PHYSICAL ACTIVITY IN CHRONIC FATIGUE SYNDROME: ASSESSMENT AND ITS ROLE IN FATIGUE

J. H. M. M. VERCOULEN,* E. BAZELMANS,* C. M. A. SWANINK,† J. F. M. FENNIS,‡ J. M. D. GALAMA,† P. J. H. JONGEN,§ O. HOMMES,§ J. W. M. VAN DER MEER‡, and G. BLEIJENBERG*

*Department of Medical Psychology, University Hospital Nijmegen, The Netherlands; †Department of Medical Microbiology, University Hospital Nijmegen, The Netherlands; ‡Department of General Internal Medicine, University Hospital Nijmegen, The Netherlands; §Department of Neurology, University Hospital Nijmegen, The Netherlands

(Received 26 September 1996; revised 10 February 1997; accepted 29 April 1997)

Summary—This paper describes the assessment of physical activity in chronic fatigue syndrome (CFS) and investigated the following questions: Do patients with CFS have low levels of physical activity; is there a relationship between actual level of physical activity and fatigue; can self-report measures adequately assess actual level of physical activity; what is the role of cognitions with respect to physical activity; and are results with respect to physical activity specific to CFS? Three different types of activity measures were used: self-report questionnaires, a 12-day self-observation list, and a motion-sensing device (Actometer) which was used as a reference for actual activity level. Fifty-one patients with CFS, 50 fatigued patients with multiple sclerosis (MS), and 53 healthy subjects participated in this study. Although none of the self-report questionnaires showed high correlations with the Actometer, questionnaires that require simple ratings of specified activities were related to the Actometer and can be used as acceptable substitutes, in contrast to instruments that require general subjective interpretations of activity that had low or non-significant correlations with the Actometer. Actometer results showed that CFS patients and MS patients had similar activity levels and both groups were significantly less active than healthy subjects. Compared to MS patients, CFS patients were more likely to indicate that they had been less active than other persons they knew. Activities which patients expected to result in higher fatigue levels were less frequently performed. Patients with CFS had significantly higher scores on this measure than MS patients and healthy subjects. Low levels of physical activity were related to severe fatigue in CFS but not in MS. In conclusion, although CFS patients have similar low activity levels than MS patients, there are also important differences between both groups: in CFS cognitive factors are more prominently involved in producing the low activity levels than in MS and in CFS patients activity level is related to fatigue but not in MS. © 1997 Elsevier Science Ltd. All rights reserved

Introduction

Chronic fatigue syndrome (CFS) is a condition of severe disabling fatigue, lasting for at least six months, and for which no somatic explanation can be found (Sharpe et al., 1991). Many accompanying complaints may be present, such as myalgia, headache, sore throat, gastrointestinal complaints, and memory and concentration problems.
Analogous to mechanisms described in chronic pain patients (Keefe & Gil, 1986; Philips, 1983; Weisenberg, 1987), Wessely and colleagues hypothesized about the role of avoidance of physical activity in the perpetuation of fatigue in CFS (Wessely et al., 1991). According to these authors the patient experiences genuine symptoms and learns that physical activity aggravates these symptoms, in particular fatigue and myalgia, and attributes them to ongoing physical illness. The patient tries to prevent symptoms by avoiding physical activity. Prolonged inactivity leads to physical deconditioning such that symptoms emerge at progressively lower levels of physical activity. Hence, a vicious circle of avoidance and symptoms has been established. However, there are no empirical data to support this hypothesis in CFS.

In many studies a positive relationship between physical activity and psychological and physical health has been documented (see Clearing-Sky, 1988 and Dubbert, 1992 for reviews). An association between low levels of physical activity and fatigue has been reported in several studies (e.g. Hughes et al., 1984; Chen, 1986; Kroenke et al., 1988). At present, a large number of studies has been published on chronic fatigue syndrome but there are only three studies, all from our research group, in which the relationship between fatigue and physical activity in CFS was assessed empirically. In these studies we found that patients who were physically inactive had higher fatigue levels than those who were more active (Vercoulen et al., 1996a; Vercoulen et al., 1996b) and in one study we found that the causal direction of this relationship was going from low levels of physical activity to high fatigue severity (Vercoulen et al., submitted).

