Perceived dyscognition reported by patients with fibromyalgia

S.J. McAllister[1], L.L. Toussaint[3], D.A. Williams[4], T.L. Hoskin[2], M.O. Whipple[1], A. Vincent[1]

[1]Division of General Internal Medicine, [2]Division of Biomedical Statistics and Informatics, Mayo Clinic, Rochester, Minnesota, USA; [3]Department of Psychology, Luther College, Decorah, Iowa, USA; [4]Chronic Pain and Fatigue Research Center, University of Michigan Health System, Ann Arbor, Michigan, USA.

Samantha J. McAllister, CCRP
Loren L. Toussaint, PhD
David A. Williams, PhD
Tanya L. Hoskin
Mary O. Whipple, CCRP
Ann Vincent, MD

Please address correspondence to:
Ann Vincent, MD,
Division of General Internal Medicine,
Mayo Clinic,
200 First St. SW,
Rochester, MN 55905, USA.
E-mail: vincent.ann@mayo.edu

Received on June 9, 2015; accepted in revised form on September 4, 2015.

Clin Exp Rheumatol 2016; 34 (Suppl. 96): S48-S54.

Key words: chronic pain, cognitive symptoms, dyscognition, fibromyalgia

Presented at the 3rd International Congress on Controversies in Rheumatology and Autoimmunity, Sorrento, Italy, March 12-14, 2015.

Funding: this study was supported in part by the Center for Clinical and Translational Science (CCaTS) at Mayo Clinic. The centre is funded in part by a grant from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (RR024150). The manuscript contents are solely the responsibility of the authors and do not necessarily represent the official views of CCaTS, NCRR, or the National Institutes of Health. The funders had no role in study design, data collection and analysis, decision to publish, or manuscript preparation.

Competing interests: none declared.

ABSTRACT

Objective. *Patients with fibromyalgia often report dyscognition as a symptom; however, the literature on this symptom is sparse. Our objective for this cross-sectional study was to characterise dyscognition among patients with fibromyalgia, identify comorbid symptoms associated with dyscognition, and evaluate its relation with fibromyalgia severity.*

Methods. *Dyscognition was assessed with the Multiple Abilities Self-report Questionnaire (MASQ) for 681 patients with fibromyalgia. Other assessed comorbid symptoms were pain, fatigue, sleep problems, mood, physical and mental health, and autonomic function. Correlation and regression modeling were used to identify relations between the MASQ subscales and other fibromyalgia symptoms. Mixed analysis of variance was used to examine the profile of dyscognition in different levels of fibromyalgia. MASQ subscale scores from a previously described healthy normal control population were used for comparison.*

Results. *The mean (SD) age of the study patients was 55.8 (12.6) years, and most patients were female (93%) and white (91%). Perceived dyscognition was most related to depression, anxiety, and autonomic function. Across all fibromyalgia severity levels, patients had significantly higher levels of perceived dyscognition than the healthy controls. Significant differences existed for the MASQ total and most MASQ subscales among patients with mild, moderate, and severe fibromyalgia.*

Conclusion. *Our study results provide further evidence that perceived dyscognition in fibromyalgia is influenced by various comorbid symptoms. In treating patients with fibromyalgia who have dyscognition, clinicians should consider the multiple types of dyscognition and the effects of other fibromyalgia symptoms.*

Introduction

Fibromyalgia is a chronic condition of widespread pain often accompanied by comorbid symptoms, including debilitating fatigue, unrefreshing sleep, and cognitive difficulties (1-5). Of these comorbid symptoms, perhaps least understood are the cognitive symptoms commonly referred to as *dyscognition* in the fibromyalgia literature and as *fibro fog* by patients (6-8). Despite patient reports of cognitive difficulties, studies using neuropsychological tests often find no differences between patients and healthy normal controls (HNCs) (8, 9). Whether these results reflect the absence of cognitive impairments in patients with fibromyalgia or the inherent limitations of performance-based neuropsychological tests is unclear. Rather than showing a brain abnormality, some studies credit the subjective reports of cognitive impairment to such psychological factors as effort, depression, sleep difficulties, and fatigue (9-12) or to pain (11, 13-16). Although neuropsychological testing is often considered the gold standard for assessing cognitive deficits, a patient's perceived dyscognition is important because it drives health care utilisation and cost (17, 18). In addition, self-report questionnaires provide distinctive information on cognitive symptoms that may be more relevant than neuropsychological results because assessment instruments and clinical diagnostic criteria for fibromyalgia rely largely on the patient's report (19-21).

