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Corresponding Author: Dr. Dana N. Rutledge, RN, PhD

Corresponding Author's Institution: California State University, Fullerton

First Author: Dana N. Rutledge, RN, PhD

Order of Authors: Dana N. Rutledge, RN, PhD; Michele Mouttapa, PhD; Patrick B Wood, MD

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Objective: We aimed to determine whether -- among 26 symptoms that participants in a prior online study identified -- clusters of symptoms could be identified as well as to elucidate the underlying structure of this set of symptoms.

Methods: The current analysis relied on data from a National Fibromyalgia Association-sponsored study of 2569 persons with FM who responded to an online survey during a 3-day period in 2005. Factor analysis was employed.

Results: In this well educated, primarily Caucasian sample, morning stiffness, fatigue, and not feeling rested in the morning were symptoms with highest severity scores. A series of exploratory factor analyses followed by confirmatory factor analysis and Cronbach's alpha testing led to a 7-

factor model with the following domains containing 24 symptoms: Somatic; Distress; Dyscognition; Fear of Illness; FM Core; Nonrestorative Sleep; Perceived Support.

Discussion: Our findings support the heterogeneity of the FM experience, the presence of symptom clusters, and the possibility of tailoring interventions based upon symptomatology. Further work is needed to develop symptom inventories that can be used as outcomes in clinical trials, as well as by practitioners to describe clinical burden and effect of treatments.

July 22, 2008

Molly Dougherty, PhD, RN, FAAN
Editor, *Nursing Research*

Dear Dr. Dougherty –

I am submitting a manuscript “Symptom Clusters in Fibromyalgia: Potential Utility in Patient Assessment and Treatment Evaluation” for review. My coauthors and I believe it will be of interest to the journal's audience, both those in clinical and academic settings. We look forward to reviewers’ comments.

Dana N. Rutledge, RN, PhD
Professor, Nursing
California State University, Fullerton

Running head: SYMPTOM CLUSTERS IN FIBROMYALGIA

Symptom Clusters in Fibromyalgia: Potential Utility in Patient Assessment and Treatment
Evaluation

Dana N. Rutledge RN PhD¹

Professor, California State University, Fullerton Department of Nursing

Michele Mouttapa PhD

Assistant Professor, California State University, Fullerton Department of Health Sciences

Fullerton CA

Patrick B. Wood MD

Chief Medical Officer, Angler Biomedical Technologies, LLC

Jonestown, TX

¹ Corresponding Author:

9 Gardenia Irvine CA 92620-1984

714-730-4806

FAX 714-730-5165

drutledge@fullerton.edu

Abstract

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Discussion: Our findings support the heterogeneity of the FM experience, the presence of symptom clusters, and the possibility of tailoring interventions based upon symptomatology. Further work is needed to develop symptom inventories that can be used as outcomes in clinical trials, as well as by practitioners to describe clinical burden and effect of treatments.

KEY WORDS: fibromyalgia, symptoms, outcome assessment, cluster analysis, factor analysis

1 Symptom Clusters in Fibromyalgia: Potential Utility in Patient Assessment and Treatment
2 Evaluation

3 Persons with fibromyalgia (FM) suffer from a myriad of symptoms, some of which may
4 go unrelieved due to improper diagnosis (Aaron, Burke, & Buchwald, 2000) and the lack of
5 effective pharmacologic and other management strategies (Sarac & Gur, 2006). Recent evidence
6 has pointed to the likelihood of diversity in presentation and perhaps etiology of FM (McLean et
7 al., 2006; Raak, Hurtig, & Wahren, 2003; Thieme & Turk, 2006; Turk, 2002). A clearer
8 understanding of symptomatology experienced by persons with FM could therefore add
9 additional insights regarding this potential heterogeneity.

10 FM is thought to be present in 2 to 10% of populations studied, although its prevalence is
11 likely underestimated (Jain et al., 2003). Most persons with FM suffer from multiple symptoms
12 beyond the classic triad of pain, fatigue, and disordered sleep (Clauw & Crofford, 2003; Mease,
13 2005). Unfortunately, in persons suffering from FM, this symptomatology can stay stable over
14 time (Jain et al.; Wolfe et al., 1997).

