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Memory for Fatigue in Chronic Fatigue Syndrome: Relationships to Fatigue Variability, Catastrophizing, and Negative Affect

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Abstract

Fatigue in chronic fatigue syndrome (CFS) is usually assessed with retrospective measures rather than real-time momentary symptom assessments. In this study, the authors hypothesized that in participants with CFS, discrepancies between recalled and momentary fatigue would be related to catastrophizing, anxiety, and depression and to variability of momentary fatigue. They also expected that catastrophizing, anxiety, and depression would be associated with momentary fatigue. The authors asked 53 adults with CFS to carry electronic diaries for 3 weeks and record their experiences of momentary fatigue. The authors assessed participants' fatigue recall with weekly ratings and administered questionnaires for catastrophizing, depression, and anxiety. Recall discrepancy was significantly related to the variability of momentary fatigue. In addition, catastrophizing, depression, and momentary fatigue were all significantly related to recall discrepancy. Catastrophizing, depression, anxiety, and momentary negative affect were all significantly associated with momentary fatigue. The findings suggest that momentary fatigue in patients with CFS is related to modifiable psychological factors.

Keywords

affect; chronic fatigue syndrome; fatigue; measurement; pain

In the absence of a definitive biomedical test for chronic fatigue syndrome (CFS),[1,2] symptom self-reports have played a vital role in clinical assessments. Researchers have used experience sampling methods to quantify the differences between what patients remember about their symptoms and their actual experience of symptoms.[3] Participants typically are asked to recall momentary symptom levels for a predetermined period of data collection (eg, pain intensity over 1 week). One interpretation of experience sampling data is that momentary ratings may capture symptom experiences that are less affected by memory factors than are recall ratings.

In previous experience sampling studies with electronic diaries, chronic pain patients (most suffering from fibromyalgia and arthritis) reported (1) higher pain levels for recalled versus momentary pain reports[4] and (2) higher recalled pain relative to momentary ratings as the variability of momentary pain increased.[5]

Catastrophizing is associated with increased self-reported pain across many conditions,[6,7] whereas *negative affect* has been associated with somatic symptom complaints in general.[8] Furthermore, ongoing negative emotional states (eg, anxiety, depression) may increase the

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likelihood of catastrophic misinterpretations of symptoms[9] and symptom-focused attention.[10] Catastrophizing also has been associated with higher recall agreement for momentary pain experienced in the home environment.[11]

Recall of fatigue is of interest because it is unknown whether fatigue recall in CFS patients follows patterns similar to those found for individuals with chronic pain. Given that psychological factors and the variability of momentary symptoms may substantially influence pain complaints,[5,9] we assessed whether these factors also affected fatigue, when presented as a primary symptom.

In the current study of CFS patients, we tested the following hypotheses: fatigue recall will be related to (1) the variability of momentary fatigue and (2) the psychological variables of catastrophizing, anxiety, and depression. In addition, we expected that momentary fatigue intensity would be related to catastrophizing, anxiety, and depression.

METHODS

Participants

Participants were 53 adults with CFS living in the Stony Brook, NY, area, whom we recruited as part of a larger naturalistic study over a 30-month period using radio, TV, and newspaper advertising; ongoing announcements in a quarterly wellness newsletter; CFS and fibromyalgia Web sites; physician referrals; campus and hospital listserv announcements; and talks given by the second author (FF). There were no demographic differences among these sources of recruitment. We offered candidates $100 as compensation for participation. All participants signed consent forms in a face-to-face meeting with the research staff during their initial appointment. The Stony Brook University Institutional Review Board approved this study.

As supervised by the project physician, the study physician or physician's assistant diagnosed participants with CFS. The diagnosis was made on the basis of established criteria for CFS,[1] which include 6 months of medically unexplained, debilitating fatigue plus 4 of 8 secondary symptoms that fit into 3 categories: flulike or pain symptoms, neurocognitive difficulties, and post-exertional malaise.

In addition, CFS criteria exclude patients with identifiable medical (eg, cancer) and psychiatric (eg, melancholic depression) conditions that might explain their fatigue. We made psychiatric exclusions on the basis of results from the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, 4th ed,[12] which the second author (FF) or his graduate student (D.W. Leung) conducted. Participant exclusions, made on the basis of definitional criteria for CFS,[1,2] were primarily due to melancholic depression in the previous 5 years, fewer than 4 of 8 secondary symptoms, sleep apnea, substance abuse in the past 2 years, or other identifiable medical conditions associated with significant fatigue.