In all the above-mentioned studies on physical activity in CFS, self-report questionnaires were used, reflecting subjective interpretations of physical activity level. It is not clear whether subjective accounts of physical activity level adequately reflect the actual level of physical activity. Therefore, the primary aims of the present study were to assess actual activity level in patients with CFS to validate claims of lower levels of physical activity and to validate the reported relationship between fatigue and activity level that was found on self-report questionnaires. In addition, we evaluated whether physical activity level adequately can be assessed by self-report measures. An accelerometer was used as a reference for actual level of physical activity. Accelerometers are motion-sensing devices which yield highly reliable data (Tryon, 1991) and have been reported to be valid instruments in measuring human physical activity as close correlations were found with energy expenditure (Montoye et al., 1983; Servais & Webster, 1984; Meijer et al., 1989). Accelerometers (or any other motion-sensing device) never have been used in studies on CFS before.

In the hypothesis described above, patients avoid physical activity because in their view activity causes symptoms. In a previous study we have developed a model on factors perpetuating fatigue in CFS. The model showed that the patient's opinion that complaints had a physical cause contributed to low levels of physical activity (Vercoulen et al., submitted). Thus, cognitions appear to play a part in physical activity in CFS. In the present study we also investigated patients' cognitions with respect to activity and their relationship with fatigue in more detail.

Finally, to investigate the specificity of physical activity results to CFS, we included patients with multiple sclerosis (MS) into the study. Patients with MS form a useful comparison group as in MS fatigue is a prominent and disabling symptom (Vercoulen et
al., 1996b), and—in contrast to CFS—a somatic substrate (inflammation and demyelisation of the central nervous system) is established.

Concluding, the present study investigated the following questions: Do patients with CFS have low levels of physical activity compared to healthy subjects; can self-report measures adequately assess actual level of physical activity; what is the role of cognitions with respect to physical activity; is there a relationship between level of physical activity and fatigue; and are results with respect to physical activity specific to CFS?

Method

Subjects

Fifty-one patients with chronic fatigue were randomly selected from our CFS-database, acquired by referral to the General Internal Medicine outpatient clinic of our hospital by a general practitioner or specialist and by self-referral. Patients had to experience severe disabling fatigue, of definite onset, lasting for at least six months. In addition, patients with established medical conditions and patients with a diagnosis of schizophrenia, bipolar disorder, psychotic depression, substance use disorder, eating disorder, or proven organic disability were excluded from the study (Sharpe et al., 1991). Fifty patients with a definite diagnosis of MS (Poser et al., 1983) were included by the Department of Neurology (chronic progressive: N = 19; relapsing remitting: N = 31). All patients were mobile. Mean Expanded Disability Status Scale (EDSS) of Kurtzke (Kurtzke, 1983) was 2.8 (range = 1–6). Fifty-three healthy subjects were included to provide a standard for normality. These subjects were selected through a regional newspaper advertisement. All patients participating in this study received full physical examination at the beginning of the study and, if indicated, further technical investigations. Healthy subjects were matched to the patients with CFS on age, sex, and educational level. Educational level was determined by a Dutch standardized scoring system which is especially used in research (range: 1 “no education" to 7 “university”).

