ORIGINAL ARTICLE

Pain characteristics in fibromyalgia: understanding the multiple dimensions of pain

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Abstract Fibromyalgia is a common disease with a high economic burden. The etiology of this disease remains unclear, as there are no specific abnormalities on clinical or technical examinations. Evidence suggests that central pain sensitization at the brain pain matrix might be involved. Understanding the pain characteristics of this disease is of importance both for diagnosis and treatment. The authors present their findings of pain characteristics in a Belgium population of fibromyalgia patients. Data of 65 patients (57 male and 8 female patients) were analyzed in this study (mean age 46.86, SD=+8.79). Patients filled out the following questionnaires: visual analogue scale, fibromyalgia impact questionnaire, pain-catastrophizing scale, pain vigilance and awareness questionnaire, modified fatigue impact scale, the Beck depression inventory, the short form 36 and the Dutch shortened profile of mood states. Statistical analysis was performed making use of a factor analysis and a hierarchical cluster analysis. We were able to define pain characteristics in this group of patients. The reciprocal effects of mood and fatigue on pain experience could be identified within the data, catastrophizing scores show a high correlation with overall life quality and pain experience. We have performed a cluster analysis on the fibromyalgia patients, based on the four main principal components defining the overall disease burden. Mood explained most of the variance in symptoms, followed by mental health state, fatigue, and catastrophizing. Three clusters of patients could be revealed by these components. Clusters: 1 high scores on mood disorders, pain, and decreased mental health, 2 high scores on fatigue and physical health, and 3 a mixture of these two groups. This data suggest that different subgroups of fibromyalgia patients could be identified and based on that, treatment strategies and results might be adapted.

Keywords Affective state · Awareness · Catastrophizing · Fibromyalgia · Mood disorders · Pain · Pain characteristics · Vigilance

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Introduction

Pain is a common symptom, encountered in virtually every medical discipline. It has an overall prevalence of 20 % and consumes a big part of the available resources of health-related care [1]. Pain is a subjective experience, which is characterized by multiple factors. Besides the sensory aspects of pain, affective, autonomic, cognitive, and behavioral factors determine the overall pain perception. All of these factors influence the outcome of clinical results in the treatment of pain [2, 3].

Affective components of pain include both the underlying state of the person as well as the effects on affect caused by pain on a subject. It is well known that underlying depressive and anxious mood states alter pain experience and impair pain

improvement due to treatment [4–6]. Besides that, the co-incidence of chronic pain syndromes and depressive or anxious mood states is high [5]. The distress experienced by pain might be generated by a nonspecific distress network, analogous to the one described in tinnitus, social rejection, asthmatic dyspnea, and overlaps with the salience network, also known the pain matrix [7].

The cognitive components of pain involve the rational and personal interpretation of pain. Pain-related behavior can be described in terms of vigilance, the awareness to pain and changes in pain. The overall awareness for pain varies from subject to subject, which might be genetically determined [8], and more importantly, pain-related behavior influences the overall pain experience as well.

Catastrophizing behavior is extensively described in the pain literature [9]. It represents the cognitive reflection of a subject to pain in a chronic pain state. High catastrophizing subjects are more aware, more anxious, and more distressed by smaller painful stimuli compared to low-catastrophizing patients. Catastrophizing can be modulated by treatment [10, 11]. These different components in chronic pain all contribute to the most important feature of pain: disability to fulfill daily tasks and, in general, a decrease in the subjective quality of life.

Fibromyalgia is a poorly understood chronic pain condition in which the patients experience pain in the four quadrants of their body. Besides the pain, patients suffer from sleep disturbances, fatigue, and mood disorders [12].

The overall prevalence of fibromyalgia is varying between 0.4 and 9.4 % in the literature [13]. The economic burden of this disease is very high. Health-related costs are estimated up to €10.087 per year per patient in France and up to $11,049 per patient per year in a US population [14, 15].

Fibromyalgia is diagnosed in a purely clinical manner, and awareness of other diseases, which mimic or overlap the main symptoms of fibromyalgia, is crucial. The diagnosis can be made with more confidence by improving knowledge of the general symptoms and different aspects of these symptoms in this population [12, 16]. In order to achieve this aim, more research is needed in the dimensions of these symptoms. Pain-related behavior and characteristics, knowledge of the accompanying symptoms, is a fundamental start to increase knowledge.

In this publication, we discuss our findings in a Belgium population of fibromyalgia patients. Pain questionnaires were performed and statistical analysis has been performed to identify the correlations between the different components of the pain sensation. Furthermore, we have performed a factor analysis, in order to define three different groups of patients with different clinical aspects. This might help to optimize diagnostic clinical and treatment approaches for these distinct patient groups.

Methods

Trial design

The data presented in this study is a retrospective collection of data acquired during hospital visits of patients diagnosed with fibromyalgia at the University Hospital Antwerp, Belgium.

