rate and GSR. Heart rate was measured from an electrocardiograph, using three chest electrodes. GSR was measured using disposable paediatric silver/silver chloride electrodes attached to the middle phalanx of the second and third fingers of the nondominant hand. An increase in arousal was indicated by a decrease in skin resistance as the electrical current between the two points was conducted more readily [20]. The ambulatory monitor was set up to sample all three parameters at a rate of five times per second.

The ranges taken for the physiological variables were 25 to 1011 kΩ for GSR, 50 to 198 beats per minute (bpm) for heart rate and 0 to 254 arbitrary units for activity. Values outside of these ranges were treated as missing data. Any artefact in the heart rate was eliminated using a discriminate function in the software for the ambulatory monitor. Any sudden increase in heart rate of more than 40 bpm was regarded as artefact until three consecutive data points were found to be less than 40 bpm apart (D. Johnston, personal communication).

Activity measures and the exercise test

Leg movement was measured using an accelerometer attached at the midpoint of the left thigh [32]. This was proportional to the amount of physical activity undertaken. To demonstrate similar levels of inactivity between cases and controls, measurements of fitness and physical activity were undertaken. An assessment of aerobic capacity was undertaken using an incremental walking test on a motorised treadmill (Powerjog m30) with the speed kept constant at 5 km/h. To acclimatise all participants to the treadmill test, they undertook a short practice before the test proper on a level slope. The gradient of the slope increased by 2.5% every 2 min until volitional fatigue. Throughout the test, continuous measurements of the volume of oxygen uptake (VO_2), ventilation and heart rate were recorded. All three measures were recorded every 2 min and during the first 3 min of recovery. Predicted maximum heart rate was calculated using the Karvonnen formula (i.e., 220-age; [33]). To provide a measure of how hard the participants perceived they were working on the treadmill test, the Rating of Perceived Exertion (RPE) scale was used [34].

Analysis

Two power calculations were performed to minimise the chance of Type II errors. Because there were no previous studies of GSR in CFS, we employed two proxy measures related to phobia: avoidance of activity and insomnia. The first was based on an estimate of the amount of time spent inactive during the 8 h of monitoring on Day 1 as our indicator of avoidant behaviour. The estimated proportion of time spent inactive during the 8 h was 28% (or 2¼ h) for the CFS group and 3% (¼ h) for the control group. With alpha set at .05 and the power at 0.80, we needed 43 participants in each group to detect a difference between 30% and 5% [35]. Because there were no normative values available for GSR, we took a proxy measure of arousal, namely, sleep disturbance, as the basis for our second power calculation. We estimated the proportion of CFS patients with light or poor sleep as 50%, compared with 15% for the control group [36]. With alpha set at .05 and the power at 0.80, we needed at least 32 participants in each group to detect such a difference [35]. Forty-two patients would give a power of 90%.

P values for the other variables were considered significant at the 1% level or less, to adjust for the potential Type I errors. Demographic and symptomatic variables were compared using the *t* test, or Mann–Whitney test, where data were not normally distributed. From the psychophysiological data, descriptive statistics were calculated for GSR, heart rate and activity. The general pattern of GSR and heart rate were compared between the groups using a repeated measures analysis of variance (ANOVA). A Wilcoxon signed rank test was used to compare anxiety before and after the exercise test. The chi-square test for a trend across the groups was used to compare social class data.

Results

Description of the samples

Twenty-two of 27 (81%) patients asked to participate from the psychiatry clinic agreed, and 20 out of 61 (33%) from the ID clinic did. The main reasons for nonparticipation were a lack of interest in the study (n=25), the distance between home and the hospital being too far (n=18) and concern that they would feel worse after the study (n=3). Eighteen of the 19 who refused due to distance were from the ID clinic, which was several miles from the psychiatry clinic where the study took place. There were no significant differences between participants and nonparticipants in either age [mean (S.D.)=37.7 (9.5) vs. 38.7 (10.4), respectively, P=.70] or sex (80% vs. 72% female, P=.37). Patients had been ill for a mean (S.D.) of 5.8 (5.2) years compared with 8.7 (6.3) years for nonparticipants (P=.06).

There were no significant differences between the CFS patients recruited from the two fatigue clinics in sex, age, socioeconomic class, marital status, duration of illness, proportion working or membership of a self-help organisation (data available from authors). Therefore, the two groups were combined for further analyses.

There were 42 CFS patients and 42 healthy sedentary controls. All responders to the advertisement for controls participated if they fulfilled the sedentary and matching criteria. One CFS patient was excluded due to having a fatigue score of zero, leaving 41 CFS patients. No significant differences were found between patients and controls in the demographic variables of age, sex, socioeconomic class, or in BMI (Table 1).