Additional inclusion criteria were age requirements (18−60 years), English fluency, and wakefulness between 9 AM and 9 PM daily. The second author (FF) conducted 841 telephone-screening interviews, which yielded 231 candidates (27.4%) eligible for the study. Of these, 126 (54.5%) agreed to participate. Participant withdrawal was largely due to the time commitment involved in the larger study.

We confirmed a final CFS diagnosis in 123 (95.5%) of these participants. Because we began data collection for this study 12 months after the larger study, complete data were available for only 53 participants. There were no demographic differences in age, sex, ethnicity, education, marital status, or illness duration between the larger participant pool and the subset who participated in this study. The average age of the participants was 41.7 years (*SD* = 9.6),

and 85.3% were women. Participants were predominantly white (97.0%), highly educated (75.8% attending at least some college), and married or cohabitating (51.5%). The mean duration of the CFS illness was 8.27 years (*SD* = 6.8, range = 9 months–37 years).

Measures and Materials

Momentary Measure: Electronic Diary—The electronic diary was a Palm Vx Palm Pilot computer (Palm Inc, Sunnyvale, CA) with Satellite Forms software (Thacker Network Technologies Inc, Lacombe, Canada) designed to record momentary data. The system has been successfully used in many other studies.[4,13] The Palm Pilot emitted auditory prompts linked to a display of symptom rating scales. Participants used a stylus to select a response to each numerical symptom scale. The software recorded the time and date of each entry.

To obtain a representative diurnal sample of fatigue and negative affect without undue participant burden,[14] the Palm Pilots prompted participants for 21 days, 6 times a day every 2 hours plus or minus a randomly programmed 1- to 20-minute interval (a process known as *ecological momentary assessment*[3]). The first daily prompt occurred within 1 hour of the participant's awakening, and the last daily prompt occurred approximately 12 hours later. No prompt signals occurred during the participant's reported sleep time. After each prompt, 2 response-activated screens were displayed, each with a numerical rating scale ranging from 0 (*none*) to 10 (*highest*). We labeled the scales Fatigue Now and Negative Feelings Now. These 11-point numerical rating scales have shown good reliability, sensitivity, and convergent validity.[15,16]

To avoid interruptions of important ongoing activities (eg, business meetings), participants could enter data between scheduled prompt times; however, they rarely did so, as evidenced by participants answering 93% of the scheduled prompts. Participant compliance with the Palm Pilot prompts was excellent: weekly compliance rates for responding within 5 minutes of the scheduled auditory prompts were 92.6% for week 1, 92.3% for week 2, and 92.4% for week 3. Three-week average compliance rates for individual participants ranged from 71% to 100%. Only 1 participant had a compliance rate below 80%.

Retrospective Measures

Weekly Recall Assessment of Fatigue and Affect: At the end of each week of momentary assessment, we called each participant at a prescheduled time to collect recall ratings for average fatigue levels and average negative affect experienced for that week. We decided to use telephone-elicited weekly ratings because person-to-person data collection is similar to in-person healthcare visits where patients verbally respond to requests for fatigue symptom reports. We obtained 3 weekly recall ratings for each participant.

Catastrophizing Subscale (Fatigue-Related Cognitions Scale): The catastrophizing subscale of the Fatigue-Related Cognitions Scale[17] contains 10 items associated with a 5-point response format (ranging from 1 [*disagree strongly*] to 5 [*agree strongly*]) and queries participants about their cognitive reactions to fatigue symptoms in the past 2 weeks. The subscale items reflect different aspects of catastrophizing about fatigue consistent with the 3 replicated dimensions of catastrophizing (ie, magnification, rumination, and helplessness).[18] Adequate internal consistency for the catastrophizing subscale was demonstrated in our study sample ($\alpha = .79$).

Beck Depression Inventory: We measured depressive symptomatology with the Beck Depression Inventory (BDI-II),[19] a 21-item self-report instrument with well-established psychometric properties.[20] On a 4-point adjective rating scale, participants recall depression-related symptoms for the past 2 weeks, including the current day. Several researchers have

investigated the psychometric characteristics of the BDI-II with respect to both clinical and nonclinical populations.[21] These investigators have generally found that total scores on the BDI-II have high internal consistency ($\alpha > .90$) and moderate to strong convergent validities ($r > .50$) with other self-report and clinical rating scales of depression in psychiatric patients, college students, and normal adults. In the current study, we corrected BDI-II scores (BDI-II corrected) by removing the effect of the somatic factor,[22] which included fatigue-related symptoms, from the total score. The remaining items focused on cognitive and emotional phenomena related to depression.