15 Researchers have begun to study symptoms in clusters “that may or may not share a
16 common etiology or link to comorbid conditions” (Gift, Jablonski, Stommel, & Given, 2004,
17 p.204). Liedberg and colleagues (Liedberg, Gullberg, & Wood, 2007) evaluated the construct
18 validity of the Fibromyalgia Symptom Inventory, a novel 29-item clinical inventory in which
19 patients self-report the severity of symptoms on a 6-point scale. Factor analysis demonstrated the
20 emergence of seven factors that accounted for 59% of the variance between items in a sample of
21 351 Swedish patients (manuscript in preparation). Kohnen and colleagues (Kohnen, Farber, &
22 Spath, 2004) analyzed clustering of 17 “vegetative” and functional symptoms in 195 patients
23 with FM. From among these 17 symptoms, the authors found six factors, which they interpreted
24 as cardiovascular, gastrointestinal, sleep, nervous, general, and autonomic.

25 While the term *symptom* refers to subjective evidence of disease or physical disturbance
26 observed by the patient, *symptom cluster* may be defined as a group of symptoms that are
27 relatively independent of other clusters (Kim, McGuire, Tulman, & Barsevick, 2005). By
28 exploring symptom clusters using methods such as factor analysis, interventions that are
29 common to each symptom in a cluster may be tested for efficacy in terms of effect on other
30 symptoms in a cluster (Kohnen et al., 2004; Wilmoth, Coleman, Smith, & Davis, 2004). The

1 move from single symptom research in FM may then allow further elucidation of the symptom
2 experience from both a qualitative and quantitative perspective.

3 In fact, evaluation of symptom clusters may be fundamental to understanding FM as a
4 complex syndrome. In discussing the major features of FM, experts have described pain and
5 neurological manifestations, neurocognitive dysfunction, fatigue, sleep dysfunction, autonomic
6 and neuroendocrine dysfunction, and other associated signs (Clauw & Crofford, 2003; Jain et al.,
7 2003; Mease, 2005). Moreover, an expanded appreciation of symptomatology may be critical to
8 the refinement of diagnostic criteria. What symptom clustering allows us to consider are multiple
9 questions such as whether one symptom leads to or causes another, whether the presence of two
10 or more symptoms together leads to worsened quality of life, whether symptom etiology for one
11 or more symptoms is related and thus, can be treated similarly, and whether certain symptoms
12 may be FM treatment-related, FM-related, or comorbid condition-related. The identification of
13 symptom clusters in persons with FM may yield important information for those who diagnose
14 and treat these patients. Also, enhanced understanding of specific symptom clusters might allow
15 novel approaches in terms of interventions that may minimize symptomatology and its impact on
16 health-related outcomes. There may be groups of symptoms that are consistently experienced by
17 persons with FM, or there may be groups of persons with FM who consistently experience
18 specific groups of symptoms. Each of these phenomena is worthy of study to understand more
19 about the symptom experience and, thus, the potential treatment of persons with FM.

20 Several methods have been used to examine and validate symptom clusters or domains.
21 These include factor analysis (Chen & Tseng, 2006; Gift et al., 2004), cluster analysis (Bender,
22 Ergun, Rosenzweig, Cohen, & Sereika, 2005; Thieme & Turk, 2006), multiple regression
23 (Gaston-Johansson, Fall-Dickson, Bakos, & Kennedy, 1999), and multistage linear regression
24 (Beck, Dudley, & Barsevick, 2005). Factor analysis allows prediction of a set of latent factors
25 that produce covariance among a group of symptoms (Barsevick, Whitmer, Nail, Beck, &
26 Dudley, 2006), thereby allowing identification of symptom groupings (factors or domains).
27 Factor analysis can be used to examine underlying structure of a set of symptoms.

28 Bennett and colleagues have reported that among 2569 respondents to an online survey of
29 persons with FM (98.4% reported having been diagnosed by a health care provider; all reported
30 having FM symptoms, 76% of whom had these for > 4 years), the most common problems
31 endorsed were morning stiffness, fatigue, nonrestorative sleep, pain, and difficulty with both

1 concentration and memory (Bennett, Jones, Turk, Russell, & Matallana, 2007). The current study
2 employed factor analysis to determine: (a) whether clusters of symptoms could be identified
3 from among the 26 symptoms that participants in the online study reported; and (b) to elucidate
4 the underlying structure of this set of symptoms.