Instruments

Accelerometer (actometer). Accelerometers based on a piezo-electric sensor yield highly reliable and valid data on human physical activity (Tryon, 1991; Montoye et al., 1983; Servais & Webster, 1984; Meijer et al., 1989). The Actometer will be used as a reference to evaluate the abilities of self-report questionnaires to measure actual activity level. The Actometer was manufactured by the Department of Electronics and Instrumental Services of the Psychological Laboratory of the University of Nijmegen (size: 43 × 29 × 16 mm; weight 41 g). It consists of a piezo-electric sensor which is sensitive in three directions. Sensitivity is approximately 0.1 g. Acceleration of the sensor results in an output-signal. This signal is amplified and filtered by a bandpass filter with a frequency between 0.8–10 Hz. All signals above a certain threshold are added to a monostable multivibrator with a “one-shot" time of 250 ms. This pulse-generator triggers a 2-bit counter, such that accelerations are added to a maximum of three. Each second this counter is read and reset by the microcontroller, which adds the value to the integration counter. The integration counter is set at 5 min. In this way every 5 min an activity score is produced, with a
maximum of 255 counts. This maximum is reached only when continuously walking during
this epoch. To allow for inter-instrument comparability all Actometers were calibrated at
equal thresholds. This was done in a standardized way. A speaker connected to a frequency
oscillator with variable amplitude settings was used to produce standard movements. All
Actometer thresholds were set at the same amplitude. The Actometer was attached to the
non-dominant ankle, which is a suitable site to measure gross body movements (Tryon,
1991). Patients wore the Actometer for a period of 12 days, day and night, unless taking a
bath or when swimming. Mean score of all 5 min epochs were used.

**Self-report measures.** In the same period of 12 days the Actometer is worn, the patient
completes a self-observation list. Level of physical activity was rated daily on a 7-point
Likert scale. Mean score for the two-week period was used in analyses (Daily Observed
Activity score). Also, once a day patients reported the number of hours spent on occu­
pational activities and on housekeeping activities.

The Activity subscale of the Checklist Individual Strength (CIS) (Vercoulen et al., 1994)
and the subscales mobility (SIP-MOB) and walking (SIP-WLK) of the Sickness Impact
Profile (Bergner et al., 1981; Jacobs et al., 1990) measure the level of physical activity.
Responses were made in reference to the past two weeks.

On the specially designed Physical Activities Rating Scale (PARS) 20 different activities
were presented. These consisted of daily activities, such as 30 min walking, doing the dishes,
watching T.V., and walking staircases. For each activity, patients were asked to indicate
how frequently they had performed the specified activity during the past two weeks (never—
rarely—now and then—often—very often). Scores were summed into a total score (PARS-
Activity score).

With respect to self-perceived activity level, patients were asked to rate activity during
the past month (inactive—neutral—active) and activity compared with other persons they
knew (less active—equally active—more active).

**Cognitions related to physical activity.** For each of the 20 activities of the PARS patients
indicated on a 5-point scale how fatigued they expected they would become if they would
perform the specified activity. These items were summed into the PARS-Expected Fatigue
score. In addition, patients indicated on a 5-point scale how fatigued they expected other
persons they knew would become if these persons would perform the specified activity.
These items also were summed into a total score (PARS-Expected Fatigue Others score).

**Subjective feeling of fatigue.** The subjective feeling of fatigue was measured by the
Subjective Fatigue subscale of the fatigue questionnaire Checklist Individual Strength
(CIS)(Vercoulen et al., 1994). Responses were made in reference to the past two weeks. The
CIS is a sensitive measure with good discriminating power and reliability.

**Sleep pattern.** Sleep pattern may be a possible confounding factor for physical activity.
Therefore, a special Sleep Pattern Observation List was completed in the period of 12 days
the Actometer was worn and the self-observation list was completed. The patient recorded
daily every 30 min: hours asleep at night, hours asleep during the day, hours awake before
falling asleep, hours awake during the night, hours resting after waking up in the morning, and hours resting during the day.

Depression. Depression also may be a confounding factor as depressed patients are known to be inactive. Depression was measured by the Beck Depression Inventory (Beck et al., 1961; Beck et al., 1988). Fatigue was excluded as a symptom.

Additionally, data concerning age, sex, education, duration of complaints, occupational status, and type of work (predominantly sitting—sitting and standing/walking—predominantly standing/walking) was collected.

Questionnaires usually were completed on the first day after the period of 12 days the Actometer was worn and the self-observation list was completed.