Participants

Patients suffering from fibromyalgia, which were followed at the Department of Physical Medicine and Rehabilitation at the University Hospital Antwerp, Belgium, filled out a set of questionnaires during their visits. Data were included in the analysis when patients met the criteria for fibromyalgia according to the American College of Rheumatology (ACR)-90 criteria, and mimicking pathologies were excluded. The patients were diagnosed with fibromyalgia if they met the following criteria: (a) suffering from pain in all four quadrants of the body, (b) suffering from pain for at least 3 months, and (c) pain in at least 11 out of 18 designated trigger points by manual palpation.

Trigger points were measured by applying a manual pressure of approximately 4 kg. Points were positive when the patient noted a painful sensation. The points were located (two at each location: one left-sided and one at the right side) at the: (1) suboccipital muscle insertions, (2) anterior aspects of the intertransverse spaces at C5–C7, (3) midpoint of the upper border of the trapezius muscle, (4) origins of the supraspinatus muscle, (5) second rib lateral to the costochondral junction, (6) lateral epicondyle 2 cm distal to the epicondyle, (7) upper outer quadrants of the gluteal region, (8) greater trochanter, posterior to the trochanteric prominence, and (9) medial fat pad of the knee.

Besides these criteria, patients underwent physical examination and technical examinations to rule out mimicking diseases like rheumatoid arthritis and others. The data of 65 patients were included in this study. Period of data collection was during 2009.

Outcome parameters

Visual analogue scale (VAS)

Pain scores were measured on a visual analogue scale rating from 0 ("no pain") to 10 ("maximal pain"). Patients were asked to score their average pain for: (a) fibromyalgia-related pain complaints, (b) axial bone pain: pain originating from the spinal axis, and (c) other pain: pain caused by well-appointed etiologies like a recent wound or soft tissue damage caused by a minor trauma.

Fibromyalgia impact questionnaire (FIQ)

The fibromyalgia impact questionnaire makes an inventory of the overall impact of fibromyalgia-related symptoms on daily life. It has proven to be a well-designed questionnaire to measure the impact of fibromyalgia on the overall quality of life of the patients. The maximum score is 100 and a higher score indicates a greater impact of the syndrome on the patient [17].

Back pain

A specific questionnaire developed by the Department of Physical Medicine and Rehabilitation measured the amount of pain related to lower back pain problems. This questionnaire consists of 15 questions which patients have to score between 0 "completely disagree" and 4 "completely agree". Questions are dealing with anxiety and distress caused by the back pain (e.g., "I can control my pain;" "My low back pain implies there is tissue damage"). It also handles with the impact of low back pain on the capability to perform their job ("I am scared to do my work;" "I am not capable of doing my work"). It provides a global view on the impact of low back pain. It provides a clue of the amount of low back pain-related pain behavior in the patient population.

Pain-catastrophizing scale (PCS)

The PCS is a 52-point scale which indicates the catastrophizing impact of pain experienced by the patient. Catastrophizing is described as experiencing pain as awful, horrible, and unbearable. There are 13 statements concerning pain experiences (e.g., "I feel that I can't hold it much longer") are rated between 0 ("not at all") and 4 ("always") [18].

Pain vigilance and awareness questionnaire (PVAQ)

The PVAQ measures the preoccupation with or attention to pain and is associated with pain-related fear and perceived pain severity. It consists of 16 items (e.g., "I am very sensitive for pain") rated between 0 ("never") up to 5 ("always") [19].

Modified fatigue impact scale (MFIS)

The MFIS is a self-report instrument designed to rate the extent to which fatigue affects perceived function over the preceding 1-week time interval. It includes three subscales: cognitive functioning (10 items), physical functioning (10 items), psychosocial functioning (20 items). Each item is rated on a scale from 0 ("no problem") to 4 ("extreme problem") with a maximum score of 120 [20].

Beck depression inventory (BDI)

The BDI is a questionnaire to evaluate the severity of depressive mood states. It scores components like hopelessness and guilt feelings, as well as fatigue and other physical symptoms. It consists of 21 questions, rated between 0 (no symptom impact) and 3 (maximum symptom impact) with a maximum score of 63 [21].

Short form (SF36)

The SF36 is an instrument designed to measure an overall view of the health-related quality of life experienced by the patient. It is a self-administrated questionnaire, which assesses physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, and pain. All seven dimensions are independent of each other. Two components can be extracted: (1) physical health and (2) mental health. It consists of 36 items [22].

Dutch shortened profile of mood states (POMS-32)

The shortened version of the profile of mood states consists of 32 items of mood descriptors (e.g., sad) and is based on the profile of mood states (POMS) [23]. The items are rated on a five-point scale starting from 0 indicating a low level ("not at all") up to 4 indicating a high level ("extremely") to evaluate the current feelings. It measures five covarying mood factors (depression–rejection, anger–hostility, fatigue–inertia, vigor–activity, and tension–anxiety) [24].

Statistical methods

Pearson correlations were calculated between the different outcome measures as well as with the age, the onset of the pathology, and the trigger points.