Beck Anxiety Inventory: We measured anxiety symptoms with the Beck Anxiety Inventory (BAI), a 21-item self-report measure in which participants report their anxiety for the past week, including the current day. The BAI has high internal consistency ($\alpha = .92$) as well as established and replicated construct validity.[23,24] Factor analysis of the BAI yielded a first-order factor labeled *anxiety* that had salient loadings for all 21 items on the BAI but only 1 item on the BDI-II.

Procedure

We trained participants individually on how to use the Palm Pilot diary and answer the questions about fatigue and affect ratings (momentary fatigue and negative affect). After that, participants began the 3 weeks of momentary and recall data collection. We then administered the previously described retrospective questionnaires.

Statistical Analyses

We conducted all analyses using SAS (SAS Institute Inc, Cary, NC); we conducted analyses involving momentary data with the PROC MIXED multilevel modeling procedure using Full Information Maximum Likelihood. This procedure allows for adjustment for autocorrelation and takes into account different intervals of time between assessments.[25] We performed paired *t* tests to test for differences between average momentary and recall ratings of fatigue.

Variability of Momentary Fatigue and Recall Discrepancy Scores—We defined the variability of daily fatigue patterns as the weekly standard deviation of momentary fatigue ratings for each of the 3 weeks. We determined the recall discrepancy score by finding the difference between the weekly recall ratings and average momentary ratings for fatigue intensity, so that larger differences indicated lower agreement. We used Pearson correlations to determine the relationship between weekly recall discrepancy scores and the variability (standard deviation) of momentary fatigue for that week.

Recall Discrepancy and Psychological Variables—Weekly recall discrepancy scores were correlated with the catastrophizing subscale of the Fatigue-Related Cognitions Scale, BDI-II, BAI, and momentary negative affect. Each measure's recall period (ie, week 1, 2, or 3) determined the number of weeks of recall discrepancy data we entered into the calculation of the correlation coefficient. For instance, we calculated the association between catastrophizing and recall discrepancy by correlating the catastrophizing scores with the associated recall discrepancy data for weeks 2 and 3. For momentary negative affect, we used all 3 weeks of recall discrepancy scores.

We ran a hierarchical regression to further examine the relationships between psychological variables (predictors) significantly associated with recall discrepancy (criterion variable), with age and sex entered in step 1. This order of entry enabled us to examine the effects of fatigue coping and negative affect after controlling for the potentially confounding demographic variables of age and sex.[26-28]

Momentary Fatigue Intensity and Psychological Variables—We used Pearson correlations to determine the association between average momentary fatigue intensity and the variables of catastrophizing, depression, and anxiety. As with recall discrepancy, the recall period for each measure determined the number of weeks of momentary data used to calculate the correlation coefficient. All significance tests were two-tailed ($\alpha = .05$).

RESULTS

Three weeks of momentary and weekly recall data were available for analysis (see Table 1). Paired *t* test results showed that recall fatigue ratings were not significantly higher than momentary fatigue ratings ($t[28] = -1.83$, $p = .07$) on the basis of 3-week averages. We observed a small effect size ($d = .15$) for recall versus momentary fatigue. In addition, recall discrepancy scores were not significantly related to illness duration ($r = -.01$, $p = .94$) or medication use (use vs nonuse of any medication; $r = .18$, $p = .28$).

Fatigue Variability and Recall Discrepancy

The distributions of standard deviations for momentary fatigue for each week were approximately normal. For week 1 data, the correlation between the standard deviations of the momentary data and recall discrepancy scores for fatigue was significant ($r = .43$, $p < .01$). Therefore, participants with higher variability of momentary fatigue ratings were less able to recall their average levels of momentary fatigue. This was not the case for weeks 2 ($r = .27$, $p = .07$) and 3 ($r = .07$, $p = .65$), which yielded nonsignificant results.