5 Methods

6 The current analysis relied on data from a National Fibromyalgia Association (NFA)-
7 sponsored study of persons with FM who responded to an online survey during a 3-day period in
8 2005 (Bennett et al., 2007). Subscribers to the online NFA newsletter (~36,000) were sent an e-
9 mail link that invited participation in the survey, and a notice was also posted prominently on the
10 NFA website that invited persons with FM to respond. When potential participants clicked on the
11 link, they were asked to participate in the NFA Epidemiological Study, the first large-scale
12 online survey to collect data concerning prevalence, onset, and impact of FM along with
13 effectiveness of treatments. Within three days, over 3000 persons responded, thereby meeting
14 sampling goals of the original study and leading to closure of study accrual. Of these responses,
15 2569 gave adequate data on major variables to be included in the initial publication (Bennett et
16 al.). Because of the unique nature of the invitation (open to those accessing the NFA website)
17 and unknown potential population (email addresses may/may not have been accessed during the
18 three days of the survey's duration), the actual response rate is unknown.

19 *Measures.* The NFA Epidemiological questionnaire (NFAQ) contained 121 items, which
20 measured the following factors: (1) demographics and sources of information about FM, (2)
21 symptoms and functionality, (3) perceived aggravating factors, (4) perceived triggering events,
22 (5) diagnosis and health care utilization, (6) management strategies, and (7) medication use. The
23 survey was developed by a multidisciplinary task force of FM experts (Bennett et al., 2007). For
24 the current study, only items pertaining to demographics and symptoms were used. There were
25 26 symptoms or conditions measured in the original study (listed in Table 1), which used a 0 to
26 10 numerical rating scale in which higher scores indicated greater severity. For example, the item
27 'pain' was anchored as 0 = no pain and 10 = worst possible pain; 'ability to manage symptoms'
28 was anchored as 0 = excellent symptom management and 10 = unable to manage symptoms at
29 all. Evidence of content validity, internal consistency (Cronbach's alpha, .88) and initial test-
30 retest reliability has been previously discussed (Bennett et al., 2007; Rutledge, Jones, & Jones,
31 2007).

1 *Data Analysis.* Demographic variables and intensity of symptoms were evaluated using
2 descriptive statistics. Descriptive statistics were also used to evaluate FM-related information
3 such as length of time since diagnosis and comorbidities. Next, 50% of the initial sample was
4 randomly selected using SPSS version 14.0 to conduct exploratory factor analysis (EFA). The
5 principal components method of extraction and Varimax rotation was used to identify clusters of
6 symptoms. Factor analysis requires a large sample size and should lead to “uniformly high
7 communalities without cross-loadings, plus several variables loading strongly on each factor”
8 (Costello & Osborne, 2005, p.4). Our sample size clearly exceeded the subject-to-item ratio of
9 5:1 recommended as an appropriate factor solution (Arrindell & van der Ender, 1985). In
10 principal components analysis, components or factors are calculated using all of the variance
11 within symptoms entered (Costello & Osborne). Shared variance of a variable (symptom) is
12 partitioned from its unique and error variance, identifying an underlying factor structure with
13 only shared variance in the final solution. To determine the number of factors to retain in the
14 final model, two methods were used: eigenvalues greater than 1.0 and visual analysis of the scree
15 test. In the latter, the scree graph of eigenvalues is examined for the “break point” where the
16 curve flattens.

17 To determine how many variables (symptoms) to keep per factor, a cut point of .40 for
18 factor loadings (communalities) was used, which is the minimum suggested communality for an
19 item to be included into a given factor (Costello & Osborne, 2005). Essentially, a factor loading
20 of .40 indicates that an item has at least 16% overlapping variance with other items in the factor.
21 Conceptually, these communalities resemble correlation coefficients. Costello and Osborne
22 define a factor loading of .32 or higher on two or more factors as “cross-loading” (an indication
23 of variance overlap between two or more factors). When cross-loading occurred, the item in
24 question was assigned to the factor with the highest factor loading. Cronbach’s alpha was then
25 computed for each factor to determine internal consistency reliability of corresponding items.
26 Item-if deleted analyses were also conducted to determine whether any items assigned to a given
27 factor lowered Cronbach’s alpha. Those items in a given factor that lowered Cronbach’s alpha
28 were deleted and Cronbach’s alpha was re-calculated. Total standardized scores for each factor
29 were then calculated and correlations were computed between all possible pairs of standardized
30 scores.