Day 1

As would be expected, CFS patients were significantly more fatigued, had more sleep disturbance and more self-reported physical disability than controls (Table 2). Despite excluding patients with comorbid psychiatric disorders, the levels of both state and trait anxiety, HADS depression and

Table 1
Demographic variables

	CFS patients	Controls	*P* value
Age, Mean (S.D.) [years]	37.7 (9.5)	35.3 (8.7)	.22
BMI, Median (IQR)	24.7 (20.5–27.1)	24.4 (22.3–27.1)	.64
Social class (%)			
Professional	23	29	.34*
Intermediate	56	59	
Skilled	21	12	
Gender (%)			
Male	20	19	.96
Female	80	81	

* Chi-square test for a trend.

somatic amplification scores were significantly higher in CFS patients compared with controls on Day 1 (Table 2). However neither HADS anxiety nor HADS depression scores indicated severity consistent with a psychiatric disorder. There were no statistically significant changes in state anxiety between Days 1 and 2 in either CFS patients or controls (Table 2; paired test result P=.64). There were no statistically significant differences in physical activity, GSR or heart rate during Day 1 (Table 3). There was no statistically significant difference in the percentage of time spent inactive (Table 3).

Day 2

The CFS patients walked for less time on the treadmill and yet had significantly greater ratings of perceived exertion at all three stages of the exercise test (Table 4). There were no significant differences between the groups in heart rate, VO_2 or ventilation in response to exercise.

Figs. 1 and 2 show the comparison of the two groups in GSR and heart rate at each time point. There was no statistically significant difference in either the pattern of GSR or heart rate between the groups (GSR: P=.84; HR: P=.80). As would be expected, within each group, the effect

Table 2
Symptomatic measures

Measures	CFS patients	Controls	*P* value
Chalder fatigue score, median (IQR)	11 (9–11)	0 (0–2)	<.01
Sleep quality score, median (IQR)	7 (4.5–9.0)	4 (2–5)	<.01
Poor Sleep, %	72.5	22.5	<.01
Spielberger's state anxiety, Day 1, median (IQR)	36.5 (30.5–41.0)	30.5 (25.0–34.0)	<.01
Spielberger's trait anxiety, Day 1, median (IQR)	38.0 (35.0–47.0)	32.5 (31.0–40.0)	<.01
HADS anxiety, median (IQR)	5.0 (4.0–7.0)	3.5 (2.0–6.0)	.08
HADS depression, median (IQR)	5.5 (3.0–7.0)	1.0 (0.0–4.0)	<.01
Somatic amplification, median (IQR)	9 (5–12)	5 (4–8)	<.01
SF-36 physical function subscale, median (IQR)	47.5 (27.5–65)	95 (90–100)	<.01
Spielberger's state anxiety postexercise, Day 2, median (IQR)	34.5 (28.0–41.0)	30.0 (24.0–35.0)	.02

HADS = Hospital Anxiety and Depression scale.

Table 3
Physiological measures from Day 1

Measures	CFS patients	Controls	*P* value
Galvanic skin resistance (kΩ)			
Overall, median (IQR)	208 (178–244)	233 (192–269)	.13
Minimum, mean (S.D.)	216 (54)	236 (77)	.19
Maximum, median (IQR)	332 (304–404)	354 (320–476)	.11
Range, median (IQR)	222 (174–304)	256 (178–288)	.66
Activity (arbitrary units)			
Overall, median (IQR)	6.9 (4.4–10.5)	8.4 (7.2–10.1)	.10
Time spent inactive, % (S.D.)	48.7 (15.0)	45.4 (8.2)	.23
When active, median (IQR)	14.8 (10.1–17.8)	15.2 (13.6–18.5)	.19
Heart rate (bpm)			
Overall, mean (S.D.)	86.6 (8.4)	86.5 (9.1)	.97
Minimum, median (IQR)	56 (51–61)	53 (50–59)	.13
Maximum, median (IQR)	142 (131–165)	147 (134–159)	.87
Range, median (IQR)	86 (74–109)	91 (80–103)	.46

kΩ=kilo-Ω; bpm=beats per minute.