A factor analysis using principal component extraction was performed using the outcome parameters FIQ, BP, PCSQ, PVAQ, FIS, BDI, POMS (depression–rejection, anger–hostility, fatigue–inertia, vigor–activity, and tension–anxiety), SF36 (physical and mental health), and hospital anxiety and depression scale (HADS; anxiety and depression). Four factors with eigenvalues greater than one were identified (i.e., Kaiser Criterium). Eigenvalues are a measure of the variance in the items accounted for by a given factor of dimension. In comparison, a factor solution with three factors revealed to be no good solution as different outcome parameters (FIQ, FIS, and PVAQ) have a similar factor loading over the three factors indicating that there might still be a separate component. In addition, a five-factor solution revealed to be a solution with too many factors, as the fifth factor had lower eigen value than 1 and explained less than 5 % of the variance. Therefore a

four-factor model was selected. The first factor explained 44.87 % of the total variance (eigenvalue=6.73), a second factor explained 11.06 % of the total variance (eigenvalue= 1.66), a third factor explained 9.31 % of the total variance (eigenvalue=1.40) and a fourth factor explained 7.63 % of the total variance (eigenvalue=1.15). The communalities of each item, ranged from 0.55 to 0.90.

Because the four factors might be correlated, we performed an oblique rotation to transform the factor loading matrix into a more interpretable form. Table 5 presents the factor pattern matrix after oblique rotation.

In order to differentiate the sample in groups, a hierarchical cluster analysis based on the squared Euclidean distance was conducted on the normalized factors obtained by the factor analysis. A multivariate analysis of variance (ANOVA) with the four components as dependent variables and the cluster groups as an independent variable was conducted to further explore these different clusters. Based on a dendrogram, composed out of these four factors, the sample can be clustered into three groups. A multivariate ANOVA with the four factors as dependent variables and the three cluster groups as an independent variable indicates a significant effect, $F=20.53$, $p<0.001$. Univariate analysis indicates that the main components explain these effects.

Results

Descriptive

Mean age of the patients was 46.86 (SD=+8.79, range 21–70). Data of 57 (87.7 %) females and 8 (12.3 %) males were included in this study. The mean duration of disease since onset was 9.57 years (SD=+ 8.38, range 1–39). The descriptive statistics of the patients, including symptoms and treatments, are summarized in Table 1.

Trigger points were reported in the data of 36 participants with on average 12.94 trigger points (SD=+2.90, range 5–18). Almost all patients felt fatigue (98.5 %), had difficulties falling asleep (78.5 %), or report disrupted sleeping patterns (78.5 %). Approximately 68 % associate their condition with a stressful life event. Several patients tried different interventions including physical therapy (98.5 %), osteopathy (52.3 %), or visiting a psychologist (58.8 %). Almost half of the fibromyalgia patients in this study smoked (46.2 %) and about one third was working (30.8 %). Of the patients, 86 % had surgery and take one or more medications. Table 1 gives an overview of the descriptive data.

The mean score on the VAS for fibromyalgia-related pain was 7.04, (SD=1.85), for axial bone pain 5.74 (SD=3.47) and for other pain 4.33 (SD=3.59).

Table 1 Descriptives of the patient population

	Yes	No
Consequences		
Fatigue	64 (98.5 %)	1 (1.5 %)
Difficulties falling asleep	51 (78.5 %)	14 (21.5 %)
Disrupt sleeping pattern	51 (78.5 %)	14 (21.5 %)
Stressful life event	44 (67.7 %)	21 (32.3 %)
Interventions		
Physical therapy	64 (98.5 %)	1 (1.5 %)
Osteopath	34 (52.3 %)	31 (47.7 %)
Psychologist	38 (58.5 %)	27 (41.5 %)
Demographics		
Smoking	30 (46.2 %)	35 (53.8 %)
Working[a]	20 (30.8 %)	44 (67.7 %)
Medical treatments		
Surgery	56 (86.2 %)	9 (13.8 %)
Medication: Zyrtec	3 (4.6 %)	62 (95.4 %)
Medication: Metanor	14 (21.5 %)	51 (78.5 %)
Medication: Antidepressant	25 (38.5 %)	40 (61.5 %)
Medication: Redomex	12 (18.5 %)	53 (81.5 %)
Medication: Magnesium	20 (30.8 %)	45 (69.2 %)
Medication: Benzodiazepine	42 (64.6 %)	23 (35.4 %)

[a] Missing values

Correlations

No correlations between the amount of trigger points and the questionnaires were found. No correlation was obtained between the severity of symptoms and the duration of the disease. Age did not correlate with any of the questionnaires either.

A correlation between the different outcome parameters indicated the FIQ correlates positively with the BP, PCSQ, PVAQ, FIS, BDI, POMS (depression–rejection, anger–hostility, fatigue–inertia, and tension–anxiety), and anxiety and depression of the HADS and negatively with vigor–activity of the POMS.