1 Confirmatory factor analysis (CFA) was conducted on the remaining 50% of the sample
2 that was not used in EFA by using the PROC CALIS procedure in SAS version 9.1 (SAS
3 Institute, 1990). CFA can confirm a model derived in EFA, thereby estimating an association
4 between observed variables and latent constructs while accounting for measurement error of each
5 item (Bryant & Yarnold, 1995).

6 Goodness of fit indices determined degree of fit between the specified model and the
7 data: χ^2 , Comparative Fit Index (CFI) (Bentler, 1990), Root Mean Square error of approximation
8 (RMSEA) (Brown & Cudeck, 1993). CFI compares the unspecified (null) model to the specified
9 model and is sensitive to misspecifications of variable/latent factor relationships. CFI ranges
10 from 0 to 1, with .95 and above considered “excellent.” RMSEA is sensitive to misspecifications
11 of relationships between latent factors, with the criterion for “excellent” RMSEA being .05 or
12 less.

13 Results

14 *Descriptive statistics.* A total of 2,569 persons with FM were selected from the original
15 data set for the analysis. Participants ranged in age from 16 to 78 ($M = 47.26$; $SD = 10.69$). Of
16 these, 94% were women; over two-thirds (67%) were married; 18% were divorced or separated;
17 and 12% were never married. Nearly half (46%) had a bachelor’s college degree or higher, while
18 over an additional 38% had either some college education or a technical/trade school degree.
19 Ethnicity was assessed by using a “Mark all that apply” question. The vast majority of the
20 sample (95%) indicated that they were Caucasian, while each of the other ethnic groups
21 (Asian/Pacific Islander, American Indian/Alaska Native, Hispanic, African American, and
22 Other) represented less than 4% of the entire sample.

23 As reported in Bennett et al., nearly all (93%) of the participants reported having FM
24 symptoms for over two years (2007). Participants reported on possible triggers of their initial
25 FM symptoms. Out of 15 triggers, the item most commonly endorsed was chronic stress (44%),
26 followed by emotional trauma (33%) and acute illness (28%). The majority (58%) of participants
27 had seen between one to four clinical providers in search of a diagnosis, and over one-third
28 (40%) reported seeing five or more providers. Participants were asked about other health
29 conditions that they had within the six months prior to the assessment. Nearly all reported that
30 they suffered from several comorbidities (see Bennett et al. for specific details).

1 Table 1 presents the mean and standard deviation of all 26 symptoms/conditions along
2 with the percentage of participants experiencing this condition at a level of 7 or greater
3 (considered “severe”). Scores on all items ranged from 0 (absence of the symptom) to 10 (severe
4 problem with the symptom). The three symptoms with the highest scores in this sample were
5 ‘morning stiffness’ ($M= 7.5$; $SD= 2.5$), ‘fatigue’ ($M= 7.1$; $SD= 2.1$), and ‘[not] feeling rested in
6 the morning’ ($M= 6.8$; $SD= 2.7$).

7 *Exploratory factor analysis.* A series of exploratory factor analyses (EFA) using the
8 principal components method of extraction and Varimax rotation was performed on the 26 FM
9 symptoms, from 50% of the sample selected at random. Based upon the eigenvalue ≥ 1 criterion,
10 the initial EFA suggested a 7-factor solution, which accounted for 57.3% of the variation among
11 items. Next, visual examination of the curve of the scree plot demonstrated curve flattening
12 beginning at five factors. We therefore decided to conduct EFA two more times: once specifying
13 a 5-factor solution, and once specifying a 6-factor solution. Because the goal of EFA is to
14 identify solutions with “uniformly high communalities without cross-loadings, plus several
15 variables loading strongly on each factor” (Costello & Osborne, 2005, p.23), we compared the 5-
16 , 6-, and 7-factor solutions based on: (1) percentage of variance explained, (2) number of items
17 that did not load significantly on any factor, and (3) number of items that cross-loaded with other
18 factors.