Table 4
Treadmill test results from Day 2

Variables	CFS patients	Controls	*P* value
Treadmill test duration (min), median (IQR)	11.6 (10–13)	12.8 (12–14.7)	<.01
Perceived exertion			
Stage 1, median (IQR)	11.0 (9.0–12.0)	10.0 (8.8–11.0)	<.01
Stage 2, median (IQR)	12.0 (11.0–13.0)	11.0 (10.0–12.0)	<.01
Stage 3, median (IQR)	13.0 (13.0–16.0)	12.0 (11.0–13.0)	<.01
Heart rate (bpm)			
Maximum, median (IQR)	178 (167–189)	183 (174–188)	.38
Maximum as percentage (%) of predicted (S.D.)	97 (7.1)	97 (6.1)	.64
Recovery, mean (S.D.)	114 (11.8)	114 (14.0)	.88
VO_2 (ml/kg/min)			
Peak, mean (S.D.)	27.8 (7.6)	31.3 (5.8)	.02
Stage 1, median (IQR)	11.1 (9.0–2.1)	9.8 (8.0–11.9)	.08
Stage 2, median (IQR)	14 (13.0–16.4)	13.3 (11.4–15.4)	.08
Stage 3, median (IQR)	18.5 (16.8–20.1)	17.5 (15.2–19.8)	.17
Maximum ventilation (l/min), median (IQR)	71 (60–88)	77 (65–95)	.29

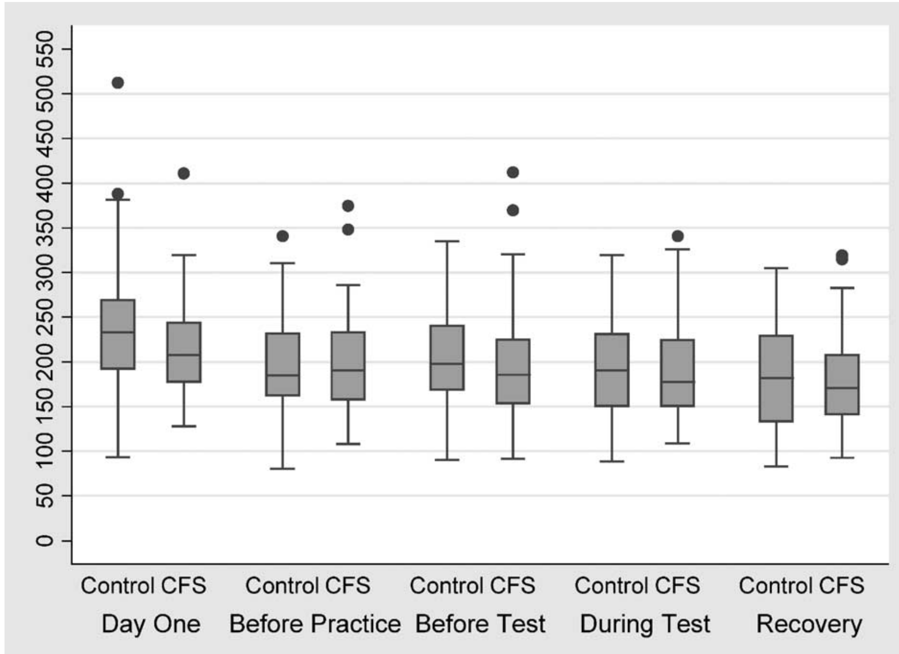

Fig. 1. Median GSR by group. The middle of the box indicates the median, with the box edges representing the 25th and 75th percentiles. The whiskers extend to a maximum 1.5 times the interquartile range. Dots indicate outliers.

of time was significant ($P<.01$); however, the interaction between time and group was not (GSR: $P=.46$; HR: $P=.18$).

Discussion

Although patients with CFS were generally more anxious and somatically sensitive than were the controls, no evidence of exercise phobia was found. In particular, there was no increase in symptomatic anxiety, GSR or heart rate in anticipation or response to exercise. The diurnal pattern of skin resistance showed that both groups were least aroused (GSR highest) at the beginning of the day. Physiological arousal increased as they anticipated and prepared for the exercise test, with the highest levels of arousal being found during recovery. The lack of

