Multiple-Site Pain in Fibromyalgia - A Confirmatory Factor Analysis

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Abstract
Fibromyalgia is a highly heterogeneous disorder occurring as widespread pain associated with general symptoms such as fatigue, depression, anxiety, insomnia, sexual dysfunction, and gastrointestinal conditions. This cross-sectional single tertiary medical center survey study aimed to investigate how multiple pain sites contribute to the construct of general pain in fibromyalgia. Altogether 266 women with fibromyalgia aged 18 to 60 years were included in the analysis. Confirmatory factor analysis of pain severity measured by a visual analogue scale (0 to 100 points) in seven major body regions. Headache, low back pain, and neck pain explained most of the total variance in general pain perceived across seven different body regions. Substantial correlations of 0.71, 0.68, and 0.61 were found between general pain and headache, low back pain, and neck pain, respectively. Pain reported for other four regions (chest, abdomen, upper extremity, and lower extremity) demonstrated fair correlations with general pain. When experiencing multi-site pain, women with fibromyalgia perceived headache, low back pain, and neck pain being subjectively more important than pain in other sites. While pain intensity and location commonly varies in fibromyalgia patients, it is important that one is aware of most common sites to be able to recognize fibromyalgia so that it can be managed properly.

Keywords: Fibromyalgia; Depression; Sexual dysfunction; Gastrointestinal conditions

Introduction
Fibromyalgia is a highly heterogeneous disorder occurring as widespread pain associated with fatigue, depression, anxiety, insomnia, sexual dysfunction, and gastrointestinal conditions among other general symptoms [1-3]. Of all fibromyalgia symptoms, multi-site pain is the most characteristic one. It has been suggested that multi-site pain differs substantially by its origin and predictors from single-site pain. It has been proposed by several previous studies that multi-site pain, as well as its impact on functioning, can be better, or even solely, described by the number of sites involved instead of specific body pain sites [4-9]. In other words, according to previous knowledge, the absolute number of pain sites might be much more important than a particular pain distribution across different body regions. Previous studies have focused on evaluating the associations of pain sites’ numbers and pain distributions with different scales and factors used mostly to describe patients’ sociodemographic and health-related characteristics and the level of functioning [4-9]. However, the question remains - how patients themselves perceive the importance of pain experienced in different body regions? Does pain perceived in one particular region contribute as much to overall pain as pain in another site does? The answer may be of great interest when planning a treatment or developing new scales and surveys for patients with fibromyalgia and, probably, with other non-specific widespread pain conditions. The objective of the study was to investigate how different pain sites contribute to the construct of general pain in fibromyalgia.

Methods
Setting and participants
The participants were identified through a consecutive search on a hospital electronic patient record system between May 2007 and November 2015. The inclusion criteria were female gender, 18 to 60 years of age, and diagnosis ‘M79’ according the International Classification of Diseases, 10th Edition. The invitation to participate was sent to 1,042 patients. Of them, 286 patients agreed to participate in the study. They received a questionnaire with a prepaid return envelope. Pain severity was assessed in seven body sites (abdomen, chest, head, low back, neck, upper extremity, lower extremity) on a visual analogue scale 0 to 100. The questionnaire included data on sociodemographic and occupational characteristics, comorbidities, medication, sleep quality, mood, alcohol and tobacco consumption, and the treatments received in the previous three months.
Statistical Analysis

Estimating the model

The estimation procedure of Confirmatory Factor Analysis (CFA) employed the maximum likelihood method considering covariances supplied as input being unbiased. For simplicity, the estimates were reported in standardized form as correlation coefficients. A correlation $\leq 0.2$ was considered poor, from 0.21 to 0.4 fair, from 0.41 to 0.6 moderate, from 0.61 to 0.8 substantial, and $>0.8$ was considered perfect.

Testing the goodness of model fit

In order to assess how well the model matches the observed data, the root mean square error of approximation (RMSEA) was used as a main indicator. First, the model fit was tested assuming there were no covariances between unique factors (Table 1). After that, the modification indices suggested by the software were used to add covariance between factors (double-headed arrows in Figure 1) one at a time, each time testing the RMSEA closeness to the value of $\leq 0.05$, or, at least, $\leq 0.08$ - the threshold for accepting the model fit. Every insertion was considered plausible if it made logical sense and did not violate the assumption that the common and the unique factors are uncorrelated. After achieving the RMSE value of $\leq 0.05$, no further covariances were imputed and the goodness of fit was assessed using a chi-square test. As the sample was relatively small considering the requirements of CFA, in an attempt to reduce dependence on sample size, the relative (or ‘normed’) chi-square test was used. Relative chi-square is a chi-square estimate divided by the degrees of freedom. The chi square value $\leq 5.0$ was considered an indication of a good fit. There was no missing data in the analysis.