The decreasing magnitude of these correlations from weeks 1−3 was accompanied by declines in the standard deviations of both the weekly recall discrepancy data and weekly momentary fatigue, suggesting the possibility of practice effects for recall fatigue. However, the decrease in standard deviations of recall discrepancy data was nonsignificant between weeks 1 and 2 ($F[45, 43] = 1.11$, $p = .37$), weeks 2 and 3 ($F[43, 40] = 1.32$, $p = .19$), and weeks 1 and 3 ($F[45, 40] = 1.46$, $p = .11$). In addition, a similar analysis for the declining standard deviations of weekly momentary fatigue over the 3-week data collection period was also nonsignificant (weeks 1 and 2: $F[54, 54] = 1.13$, $p = .33$; weeks 2 and 3: $F[54, 54] = 1.13$, $p = .33$; weeks 1 and 3: $F[54, 54] = 1.28$, $p = .18$).

Recall Discrepancy: Relation to Psychological Variables and Fatigue

Recall discrepancy scores for fatigue were significantly associated with catastrophizing ($r = -.43$, $p < .01$) and depression ($r = -.30$, $p < .05$) but not anxiety ($r = -.19$, NS) or momentary negative affect ($r = -.31$, NS). That is, greater catastrophizing and depression were associated with lower discrepancies between recall and momentary fatigue ratings. In addition, recall discrepancy was significantly related to momentary fatigue intensity ($r = -.53$, $p < .001$). A hierarchical regression controlling for age and sex ($R^2 = .79$; $F[5, 21] = 16.10$, $p < .001$) revealed that fatigue intensity remained a significant predictor of recall discrepancy ($\beta = -.73$; $t = -3.23$, $p < .01$), whereas both catastrophizing and depression were no longer significant predictors. Therefore, increased momentary fatigue intensity was predictive of lower recall discrepancy, independent of catastrophizing and depression.

Fatigue Intensity and Psychological Variables

As expected, we found significant correlations between average momentary fatigue ratings and these psychological variables: momentary negative affect, anxiety, depression, and catastrophizing (see Table 2). Given the different recall periods for the catastrophizing and anxiety measures, we did not run a hierarchical regression entering both catastrophizing and anxiety as predictors of momentary fatigue.

COMMENT

In this study, we examined how momentary fatigue variability and a number of psychological variables affected memory for momentary fatigue in patients with CFS. In addition, we examined the relationships between momentary fatigue intensity and psychological variables. Our first hypothesis was partially confirmed: higher variability of momentary fatigue was positively associated with higher recall discrepancies relative to their momentary levels but only for the first of 3 weeks of data collection.

Our second hypothesis was also partially confirmed: the discrepancy between recall and momentary fatigue was significantly inversely related to the psychological variables of catastrophizing and depression but not to anxiety or momentary negative affect. That is, higher levels of catastrophizing and depression were predictive of more accurate recall of momentary fatigue. Our third hypothesis was largely supported: momentary ratings of fatigue were significantly positively correlated with measures of momentary negative affect, anxiety, depression, and catastrophizing.

Fatigue Variability and Recall

Similar to our findings, Stone et al[5] found that higher variability of momentary pain symptoms in a sample of chronic pain patients was associated with higher levels of recalled pain relative to momentary levels. However, they also observed that recall discrepancies were accounted for by participants' preferential weighting of higher momentary pain ratings (based on transformed scores). In our study, a similar analysis (not reported) revealed that 2 of the 3 weeks of recall discrepancy data were better explained with selective weightings of higher fatigue ratings. This difference may be due to participants in the study by Stone et al[5] reporting substantially higher discrepancy scores for recalling pain (see Table 1). In other words, although fatigue recall may follow a pattern similar to pain recall, the relatively small recall discrepancies found in our participants made this pattern more difficult to detect.

The more general symptom of bodily fatigue may be less discernable than pain, which is often localized and salient— and thus more likely to be recalled at higher levels.[29,30] Furthermore, although practice effects may have contributed to our findings of lower recall discrepancies and lower variability of momentary ratings over the data-collection period (3 weeks in our study vs 2 weeks in the pain study by Stone et al[5]), these weekly changes were nonsignificant.

Fatigue and Psychological Variables

Our finding that catastrophizing was positively correlated with momentary fatigue replicates that from a prospective study on pain memory in patients with rheumatoid arthritis, in which LeFebvre and Keefe[11] found that participants who scored higher on a retrospective measure of catastrophizing (a subscale of the Coping Strategies Questionnaire) reported higher levels of pain as recorded in a 30-day diary. Furthermore, participants in that study who catastrophized showed higher recall agreement with their real-time pain intensity for the previous 30 days. Similarly, in our study, recall discrepancy, a measure of recall agreement, was negatively associated with catastrophizing. Therefore, although catastrophizing seems to negatively influence the experience of naturally occurring symptoms, it increases the accuracy of recall of these symptoms.