Statistical analyses

Variables with a skewness of more than 1 were log-transformed to produce approximately normal distributions. Testing differences between groups on dichotomous variables was done by \( \chi^2 \) test and on ordinal variables with the Mann-Whitney test. For these tests, Bonferroni-correction for multiple comparisons was applied. Considering three experimental groups, three comparisons were made. Assuming a significance level of 0.05, a difference was considered significant if the \( p \)-value was less than 0.017. Testing differences between groups on ratio variables was performed by analysis of variance. Multiple comparisons were made by Duncan multiple ranges tests. Pearson correlation coefficients were computed to evaluate the relationships between variables. To control type I error due to calculating multiple correlations, \( p \)-value for a correlation was set at 0.01. To evaluate homogeneity of activity measures principal components analyses were performed.

Results

Demographic

Results on age, sex, education, duration of complaints, and occupational situation are presented in Table 1. There were no significant differences among the three groups in age, sex, education, duration of complaints, or hours spent on housekeeping activities. Compared with healthy subjects, in the CFS and MS samples a significantly greater proportion of subjects received invalidity benefits or were on sick leave (\( \chi^2; p < 0.001 \)), and both patient groups spent fewer hours on occupational activities (\( p < 0.05 \)). There was a non-significant trend for a smaller proportion of subjects to have jobs in the CFS and MS groups than in healthy subjects (\( p = 0.04 \) and \( p = 0.07 \) respectively).

Level of physical activity

Data on the instruments measuring level of physical activity are presented in Table 2. There were no differences between CFS patients and MS patients in any instrument measuring level of physical activity. Compared with healthy subjects, both patient groups had significantly lower scores on all instruments. The CFS patients were more likely to indicate that they had been less active than other persons they knew than the MS patients and the
Table 1
Age, Sex, and Education of 50 Patients with MS, 51 Patients with CFS, and 53 Healthy Subjects

<table>
<thead>
<tr>
<th></th>
<th>CFS</th>
<th>MS</th>
<th>Healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>12 (24%)</td>
<td>17 (34%)</td>
<td>13 (24%)</td>
</tr>
<tr>
<td>female</td>
<td>39 (76%)</td>
<td>33 (66%)</td>
<td>40 (76%)</td>
</tr>
<tr>
<td>Mean age (range)</td>
<td>36.3 (19-54)</td>
<td>35.8 (19-56)</td>
<td>37.1 (19-63)</td>
</tr>
<tr>
<td>Mean education mean (range)</td>
<td>4.2 (3-7)</td>
<td>3.6 (3-6)</td>
<td>4.3 (3-7)</td>
</tr>
<tr>
<td>Median duration of complaints (range)</td>
<td>5 (1-48)</td>
<td>5 (0.5-22)</td>
<td>– (-)</td>
</tr>
<tr>
<td>Occupational situation:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>working</td>
<td>14 (27%)</td>
<td>14 (28%)</td>
<td>25 (47%)</td>
</tr>
<tr>
<td>housekeeping</td>
<td>9 (18%)</td>
<td>15 (30%)</td>
<td>14 (26%)</td>
</tr>
<tr>
<td>unemployed</td>
<td>3 (6%)</td>
<td>3 (6%)</td>
<td>3 (6%)</td>
</tr>
<tr>
<td>invalidity benefits/sick leave</td>
<td>23 (43%)</td>
<td>16 (32%)</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>retired</td>
<td>0 (0%)</td>
<td>1 (2%)</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>school</td>
<td>2 (4%)</td>
<td>1 (2%)</td>
<td>8 (15%)</td>
</tr>
<tr>
<td>Self-observation list (2 weeks)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total hours working</td>
<td>10.4 (19.7)</td>
<td>13.3 (21.5)</td>
<td>35.7 (29.3)</td>
</tr>
<tr>
<td>total hours housekeeping</td>
<td>12.7 (12.3)</td>
<td>12.8 (15.3)</td>
<td>17.1 (17.6)</td>
</tr>
</tbody>
</table>

healthy subjects. MS patients significantly were more likely to indicate that they had been less active than others than healthy subjects. Variability in activity over the two-week period was evaluated by calculating correlation coefficients between Actometer scores of the first

Table 2
Mean Scores (Standard Deviations) on Activity Instruments of CFS Patients, MS Patients, and Healthy Subjects (HS)