**Figure 1:** Confirmatory factor analysis. In the figure, circles represent unobserved and rectangles observed variables. ‘e’ variables represent a measurement error associated with the observed variable (variance that is not predicted by the latent factor). One-head arrows represent strength of correlation between two variables while two-head arrows strength of correlation between two covariant variables.

**Table 1:** Tests of the goodness of fit used.

| Method                                    | Value | 90% CI | CMIN/DF |
|-------------------------------------------|-------|--------|---------|
| Goodness of fit index (GFI)               | 0.994 |        |         |
| Bentler-Bonett normed fit index (NFI)     | 0.959 |        |         |
| Bollen’s relative fit index (RFI)         | 0.894 |        |         |
| Bollen’s incremental fit index (IFI)      | 0.994 |        |         |
| Tucker-Lewis coefficient (TLI)            | 0.983 |        |         |
| Bentler’s comparative fit index (CFI)     | 0.994 |        |         |
| Parsimony ratio (PRATIO)                  | 0.381 |        |         |
| Parsimony adjustment to the NFI (PNFI)    | 0.365 |        |         |
| Parsimony adjustment to the CFI (PCFI)    | 0.379 |        |         |
| Akaike information criterion (AIC)        | 63.3  |        |         |

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All the analyses were conducted using IBM® SPSS® Statistics for Windows, Version 22.0, IBM Corp. Released 2013, Armonk, NY:USA IBM® Corp.; IBM® SPSS® Amos™, Version 23.0, IBM® Corp. Released 2013, PA:USA IBM® Corp.; and Stata/IC Statistical Software: Release 14. College Station (StataCorp LP, TX, USA).

**Results**

Of the 286 women, 266 returned the survey (response rate 93%). The participants’ average age was 47.2 (SD 10.8, range 19 to 61) years. The patients were slightly overweighted with body mass index on average 29.0 (SD 6.5, range 17.8 to 60.2) kg/cm². They reported a mean pain severity (summarized average for all body regions) of 40.1 (SD 15.7, range 4.8 to 82.1) points on a visual analogue scale. Detailed patients’ sociodemographic, occupational and clinical characteristics are described in detail in Table 2. The confirmatory factor analysis model was built based on one latent factor - perceived general pain. Using modification indices suggested by the software, covariances were imputed resulting in the RMSEA declined to 0.029 (90% CI 0.0 to 0.91) showing an acceptable fit. At this point, the relative Chi square value was 1.17 (below the cut-off point of 5.0) with 8 degrees of freedom. In other words, the model presented in Figure 1 demonstrated a good ability to describe the data observed in the study sample. Of the pain experienced in seven body areas, headache, low back pain, and neck pain explained most of the total variance within the common latent variable-general multi-site pain-demonstrating substantial correlations of 0.71, 0.68, and 0.61, respectively. Pain reported for other body regions demonstrated only fair correlations.

**Table 2:** Participants’ sociodemographic, occupational and clinical characteristics.

| Characteristic | N = 266 |
|----------------|---------|
| **Patient-Reported Comorbidities, n (%)** |         |
| Musculoskeletal | 132 (49.6) |
| Respiratory disease | 75 (28.2) |
| Neurological | 66 (24.8) |
| Heart or circulatory disease | 62 (23.3) |
| Mental disease | 44 (16.5) |
| Thyroid | 44 (16.5) |
| Allergy or hypersensitivity | 30 (11.3) |
| Diabetes | 21 (7.9) |
| Cancer disease | 7 (2.6) |
| Other | 151 (56.8) |
| **Previous Operations, N (%)** |         |
| Musculoskeletal | 76 (28.6) |
| Gastrointestinal | 66 (24.8) |
| Urinary tract or reproductive organs | 48 (18.1) |
| Other | 168 (63.2) |
| Smokers, n (%) | 114 (42.9) |
| Cigarettes per day, mean (SD) | 9.1 (5.7) |
| Alcohol consumption, n (%) | 111 (41.7) |
Discussion

This survey study evaluated the importance of different pain sites in perception of general pain experienced by 266 women with fibromyalgia. The patients perceived headache, low back pain, or neck pain more important than pain in other sites when experiencing widespread multi-site pain. The weaknesses of the study are its retrospective design and relatively small (for the purpose of confirmatory factor analysis) sample. The sample was limited to women only. Taking into account the modest size of the sample, the age range was probably too broad to generalize the construct structure of general pain across all age groups. However, this was the first study focusing on differences in importance of pain feelings in different body sites when there is widespread multi-site pain. The study employed the reliable method of confirmatory factor analysis and the size of sample was proved to be large enough to achieve good model fit and statistically significant results.

In Finnish population, 14% of women are smoker [10]. In the present study, the rate of smokers was notably higher. Furthermore, in Finland, prevalence of depressive disorders...
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