The Multiple Abilities Self-report Questionnaire (MASQ) is the recommended self-report survey for assessing dyscognition in patients with fibromyalgia (22). The MASQ contains 38 questions that assess perceived deficits in 5 cognitive domains: language ability, visual-perceptual ability, verbal memory, visual-spatial memory, and attention/concentration (23). Although the MASQ has been used in several pharmaceutical

trials of fibromyalgia (24, 25), only 1 published study has compared MASQ scores of patients with fibromyalgia (n=72) with the scores of age-matched HNCs (n=24) (6). That study reported that patients with fibromyalgia scored significantly higher on all domains of dyscognition, and further, dyscognition was more than merely a memory problem because it was associated with measures of mood and fatigue.

The objective of the present report is to describe MASQ scores in a large, well-characterised sample of patients with fibromyalgia. We aim to add to the current knowledge of dyscognition in fibromyalgia by identifying comorbid symptoms uniquely associated with each MASQ domain.

Methods

The present report is based on data derived from a large survey consisting of questionnaires covering multiple symptoms of relevance to fibromyalgia. The survey was mailed to 1,303 randomly selected patients from a fibromyalgia registry established at Mayo Clinic's campus in Rochester, Minnesota (26). Patients in this registry had a current diagnosis or a history of fibromyalgia present in their medical records between January 1, 2000, and December 31, 2010, which was confirmed through chart review. To be eligible for this survey, patients must have completed the Fibromyalgia Research Survey Criteria (21) as part of their enrollment into the registry and have agreed to be contacted for future research. To account for potential bias related to the order in which study questionnaires were presented and completed, we used a balanced Latin square design to create different versions of the survey relative to order. Surveys were completed and returned between June 1, 2011, and December 31, 2012. This study was reviewed and approved by the Mayo Clinic Institutional Review Board, and all participants provided written informed consent.

Questionnaires covered in the present analysis included MASQ, Brief Pain Inventory (BPI), Multidimensional Fatigue Inventory (MFI), Medical Outcomes Study (MOS) Sleep Scale, Profile of Mood States (POMS), Composite Autonomic Symptom Score (COMPASS), Fibromyalgia Impact Questionnaire-Revised (FIQ-R), and Medical Outcomes Study 36-Item Short Form Health Survey (SF-36), of which all are validated self-report measures recommended for use in fibromyalgia studies (22).

Measures

• *Multiple Abilities Self-report Questionnaire (MASQ)*

Scores on the cognitive domains of MASQ range from 0 to 30 or 0 to 40, and the maximum total score is 190. Higher scores indicate greater perceived difficulties in cognitive function. MASQ has been used in clinical trials of fibromyalgia and is recommended as a representative measure of dyscognition in fibromyalgia (22, 27).

• *Brief Pain Inventory (BPI)*

The BPI is a 15-item self-report measure used in the assessment of chronic pain. The BPI yields 2 subscales, pain severity and pain interference, with total scores for each subscale ranging from 0 to 10 (28). The BPI has been recommended as a representative measure of pain in fibromyalgia and has been used to measure pain in clinical trials (22).

•*Multidimensional Fatigue Inventory (MFI)*

The MFI contains 20 items used to evaluate fatigue. The MFI contains 5 subscales, namely general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue (29). Scores on each subscale range from 4 to 20, with higher scores indicating greater symptom severity. The MFI has been identified as a representative measure of fatigue for fibromyalgia (22).

• *MOS Sleep Scale*

The 12-item MOS Sleep Scale assesses 6 dimensions of sleep. These are sleep disturbance, sleep adequacy, sleep quantity, somnolence, snoring, and awakening with shortness of breath or headache (30). The MOS sleep items can be summarised into 2 composite scores: Sleep Problem Index I (6 items) and Sleep Problem Index II (9 items). Summary scores range from 0 to 100, with higher scores indicating poorer sleep.