19 As expected, the 7-factor solution accounted for the highest percentage of variance
20 (57.3%) in comparison with the 6- (53.39%) and the 5-factor solution (49.4%). In all three cases,
21 all items loaded significantly on at least one factor. Non-significant factor loadings were,
22 therefore, not an issue. The 6- and 7-factor solutions were better than the 5-factor solution with
23 regard to cross-loadings: the 6- and 7-factor solutions each had seven items with significant
24 cross-loadings, while the 5-factor solution had ten. Because the 7-factor solution accounted for
25 the highest percentage of variance and a relatively low number of cross-loading items, we
26 retained a 7-factor solution.

27 Three items in the 7-factor solution had cross-loadings greater than .40 (i.e., ‘problems
28 enjoying life,’ ‘problems feeling rested after sleeping,’ and ‘feeling like a burden to others’). To
29 determine whether these items should be eliminated from subsequent analyses, Cronbach’s alpha
30 was calculated for the items’ corresponding factors, both with and without the items in question.
31 The items ‘problems enjoying life’ and ‘problems feeling rested after sleeping’ were determined

1 to lower Cronbach's alpha for the factor in which they had significant loading and were therefore
 2 deleted. In contrast, the item 'feeling like a burden to others' increased Cronbach's alpha for the
 3 factor in which it had the highest factor loading and was therefore retained.

4 Table 2 presents the factor loadings of the remaining 24 symptoms that together represent
 5 seven factors in total. Based upon item content, Factor I was named *Somatic*; Factor II was
 6 named *Distress*; Factor III was named *Dyscognition*; Factor IV was named *Fear of Illness*;
 7 Factor V was named *FM Core*; Factor VI was named *Nonrestorative Sleep*; and Factor VII was
 8 named *Perceived Support*. Cronbach's alpha for the scales representing the first six factors
 9 ranged from .68 to .82, which indicate acceptable levels of internal consistency (a type of
 10 reliability for paper and pencil tests). Cronbach's alpha for the last factor was not computed
 11 because it only included one item. Costello and Osbourne (2005) recommend that for reliability,
 12 factors should contain at least five items; only one of our seven factors met this recommendation.
 13 Despite this, relatively high factor loadings and acceptable levels of internal consistency
 14 reliability in this large sample were obtained.

15 Five cross-loadings occurred among the retained items (see Table 2). Three of these are
 16 among Factor III items (i.e., 'postural instability,' 'dizziness,' 'concentration problems'), one
 17 from Factor II ('feeling like a burden to others'), and one from Factor IV ('pain').

18 Table 3 presents Spearman rank correlation coefficients between all possible pairs of
 19 factors. While all correlations among factors are significant, those with Factor 7 *Perceived*
 20 *Support* are of lesser strength (.08 - .21). The high correlations between Factors I and III and I
 21 and V are not unexpected because postural instability and dizziness cross loaded on Factor I, and
 22 core FM symptoms may ostensibly share physiologic underpinnings with those in Factor I.
 23 Correlations between Factors II and IV are also expected because both factors deal with
 24 emotions.

25 Table 4 presents the fit indices for the CFA model. Results indicate that the specified
 26 model has excellent fit with the data ($\chi^2_{(108)} = 260.85$, $p < .0001$; NFI = .9697; RMSEA = .0357).
 27 Hence, the latent factors and their relationships to observed variables generated in EFA are
 28 supported.

29 Discussion.

30 This analysis of symptoms in a large sample of persons with FM demonstrates the
 31 complexity of the disorder. Moreover, most patients experience moderate to severe intensity of

1 most symptoms on average. Rankings of intensity indicate the most severity with morning
2 stiffness, fatigue, nonrestorative sleep, and pain, closely followed by fear of symptoms
3 worsening, sleep problems, concentration problems and forgetfulness. Most elements of the latter
4 group, which indicate a different type of burden (i.e., cognitive and emotional), are infrequently
5 measured in clinical studies.