<table>
<thead>
<tr>
<th></th>
<th>CFS</th>
<th>MS</th>
<th>Healthy</th>
<th>CFS/MS</th>
<th>CFS/MS</th>
<th>MS/HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actometer¹</td>
<td>23.3 (10.7)</td>
<td>26.1 (13.6)</td>
<td>35.5 (10.8)</td>
<td>ns</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>SIP-MOB¹</td>
<td>26.2 (8.7)</td>
<td>28.4 (8.2)</td>
<td>33.5 (1.5)</td>
<td>ns</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>SIP-WLK¹</td>
<td>31.6* (8.3)</td>
<td>31.1 (9.5)</td>
<td>40.8 (1.3)</td>
<td>ns</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>PARS-Activity¹</td>
<td>2.1 (0.4)</td>
<td>2.3 (0.4)</td>
<td>2.7 (0.5)</td>
<td>ns</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>CIS-Activity¹</td>
<td>3.2 (1.7)</td>
<td>3.4 (1.7)</td>
<td>5.8 (1.0)</td>
<td>ns</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Daily Observed Activity¹</td>
<td>3.8 (1.3)</td>
<td>4.3 (1.1)</td>
<td>5.4 (1.0)</td>
<td>ns</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Self-perceived Activity²</td>
<td>2.9 (1.1)</td>
<td>3.1 (1.1)</td>
<td>3.9 (0.8)</td>
<td>ns</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>CFS</th>
<th>MS</th>
<th>Healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity Compared to Others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-perceived²</td>
<td>1.5 (0.6)</td>
<td>2.0 (0.9)</td>
<td>2.7 (1.0)</td>
</tr>
<tr>
<td>PARS-Expected Fatigue²</td>
<td>4.0 (0.6)</td>
<td>3.6 (0.8)</td>
<td>2.2 (0.6)</td>
</tr>
</tbody>
</table>

¹Duncan multiple range test: p<0.05.
²Mann-Whitney test: p<0.01.
ns = non-significant.
week and Actometer scores of the second week (CFS: \( r = 0.94 \); MS: \( r = 0.92 \); healthy subjects: \( r = 0.83 \)).

Detailed analyses on self-perceived activity ratings showed that of the CFS patients and the MS patients who gave the response "neutral" or "active" on the self-perceived activity question (74% and 69%, respectively), 90% of these CFS patients and 70% of these MS patients indicated that they had been less active than others. In contrast, 96% of healthy subjects gave the response "neutral" or "active" but only 33% rated themselves as less active than others (difference with patient groups: \( \chi^2: p < 0.001 \)). There were no significant differences between CFS patients and MS patients in any of these comparisons.

Possible confounders (age, sex, education, duration of complaints, number of hours working, type of work, number of hours spent on housekeeping activities, depression, and sleep pattern) were identified per activity instrument by means of stepwise multiple regression analyses. Age, sex, education, duration of complaints, depression and sleep pattern parameters were not related to any activity measure. Number of hours working, type of work, and number of hours spent on housekeeping activities, on the contrary, were related to the instruments. Including these variables as covariates in analyses of variance, the differences between both patient groups on the one hand and healthy subjects on the other remained significant for all instruments (\( p < 0.01 \)).

**Actometer versus self-report questionnaires measuring level of physical activity**

Because CFS patients and MS patients had different scores than healthy subjects on all activity measures, the intercorrelations between the variables measuring physical activity presented in Table 3 are based on the combined data of CFS patients and MS patients only. In the table, all variables were ordered according to the degree of correlation with the Actometer. Although in general correlations between the Actometer and self-report measures were moderate or low, it can be observed that with decreasing correlations with the Actometer, instruments increasingly reflect more subjective and general interpretations of physical activity level. The self-perceived activity question can be considered as the instrument requiring the most general and subjective interpretation of activity level as it requires