• *Profile of Mood States (POMS)*

The POMS is a 30-item self-report mood questionnaire with 6 subscales. These subscales are depression-dejection, tension-anxiety, fatigue-inertia, vigor-activity, anger-hostility, and confusion-bewilderment (31, 32). Subscale scores range from 0 to 20, with higher scores indicating worse symptoms on all scales except vigor-activity, for which lower scales indicate worse symptoms.

• *Composite Autonomic Symptom Score*

The COMPASS is a 31-item, validated self-report measure of autonomic dysfunction. It yields a total summary score, as well as 6 subscales: orthostatic intolerance, vasomotor, secretomotor, gastrointestinal, bladder, and pupillomotor (33). The COMPASS total score ranges from 0 to 100, with higher scores indicating worse autonomic symptoms. It is the only comprehensive, validated self-report measure of autonomic symptoms.

• *Fibromyalgia Impact Questionnaire - Revised (FIQ-R)*

The FIQ-R is a 21-item, validated self-report measure that assesses symptoms, physical functioning, and overall impact of fibromyalgia (19). The FIQ-R total score ranges from 0 to 100; higher scores indicate greater symptoms. It is the most commonly used outcome measure in fibromyalgia clinical trials (22).

• *Medical Outcomes Study Short Form-36 (SF-36)*

The SF-36 is a 36-item, validated self-report measure that assesses overall physical and mental health (34). It yields 8 subscales and 2 summary scores – physical and mental component scores – and has been used in clinical trials of fibromyalgia (35). Scores range from 0 to 100, with lower scores indicating worse health.

Statistical methods

Descriptive statistics were reported with mean and standard deviation (SD)

or frequency and percentage as appropriate. Correlations between MASQ scores and other patient characteristics were estimated using Pearson correlation coefficients. The mean MASQ score was estimated with a 95% CI among fibromyalgia patients for each subscale and for the total score. These data were compared with the means reported in the literature for HNCs (6). The percentage of fibromyalgia patients with a decrease of more than 2 SDs from HNCs was reported descriptively. Logistic regression analysis was used to assess potential predictors of abnormal cognitive function. A *p*-value less than 0.05 was considered statistically significant. To simplify interpretation across the various quantitative scales, included as predictors, the values were standardised by subtracting the overall mean for that scale and dividing by the SD to make odds ratios (ORs) interpretable as the change in OR for 1 SD of change in the scale.

Finally, through mixed model analysis of variance, we examined the profile of MASQ dyscognition for mild, moderate, and severe levels of fibromyalgia symptomatology using the guidelines for FIQ-R severity interpretation provided by Bennett *et al*. (36). Simple effects tests were used whereby each of the 3 levels of fibromyalgia severity was examined for each MASQ variable. Pairwise comparisons for each of the simple effects were conducted with the Tukey procedure to adjust for multiple comparisons. Finally, we added the means of the MASQ subscales for HNCs reported by Williams *et al*. (6) to our profile plot. We also computed 95% CIs for all means to offer convenient comparisons between patients and HNCs. All analyses were performed with JMP statistical software version 10 (SAS Institute Inc) and SPSS software v.19 (IBM SPSS Statistics for Windows).

Results

Of the 1,303 patients to whom surveys were mailed, responses were received from 914 patients (response rate, 70%). Of them, 858 agreed to participate and returned completed questionnaire packets, and 56 declined participation. Among the 858 patients, 681 met fibromyalgia research survey criteria (21), had complete MASQ data, and were included in the analyses (mean [SD] age, 55.8 [12.6] years). Most patients were female (93%) and white (91%). The mean (SD) body mass index (BMI) of the total sample was 30.0 (7.4). Means, SDs, and scale ranges are summarised in Table I.

Table I. Demographic characteristics and clinical status variables for the 681 fibromyalgia patients.