For the VAS, the strongest correlation was with the FIS. Only a correlation between back pain could be obtained with the FIS, while the PCS correlated with PVAQ, FIS, BDI, POMS (depression–rejection, anger–hostility, fatigue–inertia, and tension–anxiety), and anxiety and depression of the HADS. In addition, a negative correlation could be seen between the PCS and mental health of the SF36. The PVAQ correlated positively with the FIS, BDI, POMS (depression–rejection and anger–hostility), and anxiety and depression of the HADS and negatively with vigor–activity of the POMS (see Table 2 for an overview).

Interestingly, the VAS fibromyalgia pain correlated positively with FIQ, PVAQ, BP, PCS, FIS, BDI, POMS (depression–rejection, anger–hostility, and fatigue–inertia) and

Table 2 Pearson correlation between the different outcome parameters

	BP	PCS	PVAQ	FIS	BDI	SF 36		POMS					HADS	
						PH	MH	T	D	A	F	V	Anxiety	Depression
FIQ	0.29*	0.57**	0.29*	0.52**	0.48**	0.00	−0.21	0.34**	0.33**	0.19	0.32**	−0.29*	0.37**	0.37**
BP		0.21	0.07	0.42**	0.24	−0.20	−0.06	0.13	0.08	0.11	0.07	−0.24	0.19	0.17
PCS			0.44**	0.41**	0.57**	0.00	−0.37**	0.57**	0.49**	0.36**	0.44**	−0.23	0.63**	0.52**
PVAQ				0.29*	0.40**	0.11	−0.01	0.26*	0.31*	0.22	0.18	−0.32*	0.37**	0.37**
FIS					0.72**	−0.09	−0.20	0.32**	0.53**	0.42**	0.52**	−0.44**	0.44**	0.67**
BDI						0.02	−0.21	0.61**	0.80**	0.70**	0.53**	−0.45**	0.75**	0.82**
PH							0.24	0.02	0.05	0.02	0.02	0.04	0.06	0.02
MH								−0.40**	−0.26*	−0.24	−0.20	−0.12	−0.32*	−0.12
T									0.78**	0.75**	0.63**	−0.15	0.74**	0.52**
D										0.84**	0.70**	−0.26*	0.68**	0.72**
A											0.63**	−0.20	0.54**	0.58**
F												−0.47**	0.42**	0.64**
V													−0.23	−0.55**
Anxiety														0.58**

FIQ fibromyalgia impact questionnaire, *BP* back pain, *PCS* pain catastrophinzing scale; *PVAQ* pain vigilance and awareness questionnaire, *FIS* fatigue impact scale, *BDI* Beck depression scale, *PH* physical health of the SF36, *MP* mental health of the SF36, *T* tension–anxiety of the POMS, *D* depression–rejection of the POMS, *A* anger–hostility of the POMS, *F* fatigue–inertia of the POMS, *V* vigor activity of the POMS.

** Correlation is significant at the 0.01 level (two-tailed), * Correlation is significant at the 0.05 level (two-tailed)

depression of the HADS and negatively with the vigor–activity of the POMS. A similar pattern was seen for VAS axial bone pain. For the VAS other pain, a positive correlation was obtained FIQ, PCS, FIS, BDI, POMS (depression–rejection, anger–hostility, and fatigue–inertia), and anxiety and depression of the HADS (see Table 3 for an overview).

No correlation could be obtained between the age, onset of the pathology, and the trigger points for the different outcome parameters (VAS scores, FIQ, BP, PCS, PVAQ, FIS, BDI, SF36, POMS) (see Table 4 for an overview).

Principal component analysis

Seven questionnaires loaded highly on factor 1, two questionnaires loaded highly on factor 2, three questionnaires loaded highly on factor 3, and three questionnaires loaded highly on

factor 4. Examination of these items indicated that factor 1 reflected especially the mood component of fibromyalgia (questionnaires: anger–POMS, depression–POMS, fatigue–POMS, tension–POMS, depression–HADS, BDI, and anxiety–HADS). Factor 2 included questionnaires that reflected the patient's mental health (questionnaires mental health SF36 and vigor–POMS). Factor 3 reflected the patient's physical health (questionnaires physical health SF36, back pain, and FIS), and factor 4 the pain questionnaires (questionnaires PVAQ, FIQ, and PCS) (see Table 5).