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Intercorrelations Between Instruments Measuring Level of Physical Activity Based on Data of CFS Patients and MS Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acto</td>
</tr>
<tr>
<td>Acto</td>
<td>1.00</td>
</tr>
<tr>
<td>SIP-WLK</td>
<td>0.39*</td>
</tr>
<tr>
<td>PAR</td>
<td>0.36*</td>
</tr>
<tr>
<td>SIP-MOB</td>
<td>0.35*</td>
</tr>
<tr>
<td>DOA</td>
<td>0.30*</td>
</tr>
<tr>
<td>CIS-ACT</td>
<td>0.24</td>
</tr>
<tr>
<td>Self-perc</td>
<td>0.17</td>
</tr>
</tbody>
</table>

*Acto = Actometer; SIP-WLK = SIP-Walking; SIP-MOB = SIP-Mobility; PAR = Physical Activities Rating Scale; CIS-ACT = CIS-Activities; Self-perc = self-perceived current activity level; DOA = Daily Observed Activity (self-observation list). *\( p < 0.01 \).
a subjective interpretation of general activity level during the last month. This instrument had the lowest (non-significant) correlation with the Actometer.

To further answer the question whether the Actometer and the self-report questionnaires measure the same concept of activity, a test of homogeneity of these instruments was performed. This was done by principal components analyses on the activity measures. These analyses yielded a two-factor solution (Table 4). As activity variables were interrelated (see Table 3) it is not reasonable to assume orthogonality of the factor solution. Therefore, oblique rotation was applied. After rotation the factors were easily interpreted and were named “General Subjective“ and “Behavioural“.

In further analyses, the number of activity measures was reduced by calculating a summary scores for the two types of self-report questionnaires that emerged from the factor solution. For each factor, the weighted scores of the questionnaires belonging to that factor were summed. The weighting was performed to achieve approximately equal standard deviations of variables per factor, which improves reliability. The Actometer was treated as a separate variable because the Actometer is the criterion for actual activity and considering the poor relationship with the self-report questionnaires. Thus, in further analyses the following activity variables will be used: the Actometer, the summary score for the “Behavioural“ questionnaires, and the summary score for the “General Subjective“ questionnaires.

Activity-related cognitions

In Table 2 data are presented on the PARS-Expected Fatigue score. Patients with CFS had significantly higher PARS-Expected Fatigue scores than MS patients and both patient groups had significantly higher PARS-Expected Fatigue scores than healthy subjects. In both patient groups there was a negative correlation between PARS-Expected Fatigue score and how often the activities actually had been performed (PARS-Activity score) (CFS: \( r = -0.37 \); MS: \( r = -0.42 \)), but there was no correlation between both variables in healthy subjects. In both patient groups this relationship extended to other activity questionnaires. High PARS-Expected Fatigue scores corresponded with low activity levels on the “Behavioural“ questionnaires (CFS: \( r = -0.56 \); MS: \( r = -0.52 \)) and to a lesser

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS-Activity</td>
<td>0.862</td>
<td>0.299</td>
</tr>
<tr>
<td>Self-perceived activity</td>
<td>0.767</td>
<td>0.365</td>
</tr>
<tr>
<td>Daily Observed Activity</td>
<td>0.763</td>
<td>0.340</td>
</tr>
<tr>
<td>SIP-Walking</td>
<td>0.232</td>
<td>0.822</td>
</tr>
<tr>
<td>SIP-Mobility</td>
<td>0.478</td>
<td>0.770</td>
</tr>
<tr>
<td>Actometer</td>
<td>0.317</td>
<td>0.723</td>
</tr>
<tr>
<td>Physical Activities Rating Scale</td>
<td>0.555</td>
<td>0.566</td>
</tr>
</tbody>
</table>
degree with the “General Subjective” questionnaires (CFS: $r = -0.37$; MS: $r = -0.38$). Considering the relationship between PARS-Expected Fatigue score and the Actometer, however, in CFS patients a correlation was found ($r = -0.28$) but not in MS patients.