The increased recall accuracy associated with both catastrophizing and depression in the current study (these variables showed substantial overlapping variance) may be due to the increased somatic awareness associated with these psychological variables.[10,19,21,22,31] Thus, if fatigue is more salient for those who catastrophize and report higher levels of depression, it may result in more accurate recall. Similarly, higher levels of average momentary

fatigue may be more salient to the individual with CFS, which could explain our finding that higher momentary fatigue was associated with decreased recall discrepancy.

In a 1995 cross-sectional investigation in people with CFS, Petrie et al[31] found that catastrophizing was significantly associated with fatigue on the Rand Vitality Index, a brief measure of fatigue. The researchers measured catastrophizing with a single question projecting a worst-case scenario if participants pushed themselves beyond their physical ability. This question also may have captured illness-related anxiety, which we found to be related to both momentary and recall fatigue in the current study.

Perhaps surprisingly, we did not find the high levels of depression reported in previous CFS studies.[32,33] The level of psychopathology may have been lower in our study as compared with chronic pain memory studies, such as that conducted by LeFebvre and Keefe,[11] given that we excluded a number of psychological disorders (eg, melancholic depression) as required by the CFS case definition.

In addition, we drew most of our sample from nonclinical sources, and thus their relatively high functional level (the majority were working full- or half-time) may have been associated with less severe illness losses and fewer reactive depression symptoms but greater anxiety, given the pressures of high functioning associated with the debilitating illness of CFS.[34]

Clinical Implications

The direct relation between momentary fatigue and momentary negative affect suggests that behavioral interventions (eg, pleasant mood induction)[35] that focus on reducing in vivo negative affect also lessen fatigue or its impact.[36] Patients may be unaware of this association and thus view their fatigue as an unmodifiable illness symptom rather than a phenomenon strongly influenced by real-time negative affect (eg, anxiety, discouragement, anger).[36]

Our findings also suggest that, as with chronic pain, catastrophizing is an important variable that influences momentary and recall fatigue. Thus, cognitive interventions designed to identify and change catastrophizing beliefs may be helpful in reducing fatigue. In a 1994 clinical trial of a cognitive coping skills intervention in CFS patients, Friedberg and Krupp[17] found that catastrophizing on the Fatigue Related Cognitions Scale was significantly reduced as a result of the 6-session treatment.

Limitations

The limitations of this study include the absence of a fatiguing illness control group, which would have provided an instructive comparison for the memory and psychological factors that may more uniquely apply to CFS. In addition, we do not know whether our findings are applicable to individuals with shorter-duration CFS. Furthermore, the small percentage of minority participants suggests that our findings may not generalize to the population of CFS patients, which includes a much higher percentage of minority members.[37]

Conclusions

Our findings confirm relationships between CFS patients' fatigue intensity and modifiable psychological factors—including momentary negative affect, anxiety, depression, and catastrophizing—thus extending previous findings on chronic pain to momentary fatigue. Clinically, our findings suggest that reductions in these psychological variables also may lessen momentary fatigue or its impact. Further research, particularly in the form of intervention studies, may clarify how these psychological factors affect momentary symptom severity in patients with CFS.

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TABLE 1

Participants' Momentary Feeling of Fatigue and Weekly Recall of Fatigue

	Week 1		Week 2		Week 3		Total	
Variable	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
Momentary	4.78	1.68	4.98	1.83	4.74	1.72	4.93	1.73
Weekly	5.26	1.67*	5.05	1.61	5.07	1.73	5.19	1.63

* $p < .05$.

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TABLE 2

Correlations Between Ratings of Fatigue and Psychological Measures

Variable	1	2	3	4	5	6
1. Momentary fatigue	—					
2. Recall of fatigue	.76***	—				
3. Negative affect	.41**	.32*	—			
4. Anxiety	.56***	.37*	.64***	—		
5. Depression	.28*	.08	.45**	.50**	—	
6. Catastrophizing	.51**	.25	.50**	.57***	.57***	—

* $p < .05$.

** $p < .01$.

*** $p < .001$.