Cluster analysis

The analysis revealed that three clusters (i.e., three groups) gave a reliable solution. Univariate analysis indicated that the effect can mainly be explained by a significant effect of

Table 3 Pearson correlation between the different outcome parameters and visual analogue scale for fibromyalgia, bone pain and other pain

VAS	FIQ	PVAQ	BP	PCS	FIS	BDI	SF 36		POMS					HADS	
							PH	MH	T	D	A	F	V	Anxiety	Depression
Fibromyalgia	0.30*	0.37**	0.06	0.38**	0.28*	0.29*	−0.02	−0.04	0.19	0.26*	0.17	0.47**	−0.43**	0.11	0.29*
Bone	0.38**	0.19	0.22	0.31*	0.37**	0.42**	0.09	0.03	0.23	0.30*	0.18	0.32*	−0.38**	0.21	0.44**
Other	0.37**	0.19	0.07	0.28*	0.26*	0.30*	0.01	−0.24	0.35**	0.25*	0.18	0.31*	−0.18	0.32*	0.34**

VAS visual analogue scale, *FIQ* fibromyalgia impact questionnaire, *BP* back pain, *PCS* pain catastrophinzing scale, *PVAQ* pain vigilance and awareness questionnaire, *FIS* fatigue impact scale, *BDI*: Beck depression scale, *PH* physical health of the SF36, *MP* mental health of the SF36, *T* tension–anxiety of the POMS, *D* depression–rejection of the POMS, *A* anger–hostility of the POMS, *F* fatigue–inertia of the POMS, *V* vigor–activity of the POMS

** Correlation is significant at the 0.01 level (two-tailed), * Correlation is significant at the 0.05 level (two-tailed)

Table 4 Pearson correlation between the different outcome parameters and the age, the onset of the fibromyalgia, and the trigger points

| | VAS | | | FIQ | PVAQ | BP | PCS | FIS | BDI | SF 36 | | POMS | | | | | HADS | |
	Fibromyalgia	Bone	Other							PH	MH	T	D	A	F	V	Anxiety	Depression
Age	−0.07	0.00	0.23	−0.06	−0.09	−0.12	−0.02	0.01	−0.20	−0.12	−0.02	0.11	−0.03	−0.05	0.11	−0.03	0.09	0.01
Onset	0.05	0.03	0.15	0.01	0.20	0.14	0.12	0.02	0.00	−0.21	0.03	−0.01	−0.09	−0.18	0.20	0.05	0.21	−0.06
Trigger points[a]	−0.03	−0.01	0.01	0.10	−0.07	−0.01	−0.04	0.01	−0.20	−0.10	0.25	0.08	0.05	0.13	−0.22	0.01	−0.03	0.05

FIQ fibromyalgia impact questionnaire, *BP* back pain, *PCS* pain catastrophizing scale, *PIAQ* pain vigilance and awareness questionnaire, *FIS* fatigue impact scale, *BDI* Beck depression scale, *PH* physical health of the SF36, *MP* mental health of the SF36, *T* tension–anxiety of the POMS, *D* depression–rejection of the POMS, *A* anger–hostility of the POMS, *F* fatigue–inertia of the POMS, *V* vigor–activity of the POMS

**Correlation is significant at the 0.01 level (two-tailed), *Correlation is significant at the 0.05 level (two-tailed)

[a] Missing values

Table 5 Pattern matrix after oblique rotation doing a principal component analysis

| | Component | | | |
	1	2	3	4
Anger	0.96	−0.06	0.04	−0.15
Depression	0.95	−0.03	0.09	0.03
Fatigue	0.85	0.18	−0.02	−0.09
Tension	0.82	−0.34	0.05	0.07
Depression (HADS)	0.70	0.33	−0.07	0.17
BDI	0.65	0.13	−0.11	0.35
Anxiety (HADS)	0.57	−0.22	0.01	0.40
Mental Health	−0.19	0.72	0.30	−0.14
Vigor	−0.28	−0.70	0.24	−0.12
Physical Health	0.04	0.18	0.79	0.28
BP	−0.09	0.13	−0.68	0.21
FIS	0.37	0.28	−0.44	0.34
PVAQ	−0.05	0.11	0.19	0.77
FIQ	−0.01	−0.03	−0.21	0.73
PCS	0.25	−0.29	−0.03	0.70

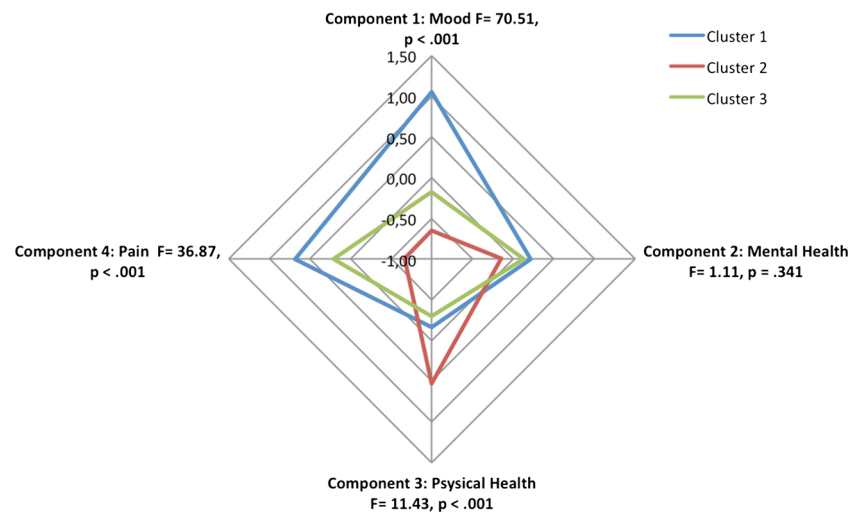components 1 (mood), 3 (physical health), and 4 (pain) but not by component 2 (mental health) (see Fig. 1).