**Relationship between physical activity and fatigue**

Table 5 contains correlations between fatigue severity as measured by the CIS subscale Subjective Fatigue and the activity measures. In patients with CFS, we found a relationship between actual activity level and fatigue severity as expressed by the correlation between the Actometer and the CIS subscale Subjective Fatigue. In MS patients and healthy subjects this correlation was not significant. The same picture was found with respect to the “Behavioural” self-report questionnaires: a relationship was found in CFS patients but not in MS patients and healthy subjects. The “General Subjective” score was related to fatigue in all groups.

**Discussion**

**Level of physical activity**

The present study shows that patients with CFS have significantly lower levels of physical activity on different types of instruments than healthy subjects. Although this was expected a priori, sleep pattern was not related to activity level. In a previous study (Vercoulen et al., 1996b) we have documented sleep pattern of the present samples in greater detail and we found that there was no difference in total sleeping time during the night between CFS patients (mean 8.0 h) and healthy subjects (7.5 h). In addition, variability in both groups was rather small (CFS: SD = 1.7; healthy: SD = 0.7). We did find that CFS patients spent more time awake before falling asleep, were longer awake during the night, and spent more time asleep and resting during the day. However, these epochs were relatively small (approximately 30 min). Thus, no correlation can be expected.

Depressive symptomatology also was not related to activity level. This may be unexpected as depressed patients are known to be inactive and depressive symptomatology is present in many CFS patients. In a previous study we did not find an effect of a potent anti-
depressant (fluoxetine) on levels of physical activity in another sample of CFS patients (Vercoulen et al., 1996c). In addition, fluoxetine also was not effective on fatigue severity or on depressive symptomatology. These results show that low activity levels in CFS are not attributable to depressive symptomatology. In fact, the presentation of depressive symptoms in patients with CFS does not indicate the same underlying mechanisms as in patients with major depressive disorder (Vercoulen et al., 1996c).

Occupational situation and housekeeping activities significantly influenced activity level. The number of hours working, having a job predominantly requiring standing or walking, and the number of hours spent on housekeeping activities resulted in higher activity levels. Nevertheless, after correcting for the effects of these variables, CFS patients still were less active than healthy subjects. This means that patients who had jobs still were less active than healthy subjects.

**Actometer versus self-report questionnaires**

Accelerometers, such as the Actometer used in the present study, are reliable and valid measures of human physical activity. A clear disadvantage of the Actometer is that it is a rather costly and time-consuming method. This particularly is a setback in clinical settings. The present study showed that one has to be very careful with using self-report questionnaires as measures for actual activity level: none of the self-report questionnaires had strong correlations with the Actometer. Thus, self-report questionnaires are no perfect parallel tests for the Actometer.

However, some self-report questionnaires can be used as acceptable substitutes for the Actometer in contrast to other questionnaires. The less an instrument required general subjective interpretations, the more this instrument was related to the Actometer. These typically were questionnaires that required only simple responses to specified activities. Also, in principal components analyses these instruments were included into the same factor as the Actometer. In contrast, self-report questionnaires requiring subjective interpretations of general activity level over a prolonged period had low or non-significant correlations with the Actometer and were included into a different factor than the Actometer. Moreover, we found that on self-perceived activity ratings CFS patients and MS patients show a response pattern different from healthy subjects.

The subjective instruments do not measure actual behaviour. Responses on these instruments appear to be an expression of the patients' views about activity and may be biased by cognitions concerning illness and disability. In healthy subjects such cognitions do not exist and therefore their responses were not biased by these cognitions.

**Activity-related cognitions**

Cognitions are prominently involved in producing low levels of physical activity in CFS but not in MS. We found that specific activities which patients expected to result in high fatigue levels were less frequently performed than activities which were expected to produce less fatigue. This was confirmed by the finding that high fatigue expectations also were related to low Actometer readings. Patients with CFS had significantly higher scores on activity-related fatigue expectations than patients with MS. These findings fit into the
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model on factors perpetuating fatigue we developed in a previous study (Vercoulen et al., submitted). In that model it was demonstrated that attributing complaints to a physical disease contributes to the establishment of low activity levels. In contrast, for MS a different model had to be developed in which low levels of activity were not caused by attributions, but by the disease process (measured with EDSS). Thus, patients with CFS believe that complaints have a physical cause (Wessely & Powell, 1989; Hickie et al., 1990; Vercoulen et al., 1994; Vercoulen et al., 1996b) and in their view physical activity is harmful. Consequently, these patients try to prevent symptoms by avoiding physical activity.