6 Strong support was found for symptom co-occurrence as demonstrated in this study with
7 seven factors documented with moderate to strong evidence of cluster strength. The
8 identification of major domains among self-reported symptoms is a benefit of approaching
9 symptoms in this way. Subscales could be used as units of analysis in future studies, possibly
10 aiding detection of clinical benefits with groups of symptoms. This work supports the World
11 Health Organization's Outcome Measures in Rheumatology (OMERACT) effort (Mease et al.,
12 2007) in trying to develop domains for assessment in studies of persons with FM. Current
13 OMERACT work is focused primarily on clinical trials of pharmacologic agents and has recently
14 expanded its emphasis to include assessment of parameters such as fatigue, sleep disturbance,
15 affect and anxiety, and cognitive dysfunction, in addition to pain, multidimensional function and
16 quality of life.

17 Analysis of individual clusters of items exposes meaningful groupings of common
18 conditions experienced by persons with FM. Factor I consists of seven somatic symptoms that
19 co-exist in patients and appear to have linkage to dysautonomia as a potentially uniting theme
20 (Martinez-Lavin & Hermosillo, 2000). Two Factor III items - postural inability and dizziness -
21 also have an autonomic component, which may therefore explain their cross-loadings with
22 Factor I.

23 Items from Factors II and IV have affective qualities in common, which may indicate an
24 emotional state. Factor II is composed of three distressing symptoms (depression, anxiety,
25 anger), which may ostensibly result from having chronic widespread pain with decreased
26 function (Clauw & Crofford, 2003). Alternatively, these may represent manifestations of an
27 underlying neurochemical abnormality, which may then account for other aspects of the
28 symptom experience (Gold & Chrousos, 1999). Key mood disorders, depression and anxiety, are
29 well-documented in persons with FM (Mease et al., 2007; Wolfe et al., 1995). Concentration
30 problems, a Factor III item, cross-loaded on Factor II; this may reflect the distress felt by persons
31 who have this condition. Similarly, feeling like a burden to others (Factor IV) is distressing and

1 also cross-loaded on Factor II. Factor IV symptoms reflect the vulnerability or perceived stress
2 experienced by many with FM (Davis, Zautra, & Reich, 2001; Dobkin, Civita, Bernatsky, Kang,
3 & Baron, 2003; Hallberg & Carlsson, 1998). As a group, these symptoms may be amenable to
4 counseling or patient education (Burkhardt, 2005). Pain (Factor V) cross-loaded on Factor IV;
5 further studies may elucidate whether this is a sample-specific association since conceptually,
6 pain fits much better with Factor V.

7 Dyscognition, which reflects difficulty concentrating, disorganized thinking, memory
8 problems, and inability to stay focused or alert (Mease et al., 2007) encompasses two Factor III
9 items, concentration problems and forgetfulness. The other two items in this factor relate
10 together: postural instability and dizziness. They are not truly elements of dyscognition, so
11 further research is needed to see whether these latter two items indeed belong in this domain. In
12 light of cross-loading on Factor I, superior conceptual fit (e.g., as aspects of dysautonomia) could
13 dictate their placement with other somatic symptoms.

14 Factor V contains three core symptoms of fibromyalgia (Mease et al., 2007; Wolfe et al.,
15 1995), that is, pain, fatigue and morning stiffness, which were among the top five symptoms in
16 terms of intensity (Table 1). Nonrestorative sleep, another core symptom (Mease et al.), seems
17 represented by Factor IV, with two items focusing on sleep issues. Factor VII is unique in that it
18 relates to an extrinsic factor, support from others. Because this item is not really a symptom in
19 the strictest sense, it may not belong in a symptom inventory. However, its importance as a
20 component of patient experience is highlighted by the observation that participants rated this
21 4.55 on average.