Discussion

Fibromyalgia is a poorly understood disease in which pain, fatigue, mood disorders, and other symptoms severely compromise the overall life quality of the patient. Pain seems to be the most important feature of this pathology decreasing the quality of life [25, 12].

For a long time, the ACR-90 criteria have been used for the diagnosis [26, 27]. An important part was based on the amount of trigger points. These criteria have been adjusted and the trigger points were abandoned by the new ACR criteria. Interestingly, some publications suggest making use of the trigger points might underdiagnose male patients [28, 29]. Our data did not show a correlation between the amount of trigger points and the questionnaires. No correlation was obtained between the severity of symptoms and the duration of the disease which might suggest that pain experience is stable over time.

Both the FIQ and the SF36 were analyzed in this data. The SF36 provides information of the health-related quality of life and the FIQ of the overall impact of fibromyalgia on life quality. The FIQ correlates with the mental health component of the SF-36, but not with the physical health component. This suggests that fibromyalgia mainly influences the mental health in the health-related quality of life.

The VAS for fibromyalgia-related pain correlated strongly with the questionnaires providing an overall view on the

Fig. 1 Cluster analysis

Component 1: Mood F= 70.51, p < .001

Component 2: Mental Health F= 1.11, p = .341

Component 3: Pysical Health F= 11.43, p < .001

Component 4: Pain F= 36.87, p < .001

— Cluster 1
— Cluster 2
— Cluster 3

burden of fibromyalgia, not solely caused by pain. This suggests the VAS is a good tool to evaluate the overall burden of fibromyalgia in patients.

In order to understand fibromyalgia-related pain, pain should be looked upon as a multidimensional experience in which affective, autonomic, cognitive, and behavioral aspects play a role in the overall experience. The interaction of these multiple aspects of pain highly influences the presentation of the disease. Fatigue and mood disorders are commonly found in fibromyalgia and alter pain experience. Pain-catastrophizing behavior is known to be high in fibromyalgia patients and, overall, in chronic pain patients [30, 31]. Vigilance and awareness to pain tend to influence pain experience as well [32]. Multiple studies have shown that expectation of a painful stimulus increases the scores on visual analogue scales for this stimulus [33]. In fibromyalgia states of hyperarousal, hypervigilance are well known. However, the interaction between these components and, more importantly, the influence of these factors on life quality are poorly understood [34, 35]. Furthermore, the amount of influence of these components might vary from patient to patient [36].

Therefore, a principal component analysis was performed followed by a cluster analysis. The principal component analysis revealed four different components (mood, mental health, physical health, and pain). The cluster analysis further demonstrated that there are basically three kinds of fibromyalgia patients: a group with predominantly mood problems, a group with predominantly physical health problems, and a group in which all four components are equally important.

Four clinical components

Most of the variance could be explained by the mood component, which includes symptoms of anger, depression, fatigue, and anxiety.

The second component consists of two questionnaires related to mental health: the mental health score of the SF36 and the vigor of the POMS. Vigor can be described as feeling strong. Hence, feelings of weakness and weak mental states are an important factor in this group of fibromyalgia patients. The third component is determined by physical health on the SF36 (including fatigue). States of fatigue differ among patients and cause variance in disease presentation. The fourth component is determined by the PCS, PVAQ, and the FIQ and basically measures the pain perception. Catastrophizing and hypervigilance are related to the hyperarousal state of the patient.

As mentioned, in addition, a cluster analysis was conducted in order to determine different subgroups of fibromyalgia patients. The first cluster reveals high scores on mood, pain, and mental health. This subgroup can be described as patients suffering from the general hyperarousal caused by fibromyalgia. It should be noted that fatigue is less pronounced in this cluster of patients. The second cluster of patients reveals high scores on fatigue and physical health. In this group of patients, the fatigue is the most pronounced symptom. These patients might be diagnosed with chronic fatigue syndrome (CFS) and might require a different approach in treatment. The third cluster scores almost equally on all components and might represent the general fibromyalgia patient with the full-blown symptomatology.

De Souza et al. [36] described their findings in a group of 61 patients. They identified two distinct profiles: (1) characterized by low levels of anxiety, depressive feelings, and morning tiredness, and (2) characterized by high levels of pain, fatigue, depression, and anxiety. Our data provide information for three clusters, from which two correspond with De Souza's findings. However, a third cluster predominantly characterized by fatigue and pain is an additional finding. The second profile described by De Souza et al. corresponds with the third cluster in this manuscript, which seems to be a mixture of cluster one

and two. This can be useful in determining the effectiveness of treatment in different subgroups [37].