Characteristic	Data missing, n. of patients	Value[a]	Scale range
Age, y	1	55.3 (12.5)	NA
Female sex, n. (%)	0	634 (93)	NA
BMI	7	30.0 (7.5)	NA
BMI category, n. (%)			
Underweight		13 (1.90)	
Normal		176 (26.1)	
Overweight		178 (26.4)	
Obese		307 (45.5)	
BPI severity	4	5.1 (1.8)	0-10
MFI general	9	17.2 (2.7)	4-20
MOS Sleep Scale, Sleep Problem Index II	3	54.8 (19.0)	0-100
POMS anxiety	5	7.2 (4.8)	0-20
POMS depression	6	6.7 (5.1)	0-20
COMPASS total	0	36.7 (15.0)	0-100
FIQ-R total	0	55.5 (19.0)	0-100
FIQ-R category, n. (%)			
Mild		148 (21.7)	0-38
Moderate		223 (32.7)	39-58
Severe		310 (45.5)	59-100
SF-36 physical	77	30.3 (8.6)	0-100
SF-36 mental	77	40.1 (12.6)	0-100

BMI: body mass index; BPI: Brief Pain Inventory; COMPASS: Composite Autonomic Symptom Score; FIQ-R: Fibromyalgia Impact Questionnaire-Revised; MFI: Multidimensional Fatigue Inventory; MOS: Medical Outcomes Study; NA: not applicable; POMS: Profile of Mood States; SF-36: Medical Outcomes Study 36-Item Short Form Health Survey.
[a]Value is mean (SD) unless specified otherwise.

As expected, Pearson correlations between the MASQ subscales and other fibromyalgia symptoms showed statistically significant associations (Table II). BMI was the only variable that did not show significant association with MASQ. The MASQ scores of our participants were significantly higher than the HNCs (6) in all domains. In addition, more than 40% of patients had scores of perceived cognitive dysfunction that were higher than 2 SDs above the HNC mean for all subscales except visual perception (27.9% scored >2 SDs above the mean) (Table III).

Logistic regression was conducted to identify the variables that were most strongly and distinctively associated with each subscale of MASQ (Table IV). The predictor variables entered into the model simultaneously included: age per 5-year increase and sex. BMI was categorised into *underweight* (BMI <18.5), *normal* (BMI 18.5–24.9), *overweight* (BMI 25.0-29.9), and *obese* (BMI ≥30.0). Further, the variables included general fatigue (MFI), Sleep Problems Index II (MOS Sleep Scale), pain severity (BPI), anxiety (POMS), depression (POMS), and autonomic symptoms (COMPASS total score).

Perceived language deficits

Multivariate logistic regression indicated that of the 9 predictors, 3 offered a statistically significant contribution to predicting perceived language deficits. These were anxiety (OR, 1.39; p=0.02), depression (OR, 1.37; p=0.02), and autonomic symptoms (OR, 1.51; p<0.001).

Perceived deficits in visual perception

Multivariate logistic regression indicated that 2 of the predictors – pain severity (OR, 1.32; p=0.009) and anxiety (OR, 1.41; p=.002) – offered significant contributions to predicting perceived deficits in visual perception.

Table II. Multiple abilities self-report questionnaire scale correlations with clinical domains.

Clinical Domain[a]	Language	Visual perception	Verbal memory	Visual-spatial memory	Attention/ concentration
Age	0.13	0.08[b]	0.21	0.11	0.21
BMI[c]	0.00	0.05	0.03	0.02	0.01
MFI general	0.25	0.19	0.26	0.18	0.28
MOS Sleep Scale, Sleep Problem Index II	0.28	0.20	0.26	0.23	0.29
BPI severity	0.28	0.23	0.25	0.25	0.25
POMS anxiety	0.40	0.36	0.32	0.34	0.44[b]
POMS depression	0.39	0.33	0.33[b]	0.33	0.41
COMPASS total	0.40	0.28	0.31	0.29	0.35
FIQ-R total	0.55	0.46	0.46	0.43	0.53
SF-36 physical	0.18	0.19	0.18	0.17	0.18
SF-36 mental	0.42	0.37	0.37	0.34	0.44

BMI: body mass index; BPI: Brief Pain Inventory; COMPASS: Composite Autonomic Symptom Score; FIQ-R: Fibromyalgia Impact Questionnaire-Revised; MFI: Multidimensional Fatigue Inventory; MOS: Medical Outcomes Study; POMS: Profile of Mood States; SF-36: Medical Outcomes Study 36-Item Short Form Health Survey. [a]$p<0.001$ unless specified otherwise. [b]$p<0.05$. [c]$p>0.05$.