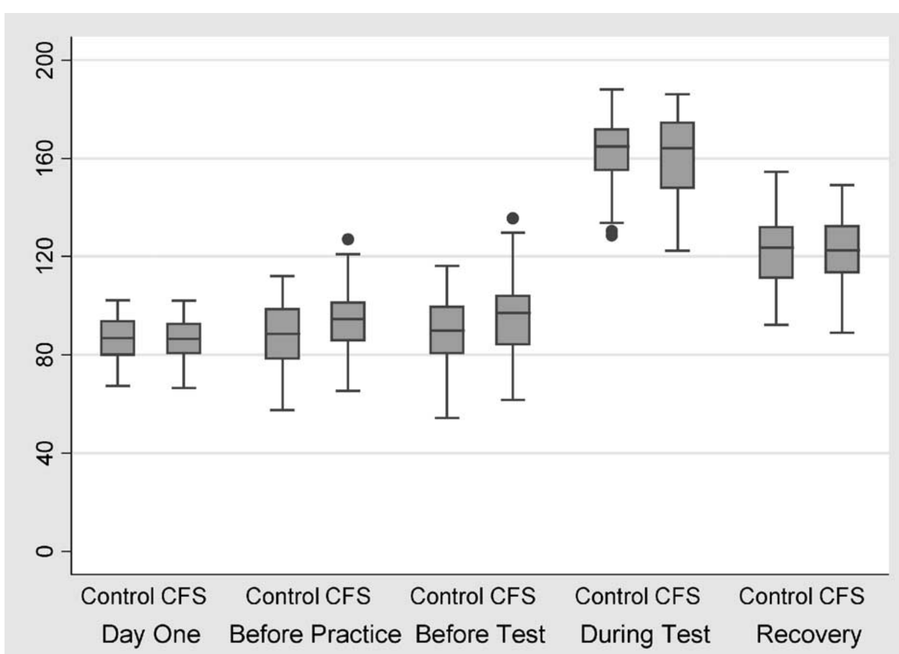

Fig. 2. Median heart rate measurements by group. The middle of the box indicates the median, with the box edges representing the 25th and 75th percentiles. The whiskers extend to a maximum 1.5 times the interquartile range. Dots indicate outliers.

significant differences in heart rates suggests that the two groups were no different in their cardiovascular response to exercise, as found in other studies [3], consistent with equal levels of deconditioning and arousal. The lack of a significant difference in physical activity in anticipation of the exercise test, both on the day of and the day before the test, suggests that there was no more anticipatory avoidant behaviour in CFS patients compared with healthy controls. However, there was a trend for the CFS group to have a shorter time on the treadmill, consistent with their perceived exertion being significantly higher at all three stages. This indicates that the CFS group found the exercise more of an effort than the controls; a consistent finding in past studies [3]. This was not associated with excessive physiological arousal, and therefore, we would conclude that it does not support the presence of an exercise phobia.

Because patients with comorbid psychiatric disorders were excluded, it is still possible that kinesiophobia is important in comorbid patients. This might explain why kinesiophobia, as measured purely by self-reported questionnaires, was found to be important in two previous studies that did include comorbid patients [9,12]. The close correlation reported by Silver et al. between the kinesiophobia questionnaire score and the HADS depression and anxiety scores would suggest that the kinesiophobia may be primarily related to comorbid mood disorders, rather than CFS itself. Our data suggest exercise phobia is unlikely to be a maintaining factor in CFS alone, without the presence of a comorbid disorder. The other contrast with previous work is that we used objective rather than subjective measures of avoidance and arousal.

A larger sample size would have facilitated more statistical analyses, and it is possible that our findings were due to a Type II error. There was not sufficient power to make comparisons within the groups, such as between the two CFS clinics. More than the relatively short 8 h of baseline activity recording could have been made. This would have given a more sustained test of arousal during ordinary activities of daily life. If the data had been collected over a longer period of recovery after the exercise test, postexertional arousal could have been investigated in more detail.

Fatigue levels and self-reported physical disability were similar to samples from other secondary care clinics [3]. However, there may have been a selection bias by kinesiophobic patients refusing to participate. We think this unlikely both because of the similar demographics between participants and nonparticipants, and because only 3 out of 46 nonparticipants (7%) refused because they thought the study would make them worse. Because the CFS patients were recruited from both a psychiatry and ID clinic, the results can probably be generalised to secondary care in general. However, as none of the patients were seen in primary care, the results are not generalisable to all health-care populations. We used a convenient sample of hospital staff as controls. This was not necessarily representative of the population at large; a random selection of controls may therefore have provided different results.

As both groups were equally sedentary and inactive, this suggests that fatigue was not caused by current levels of inactivity [37]. The results from the psychological measures lend support to some of the perpetuating factors suggested by the cognitive–behavioural model for CFS being related to mood and somatic focusing [1]. Avoidance of exercise may be caused by beliefs (or cognitions) that, in their current state of health, exercise is damaging or could exacerbate illness [5], rather than a phobia itself. CFS patients had a lower exercise tolerance than did the controls, although they were no more deconditioned than were the sedentary controls. Somatic focusing and sensitisation are more likely explanations for the excessive perception of effort [38,39].

We conclude that CFS, without a comorbid psychiatric disorder, probably is not an exercise phobia, and fear avoidance is perhaps less important in CFS than chronic pain disorders [11]. The cognitive behaviour model may need to be adapted to include beliefs and interoceptive sensitivity for avoiding activity [40].

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