Limitations

The data presented in this paper has been acquired, retrospectively, in a relative small group. One should keep this in mind while extrapolating the described findings in this paper to the general population of patients suffering from fibromyalgia. Male and female patients are taken together in the analysis. However, male patients might have a different pattern of psychological pain behavior. Trigger point information was only documented for 36 patients in the data set; therefore, interpretation of the correlations between trigger points and questionnaires should be put into perspective of this small amount of data. The sample size for the correlations is small up to medium-sized.

Conclusion

(1) The VAS for fibromyalgia-related pain showed a high correlation with the questionnaires defining the overall burden and impact of fibromyalgia. Hence, it provides a good evaluation of the overall syndrome, not restricted to the bodily pain itself.
(2) Different subgroups of patients were identified based on the variance in the questionnaires. Four components could be determined in order to explain the variance of scores on the questionnaires in these patients. (1) mood-related disorders, (2) mental health and vigor-related scores, (3) fatigue and physical health-related scores, and (4) pain-catastrophizing and hypervigilance-related scores.
(3) Based on these components, three clusters of patients could be identified: (1) a group of patients with mainly mood and catastrophizing-related symptoms, without pronounced fatigue scores; (2) a group of patients with fatigue as most important component; and (3) a mixture of both of these groups. This might have important implications in diagnosing fibromyalgia and in determining treatment options for these patients as well.

Conflict of interest   None

References

1. van Hecke O, Torrance N, Smith BH (2013) Chronic pain epidemiology and its clinical relevance. Br J Anaesth 111(1):13–18. doi:10.1093/bja/aet123

2. Bushnell MC, Ceko M, Low LA (2013) Cognitive and emotional control of pain and its disruption in chronic pain. Nat Rev Neurosci 14(7):502–511. doi:10.1038/nrn3516

3. Cortelli P, Giannini G, Favoni V, Cevoli S, Pierangeli G (2013) Nociception and autonomic nervous system. Neurol Sci Off J Ital Neurol Soc Ital Soc Clin Neurophysiol 34(Suppl 1):S41–S46. doi:10.1007/s10072-013-1391-z

4. Gureje O (2007) Psychiatric aspects of pain. Curr Opin Psychiatry 20(1):42–46. doi:10.1097/YCO.0b013e328010ddf4

5. Gureje O (2008) Comorbidity of pain and anxiety disorders. Curr Psychiatry Rep 10(4):318–322

6. Demyttenaere K, Bruffaerts R, Lee S, Posada-Villa J, Kovess V, Angermeyer MC, Levinson D, de Girolamo G, Nakane H, Mneimneh Z, Lara C, de Graaf R, Scott KM, Gureje O, Stein DJ, Haro JM, Bromet EJ, Kessler RC, Alonso J, Von Korff M (2007) Mental disorders among persons with chronic back or neck pain: results from the World Mental Health Surveys. Pain 129(3):332–342. doi:10.1016/j.pain.2007.01.022

7. De Ridder D, Elgoyhen AB, Romo R, Langguth B (2011) Phantom percepts: tinnitus and pain as persisting aversive memory networks. Proc Natl Acad Sci U S A 108(20):8075–8080. doi:10.1073/pnas.1018466108

8. Maletic V, Raison CL (2009) Neurobiology of depression, fibromyalgia and neuropathic pain. Front Biosci 14:5291–5338

9. Edwards RR, Bingham CO 3rd, Bathon J, Haythornthwaite JA (2006) Catastrophizing and pain in arthritis, fibromyalgia, and other rheumatic diseases. Arthritis Rheum 55(2):325–332. doi:10.1002/art.21865

10. Weissman-Fogel I, Sprecher E, Pud D (2008) Effects of catastrophizing on pain perception and pain modulation. Exp Brain Res Exp Hirnforsch Exp Cerebrale 186(1):79–85. doi:10.1007/s00221-007-1206-7

11. Rhudy JL, France CR, Bartley EJ, Williams AE, McCabe KM, Russell JL (2009) Does pain catastrophizing moderate the relationship between spinal nociceptive processes and pain sensitivity? J Pain Off J Am Pain Soc 10(8):860–869. doi:10.1016/j.jpain.2009.02.005

12. Wolfe F, Hauser W (2011) Fibromyalgia diagnosis and diagnostic criteria. Ann Med 43(7):495–502. doi:10.3109/07853890.2011.595734

13. Queiroz LP (2013) Worldwide epidemiology of fibromyalgia. Curr Pain Headache Rep 17(8):356. doi:10.1007/s11916-013-0356-5

14. Berger A, Sadosky A, Dukes EM, Edelsberg J, Zlateva G, Oster G (2010) Patterns of healthcare utilization and cost in patients with newly diagnosed fibromyalgia. Am J Manage Care 16(5 Suppl):S126–S137