Table III. MASQ scores in HNC sample *vs*. fibromyalgia sample of present study.

Variable	Scale range	HNC mean (SD)[a]	Fibromyalgia mean (95% CI)	>2 SD from HNC n. (%)
MASQ total	38-190	NA	95.2 (93.6-96.8)	NA
Language	0-40	12.6 (3.4)	19.5 (19.1-19.9)	330 (48.5)
Visual perception	0-30	10.3 (3.3)	14.1 (13.7-14.4)	190 (27.9)
Verbal memory	0-40	14.3 (4.1)	21.9 (21.5-22.4)	312 (45.8)
Visual-spatial memory	0-40	12.8 (2.9)	18.5 (18.1-18.9)	312 (45.8)
Attention/concentration	0-40	13.5 (3.3)	21.1 (20.8-21.5)	369 (54.2)

HNC: healthy normal control; MASQ: Multiple Abilities Self-report Questionnaire; NA: not applicable; SD: standard deviation. [a]HNC data from Williams *et al*. (6).

Perceived deficits in verbal memory

Multivariate logistic regression indicated 4 variables that were predictive of perceived deficits in verbal memory. The model identified significant and unique contributions of age (OR, 0.88; $p<0.001$), general fatigue (OR, 1.27; $p=0.02$), pain severity (OR, 1.23; $p=0.03$), and autonomic symptoms (OR, 1.39; $p<0.001$) to the perception of deficits in verbal memory.

Perceived deficits in visual-spatial memory

Four of the 9 included variables were significant predictors of perceived deficits in visual-spatial memory, according to multivariate logistic regression. These predictors were pain severity (OR, 1.28; $p=0.01$), anxiety (OR, 1.42; $p=0.009$), depression (OR, 1.38; $p=0.01$), and autonomic symptoms (OR, 1.32; $p=0.005$).

Perceived deficits in attention/ concentration

Multivariate logistic regression showed a statistically significant model predicting perceived deficits in attention and concentration. The predictor variables that uniquely contributed to this model were general fatigue (OR, 1.27; $p=0.02$), pain severity (OR, 1.18; $p=0.09$), anxiety (OR, 1.55; $p=0.002$), and autonomic symptoms (OR, 1.37; $p=0.002$).

Mixed model profile analyses

To determine whether MASQ scores differed by overall fibromyalgia symptom severity, we categorised patients into mild, moderate, and severe levels of fibromyalgia using FIQ score parameters that have been published previously (36). Statistically significant differences between fibromyalgia groups existed for each MASQ subscale, but the size of this effect differed. Significance tests and effect sizes for MASQ subscales are as follows:

- Language, $F(2,689) = 104.78$; $p<0.001$; η^2, 0.23
- Visual perception, $F(2,680) = 75.39$; $p<0.001$; η^2, 0.18
- Verbal memory, $F(2, 685) = 74.24$, $p<0.001$; $\eta^2 = 0.18$
- Visual-spatial memory, $F(2,693) = 55.18$; $p<0.001$; η^2, 0.14
- Attention/concentration, $F(2,684) = 103.18$; $p<0.001$; η^2, 0.23

Comparisons of groups with mild, moderate, or severe fibromyalgia across all MASQ subscales through Tukey pairwise comparisons showed significant differences on all comparisons between mild and moderate, mild and severe, and moderate and severe ($p<0.05$ for all) (Fig. 1).

Our final analysis examined differences in MASQ subscale scores between our sample and the HNC sample of Williams *et al*. (6). As Figure 1 shows, other than in the MASQ visual-perceptual subscale, patients with fibromyalgia in all categories of FIQ-R severity (mild, moderate, and severe) had statistically higher levels of perceived dyscognition compared with HNCs ($p<0.05$ for all).