22 Similarities can be seen in factors found by Kohnen and colleagues (2004) and ours: (1)
23 dizziness and headache/migraine loaded together (in our study, dizziness cross-loaded with
24 Factor 1 where headache loaded); (2) difficulties falling and staying asleep coincided in a single
25 factor; and (3) morning stiffness and fatigue loaded together. These authors (13) suggest that
26 creating a scale using validated items may be useful in clinical trials to measure treatment
27 effectiveness in terms of improvement of the total but also on scores derived from subscales (i.e.,
28 factors). In fact, they tested this hypothesis in several tropisetron trials with FM patients and
29 found that while individual symptoms showed changes, significant differences between
30 tropisetron/placebo patients were more likely using subscales, due to the increased power. The

1 authors concluded by suggesting that the addition of “psychiatric” symptoms (e.g., depression) in
2 future revisions may further strengthen this effort (Kohnen et al., 2004).

3 While similar to our study in terms of analysis (factor analysis), Liedberg and colleagues
4 (2007) measured symptoms with the Fibromyalgia Symptom Inventory, a list of clinical
5 conditions/symptoms with items heavily weighted on sensory abnormalities. In fact, 12 of 29
6 items are in this category (e.g., pain or discomfort with sexual intercourse, painful chewing).
7 Despite these differences, conclusions drawn from their work concur with our own and
8 emphasize the need to understand comorbid symptomatology and consideration of potential
9 ‘sub-types’ of FM. The authors concluded that use of an inventory measuring symptoms could
10 also be useful to tailor therapeutic interventions to individual patient needs (Lieberg et al.).

11 Limitations of the current study include those intrinsic to secondary analyses. In
12 retrospect, the items of the NFAQ did not include some of the symptoms that are commonly
13 experienced by persons with FM, including painful chewing (Fricton, 2004), constipation and
14 diarrhea as distinct components of the irritable bowel syndrome (Wallace & Hallegua, 2004),
15 and cold sensitivity of the extremities (Jacobsen, Petersen, & Danneskiold-Samsoe, 1993). In the
16 future, comprehensive evaluation of the constellation of symptoms is essential to fully
17 understand the experiences of persons with FM. Additionally, our sample may not have been
18 representative of the population of persons with FM symptoms due to bias represented by having
19 access to computers and participating in an on-line support community, and by an almost
20 exclusively white and highly educated constituency. Finally, those who agreed to participate may
21 have been more motivated to do so, thereby introducing self-selection bias. They thus may not
22 reflect a typical “clinical” population.

23 Despite these limitations, the findings from our study build on ongoing research that
24 points to the heterogeneity of the FM experience, the presence of clusters of symptoms, and the
25 possibility of tailoring interventions based upon symptomatology. Additional studies are needed
26 to develop tools that allow use of reliable and valid symptom inventories, which will enhance the
27 ability to detect differences resulting from clinical trials of novel interventions. Such symptom
28 inventories will also enable clinicians to efficiently assay their patients’ clinical burden and
29 evaluate the efficacy of individualized treatment regimens.

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Table 1. Frequencies of Experience with Severe Symptom Intensity and Mean Scores of Intensity

Symptom/Condition	<u>M</u>	<u>SD</u>	N	Frequency*
Stiffness in morning	7.17	2.45	2506	68.0
Fatigue	7.05	2.07	2520	65.6
Feeling rested after sleeping	6.79	2.74	2510	61.7
Pain	6.43	1.98	2521	52.9
Fear of symptoms worsening	6.42	3.23	2480	55.6
Staying asleep	6.20	3.01	2503	52.7
Concentration problems	5.90	2.60	2511	45.8
Forgetfulness	5.88	2.65	2485	45.8
Falling asleep	5.63	3.30	2488	46.9
Provider ability to manage symptoms	5.23	2.89	2484	35.7
Ability to manage symptoms	5.11	2.39	2493	30.3
Enjoyed life	5.03	2.71	2488	31.7
Feel like a burden to others	4.86	3.56	2488	38.0
Muscle spasms	4.83	3.22	2467	34.9
Received support from others	4.55	3.23	2493	31.8
Anxiety	4.50	3.05	2512	29.9
Depression	4.36	3.14	2504	29.1
Headache/migraine	4.32	3.11	2503	28.8
Anger	3.87	2.95	2497	21.9
Restless legs	3.57	3.42	2497	25.5
Abdominal pain	3.57	2.89	2502	19.2
Postural instability	3.47	2.85	2501	18.4
Swelling in legs, feet, & ankles	3.20	3.09	2511	18.9
Dizziness	2.87	2.80	2497	13.7
Bladder problems	2.49	2.97	2502	14.0
Rashes	1.88	2.93	2506	10.9

* Percentage of participants reporting intensity scores > 6 (range 0 to 10)

Note. Scores on all FM symptoms ranged from 0 (no presence of the symptom) to 10 (severe problems with the symptom). Scores greater than 6 were considered “severe” levels of the condition/symptom.