Physical activity and fatigue

The relationship between low levels of physical activity and high levels of fatigue in CFS we found in previous studies (Vercoulen et al., 1996a; Vercoulen et al., 1996b) was confirmed in the present study in which fatigue severity was related to the Actometer. This study also showed that in studying the relationship between two concepts one has to realise that the strength of this relationship is also dependent on whether the same types of methods were used to measure each concept. We found that the strength of the correlation between fatigue severity and activity measures increased as the activity measures reflected more subjective interpretation. The CIS also is a self-report questionnaire requiring a general subjective interpretation. Thus, responses on these instruments are susceptible to the same biases. It is then not surprising that, although no relationship was found between fatigue severity and actual activity level in MS patients and healthy subjects, there was a correlation between the CIS and the “General Subjective” score in both groups. This finding also is in line with Eiffert & Wilson (1991) who cautioned that the strength of a relationship between two concepts is also dependent on whether the same type of method is used.

Although we found that CFS patients and MS patients had similar (low) levels of physical activity, the actual level of physical activity was related to fatigue severity in CFS but not in MS. The question is: how can low levels of physical activity produce fatigue in one patient group but not in another patient group with similar low activity levels? A possible explanation may be distilled from our clinical observations and observations made by others (Surawy et al., 1995) that in CFS periods of rest are interrupted by short periods of marked activity during which patients perform at “normal” levels. These short periods of high activity may be due to trying to live up to high standards (Surawy et al., 1995), social demands, or because on such days the patient feels less fatigued. It can be hypothesized that in patients with a low overall activity level short periods of high activity especially may have detrimental effects. We currently are analysing the Actometer data to evaluate whether patients with CFS exhibit more pronounced oscillations in activity level than patients with MS.

Specificity of activity results to CFS

There were several similarities between patients with CFS and patients with MS with respect to activity results. Both groups had similar levels of physical activity, which were lower than activity levels of healthy subjects, and in both patient groups responses on
questionnaires requiring subjective interpretations may be biased by cognitions concerning illness and disability.

There were, however, also important differences between CFS and MS. First, in CFS cognitions appeared to play a more prominent role in causing low activity levels than in MS. Patients with CFS had stronger expectations that activity would produce fatigue and such expectations were related to low activity. Secondly, low levels of physical activity were related to fatigue in CFS but not in MS. Thirdly, although both patient groups had similar activity levels, CFS patients were more likely to indicate that they had been less active than other persons they knew. CFS patients generally feel that their illness is not taken seriously and feel that they have to defend themselves. Such cognitions may reinforce the tendency to report that had not been active. For MS patients this bias is not as prominent as for CFS patients: a somatic explanation for their complaints is established. These findings support the notion presented in the section “Actometer versus self-report questionnaires” that in patients subjective ratings concerning physical activity may be biased by illness and disability related cognitions.

A methodological remark that could be made is that we introduced a selection-bias by including referred and self-referred subjects. However, in a previous study we have shown that self-referred patients did not show any significant differences on sociodemographic variables or other important measures, such as fatigue severity, functional impairment, and self-report measures on physical activity (Vercoulen et al., 1994). In addition, the concept of referral is not applicable to healthy subjects. These subjects were selected from a pool of subjects based on whether they matched CFS patients with respect to age, sex, and education.

Successful treatment of fatigue in CFS should not be directed only at encouraging patients to increase activity level but, in addition, particular attention should be paid to the cognitive processes that lie at the root of their physical inactivity: attributing complaints to a physical cause—and believing that activity is harmful and leads to fatigue.

Acknowledgements—This study has in part been supported by Stichting Vrienden MS Research (Grant 91-89 MS). We are indebted to JCJM Walk, EHW Damhuis, and STFM Frequin for their support in the data collection.

References

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