Discussion

The results of this study showed that reports of dyscognition are indeed increased in patients with fibromyalgia, as evidenced by more than 40% of our sample scoring greater than 2 SDs above the mean MASQ subscale scores of HNCs. Furthermore, our results showed that perceived dyscognition worsens in severity as fibromyalgia increases in severity. Our results support previous reports of perceived dyscogntion in patients with fibromyalgia. They further suggest that cognitive difficulties in fibromyalgia have multifactorial associations (6, 7, 13, 37); other symptoms of fibromyalgia, including pain severity, fatigue, anxiety, depression, unrefreshing sleep, and autonomic symptoms, contribute to a patient's experience of dyscognition.

One of the most consistent predictors of perceived dyscognition in our study was autonomic symptoms, which were a significant predictor of scores on 4 of the 5 MASQ subscales. This relation of self-reported autonomic symptoms and perceived dyscogntion has not been previously reported in fibromyalgia and is distinct to our study, although earlier studies have suggested

Table IV. Logistic regression model results for predictors of abnormal MASQ subscale scores[a].

	MASQ Subscale									
	Language		Visual perception		Verbal memory		Visual-Spatial memory		Attention/Concentration	
Variable	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age, per 5-y increase	0.97 (0.90-1.04)	0.44	0.99 (0.91-1.07)	0.72	0.88 (0.82-0.95)	<0.001	0.98 (0.91-1.05)	0.60	0.93 (0.87-1.00)	0.06
Sex		0.45		0.48		0.51		0.54		0.71
Female	Reference (1.0)		Reference (1.0)		Reference (1.0)		Reference (1.0)		Reference (1.0)	
Male	1.31 (0.65-2.64)		0.77 (0.35-1.57)		1.26 (0.64-2.49)		1.23 (0.63-2.42)		0.88 (0.44-1.75)	
BMI		0.46		0.51		0.05		0.60		0.75
<18.5	2.34 (0.62-11.58)		0.86 (0.21-2.93)		0.34 (0.09-1.15)		0.96 (0.28-3.37)		1.01 (0.30-3.80)	
18.5-24.9	Reference (1.0)		Reference (1.0)		Reference (1.0)		Reference (1.0)		Reference (1.0)	
25.0-29.9	0.84 (0.51-1.36)		1.10 (0.66-1.84)		0.85 (0.53-1.37)		1.27 (0.78-2.06)		1.13 (0.70-1.85)	
≥30.0	1.01 (0.66-1.56)		0.79 (0.50-1.26)		0.60 (0.39-0.93)		0.96 (0.62-1.47)		1.27 (0.82-1.96)	
MFI general[b]	1.11 (0.91-1.37)	0.31	1.11 (0.88-1.39)	0.38	1.27 (1.04-1.56)	0.02	1.05 (0.86-1.29)	0.65	1.27 (1.04-1.56)	0.02
MOS Sleep Scale, Sleep Problem Index II[b]	1.14 (0.92-1.41)	0.22	0.90 (0.72-1.13)	0.38	1.15 (0.94-1.42)	0.18	1.07 (0.87-1.32)	0.50	1.09 (0.88-1.34)	0.43
BPI severity[b]	1.15 (0.95-1.40)	0.14	1.32 (1.07-1.64)	0.009	1.23 (1.02-1.49)	0.03	1.28 (1.06-1.55)	0.01	1.18 (0.98-1.43)	0.09
POMS anxiety[b]	1.39 (1.06-1.83)	0.02	1.41 (1.07-1.87)	0.02	1.18 (0.90-1.54)	0.23	1.42 (1.09-1.86)	0.009	1.55 (1.18-2.05)	0.002
POMS depression[b]	1.37 (1.05-1.78)	0.02	1.25 (0.95-1.63)	0.11	1.18 (0.91-1.53)	0.20	1.38 (1.07-1.79)	0.01	1.20 (0.93-1.57)	0.17
COMPASS total[b]	1.51 (1.24-1.85)	<0.001	1.16 (0.95-1.43)	0.14	1.39 (1.15-1.69)	<0.001	1.32 (1.09-1.61)	0.005	1.37 (1.13-1.68)	0.002