Table 2. Exploratory Factor Analysis (EFA) of Fibromyalgia Symptom Severity

Note: Factor loadings were obtained from the EFA Principal Components method, Varimax rotation. Blocks of factor loadings shaded in gray represent individual factors, and bolded factor loadings represent significant cross-loadings.

	Factor 1	Factor II	Factor III	Factor IV	Factor V	Factor VI	Factor VII
Factor 1 Somatic	Cronbach alpha = .710						
Swelling in legs, feet, ankles	.581	.095	.083	-.024	.306	-.010	.103
Rashes	.433	.010	.219	-.057	-.072	.080	.150
Restless legs	.460	.083	.146	.167	.194	.299	-.081
Headache/ migraine	.418	.262	.085	.110	.115	.220	-.053
Abdominal pain	.555	.251	.094	.110	.102	.042	-.001
Bladder problems	.666	.142	-.013	.037	.090	.035	.126
Muscle spasms	.516	.083	.237	.175	.284	.166	-.174
Factor II Distress	Cronbach alpha = .765						
Anxiety	.217	.739	.105	.142	.145	.068	.000
Depression	.191	.774	.158	.188	.106	.097	.085
Anger	.186	.626	.266	.062	.048	.116	-.095
Factor III Dyscognition	Cronbach alpha = .823						
Postural instability	.421	.080	.693	.226	.025	.077	.004
Dizziness	.439	.093	.633	.252	-.012	.102	-.051
Concentration problems	.022	.378	.727	.058	.277	.126	.092
Forgetfulness	.070	.307	.734	.017	.281	.110	.058

Factor IV Fear of Illness				Cronbach alpha = .680			
Feel like burden to others	.158	.421	.215	.503	.046	.101	.062
Managing symptoms	.033	.202	.171	.718	.202	.117	.095
Fear of symptoms worsening	.111	.316	.084	.549	.257	.069	-.081
Providers ability to manage	.053	-.031	.001	.680	.056	.116	.108
Factor V Fibromyalgia Core				Cronbach alpha = .702			
Stiffness in the morning	.259	-.029	.193	.167	.704	.038	-.063
Pain	.280	.142	.086	.348	.630	.165	-.122
Fatigue	.150	.319	.098	.119	.604	.177	.166
Factor VI Nonrestorative Sleep				Cronbach alpha = .663			
Experience with falling asleep	.185	.143	.141	.154	.036	.775	-.064
Experience with staying asleep	.136	.080	.065	.162	.163	.790	.031
Factor VII Perceived Support							
Received support from others	.151	-.033	.009	.187	-.018	-.056	.795

Table 3. Correlations among Fibromyalgia Symptom Severity Factors (standardized total scores)

Factor	1	2	3	4	5	6	7
1	--						
2	.462*	--					
3	.580*	.537*	--				
4	.429*	.524*	.463*	--			
5	.561*	.418*	.499**	.467*	--		
6	.392*	.313*	.355*	.345*	.394*	--	
7	.129*	.115*	.129*	.210*	.135*	.081*	--

*p < .01.

Factor 1= Somatic; Factor 2= Emotional; Factor 3= Dyscognition; Factor 4= Fear of Illness;
Factor 5= Fibromyalgia Core; Factor 6= Nonrestorative Sleep; Factor 7= Perceived Support

Table 4. Confirmatory Factor Analysis Fit Results for Fibromyalgia Symptom Severity^a

Fit Index	Value
χ^2	260.85
χ^2 df	108
χ^2 p-value	<.0001
Bentler's Comparative Fit Index (CFI)	.9816
Root Mean Square error of approximation (RMSEA)	.0357

^a Covariance Structure Analysis: Maximum Likelihood Estimation