15. Perrot S, Schaefer C, Knight T, Hufstader M, Chandran AB, Zlateva G (2012) Societal and individual burden of illness among fibromyalgia patients in France: association between disease severity and OMERACT core domains. BMC Musculoskelet Disord 13:22. doi:10.1186/1471-2474-13-22

16. Arnold LM, Clauw DJ, McCarberg BH, Fibro Collaborative (2011) Improving the recognition and diagnosis of fibromyalgia. Mayo Clin Proc Mayo Clin 86(5):457–464. doi:10.4065/mcp.2010.0738

17. Bennett R (2005) The fibromyalgia impact questionnaire (FIQ): a review of its development, current version, operating characteristics and uses. Clin Exp Rheumatol 23(5 Suppl 39):S154–S162

18. Osman A, Barrios FX, Kopper BA, Hauptmann W, Jones J, O'Neill E (1997) Factor structure, reliability, and validity of the pain catastrophizing scale. J Behav Med 20(6):589–605

19. McCracken LM (1997) 'Attention' to pain in persons with chronic pain: a behavioural approach. Behav Ther 28:271–284

20. Fisk JD, Ritvo PG, Ross L, Haase DA, Marrie TJ, Schlech WF (1994) Measuring the functional impact of fatigue: initial validation of the fatigue impact scale. Clin Infect Dis Off Publ Infect Dis Soc Am 18(Suppl 1):S79–S83

21. Richter P, Werner J, Heerlein A, Kraus A, Sauer H (1998) On the validity of the Beck depression inventory. A review. Psychopathology 31(3):160–168

22. Ware JE Jr, Sherbourne CD (1992) The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. Med Care 30(6):473–483

23. McNair DM, Lorr M, Droppleman LF (1971) Manual for the profile of mood states. Educational and Industrial Testing Service, San Diego

24. McNair D, Lorr M, Droppleman LF (1986) Manual for the profile of mood states. Educational and Industrial Testing Service, San Diego

25. Buskila D, Neumann L, Sibirski D, Shvartzman P (1997) Awareness of diagnostic and clinical features of fibromyalgia among family physicians. Fam Pract 14(3):238–241

26. Salaffi F, Sarzi-Puttini P (2012) Old and new criteria for the classification and diagnosis of fibromyalgia: comparison and evaluation. Clin Exp Rheumatol 30(6 Suppl 74):3–9

27. Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, Goldenberg DL, Tugwell P, Campbell SM, Abeles M, Clark P et al (1990) The American college of rheumatology 1990 criteria for the classification of fibromyalgia. Report of the multicenter criteria committee. Arthritis Rheum 33(2):160–172

28. Yunus MB (2002) Gender differences in fibromyalgia and other related syndromes. J Gend Specif Med JGSM Off J Partnership Women's Health C 5(2):42–47

29. Yunus MB (2001) The role of gender in fibromyalgia syndrome. Curr Rheumatol Rep 3(2):128–134

30. Homann D, Stefanello JM, Goes SM, Breda CA, Paiva Edos S, Leite N (2012) Stress perception and depressive symptoms: functionality and impact on the quality of life of women with fibromyalgia. Rev Bras Reumatol 52(3):319–330

31. Campbell CM, McCauley L, Bounds SC, Mathur VA, Conn L, Simango M, Edwards RR, Fontaine KR (2012) Changes in pain catastrophizing predict later changes in fibromyalgia clinical and experimental pain report: cross-lagged panel analyses of dispositional and situational catastrophizing. Arthritis Res Ther 14(5):R231. doi:10.1186/ar4073

32. Sanchez AI, Martinez MP, Miro E, Medina A (2011) Predictors of the pain perception and self-efficacy for pain control in patients with fibromyalgia. Span J Psychol 14(1):366–373

33. Sawamoto N, Honda M, Okada T, Hanakawa T, Kanda M, Fukuyama H, Konishi J, Shibasaki H (2000) Expectation of pain enhances responses to nonpainful somatosensory stimulation in the anterior cingulate cortex and parietal operculum/posterior insula: an event-related functional magnetic resonance imaging study. J Neurosci Off J Soc Neurosci 20(19):7438–7445

34. Woolf CJ (2011) Central sensitization: implications for the diagnosis and treatment of pain. Pain 152(3 Suppl):S2–S15. doi:10.1016/j.pain.2010.09.030

35. Phillips K, Clauw DJ (2011) Central pain mechanisms in chronic pain states—maybe it is all in their head. Best practice & research. Clin Rheumatol 25(2):141–154. doi:10.1016/j.berh.2011.02.005

36. de Souza JB, Goffaux P, Julien N, Potvin S, Charest J, Marchand S (2009) Fibromyalgia subgroups: profiling distinct subgroups using the fibromyalgia impact questionnaire. A preliminary study. Rheumatol Int 29(5):509–515. doi:10.1007/s00296-008-0722-5

37. Camerlain M, Myhal G (2009) Are we profiling patients with fibromyalgia? Pain Res Manag J Can Pain Soc J Soc Can Pour le Traitement de la Douleur 14(3):238