BMI: body mass index; BPI: Brief Pain Inventory; COMPASS: Composite Autonomic Symptom Score; MASQ: Multiple Abilities Self-Report Questionnaire; MFI: Multidimensional Fatigue Inventory; MOS: Medical Outcomes Study; OR: odds ratio; POMS: Profile of Mood States.
[a]MASQ scores are defined as >2 standard deviations above data of healthy normal controls. [b]ORs are reported per increase of 1 standard deviation.

that autonomic symptoms may contribute to the pathophysiology of fibromyalgia more generally (38-40). Because autonomic dysfunction has been associated with increased muscle tension, pain, and fatigue, it is reasonable to suspect that autonomic dysfunction could influence patients' experience of dyscognition in fibromyalgia as well (41-43).

Anxiety and depression were also significant predictors of MASQ subscales independent of other fibromyalgia symptoms. This finding is consistent with previous reports that suggested a significant influence of mood or affective disturbance on dyscognition in fibromyalgia (9, 12) and supports the notion that emotional factors have an important role in perceived dyscognition.

An unexpected observation from our results was that unrefreshing sleep did not appear to contribute significantly to any of the MASQ subscales. This result is somewhat different from Williams *et al*. (6), who found that verbal memory and visual-spatial memory were influenced by dimensions of sleep – specifically, somnolence and snoring.

Overall, our results are consistent with the findings of Williams *et al*. (6), in which dyscognition appeared to be multifaceted and correlated with other symptoms of fibromyalgia. Although they reported that fatigue and mood are most strongly related to perceived dyscognition, our results differed slightly in that fatigue was not one of the most frequently associated symptoms.

Patients with moderate-to-severe fibro-

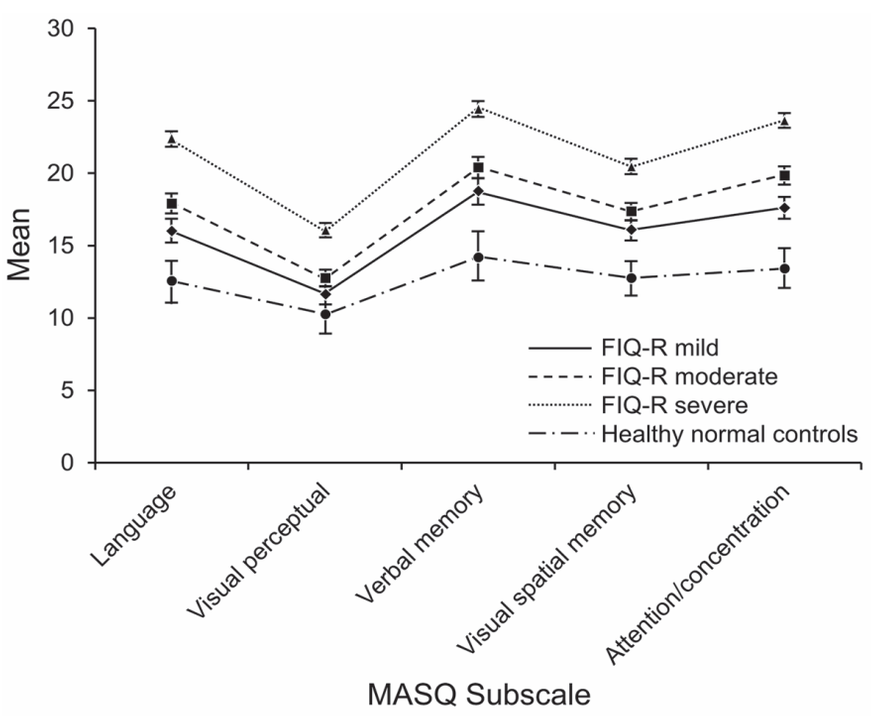

Fig. 1. Profile of MASQ Subscale Scores for Mild, Moderate, and Severe Levels of Fibromyalgia and Healthy Normal Controls. FIQ-R indicates Fibromyalgia Impact Questionnaire-Revised; MASQ, Multiple Abilities Self-report Questionnaire. Error bars represent 95% CI. Data of healthy normal controls adapted from Williams *et al*. (6).

myalgia reported significantly greater perceived cognitive difficulties than did the HNC sample (6) across all subscales. This finding, now replicated in the present study, suggests that dyscognition may be most important to assess and target in the patients presenting with moderate to severe fibromyalgia. Such patients are likely to be experiencing not only more intense pain, but also the interference of cognitive difficulties on activities of daily living.

Several limitations of our study should be considered. First, this was a cross-sectional analysis, and the correlations cannot be taken to imply causality unless further assessed through temporal associations in a longitudinal design. Second, our results may not be generalisable because our patient population was recruited from a tertiary care centre and these patients may have increased overall symptoms. Third, the majority of our sample (78%) reported moderate-to-severe fibromyalgia. Therefore, whether the same strength of associations would be observed in patients with milder fibromyalgia is unclear. Fourth, although symptoms of depression and anxiety were most related to dyscognition, we were unable to include diagnostic assessment of psychiatric comorbidities in this sample, which is an important limitation.

Conclusion

The results of our study show that perceived dyscognition is a significant problem in patients with fibromyalgia and is influenced by a number of comorbid symptoms. In treating patients with fibromyalgia who have dyscognition, clinicians should take into consideration the different types of dyscognition, to determine how to best improve the overall fibromyalgia severity. Our results are similar to previous reports but add to the literature in that we confirmed the presence of these associations in a large tertiary care sample and assessed the unique contribution of autonomic symptoms on perceived dyscognition. Further research should study these associations using longitudinal design to determine whether a causal relation exists between dyscognition and fibromyalgia symptoms.

Acknowledgments

Study data were collected and managed using Research Electronic Data Capture (REDCap) software tools hosted at Mayo Clinic (44). REDCap is a secure, Web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry, 2) audit trails for tracking data manipulation and export procedures, 3) automated export procedures for seamless data downloads to common statistical packages, and 4) procedures for importing data from external sources.

References

1. CLAUW DJ, ARNOLD LM, MCCARBERG BH; FIBROCOLLABORATIVE: The science of fibromyalgia. *Mayo Clin Proc* 2011; 86: 907-11.
2. WOLFE F, ROSS K, ANDERSON J, RUSSELL IJ, HEBERT L: The prevalence and characteristics of fibromyalgia in the general population. *Arthritis Rheum* 1995; 38: 19-28.
3. WOLFE F, SMYTHE HA, YUNUS MB *et al*.: The American College of Rheumatology 1990 criteria for the classification of fibromyalgia: report of the multicenter criteria committee. *Arthritis Rheum* 1990; 33: 160-72.
4. GRACELY RH, SCHWEINHARDT P: Key mechanisms mediating fibromyalgia. *Clin Exp Rheumatol* 2015; 33 (Suppl. 88): S3-6.
5. TALOTTA R, ATZENI F, BAZZICHI L *et al*.: Algo-dysfunctional syndromes: a critical digest of the recent literature. *Clin Exp Rheumatol* 2015; 33 (Suppl. 88): S102-8.
6. WILLIAMS DA, CLAUW DJ, GLASS JM: Perceived cognitive dysfunction in fibromyalgia syndrome. *J Musculoskelet Pain* 2011; 19: 66-75.
7. GLASS JM: Cognitive dysfunction in fibromyalgia syndrome. *J Musculoskelet Pain* 2010; 18: 367-72.
8. GLASS JM: Fibromyalgia and cognition. *J Clin Psychiatry* 2008; 69 (Suppl. 2): 20-4.
9. SUHR JA: Neuropsychological impairment in fibromyalgia: relation to depression, fatigue, and pain. *J Psychosom Res* 2003; 55: 321-9.
10. WALITT B, ROEBUCK-SPENCER T, BLEIBERG J, FOSTER G, WEINSTEIN A: Automated neuropsychiatric measurements of information processing in fibromyalgia. *Rheumatol Int* 2008; 28: 561-6.
11. WALTEROS C, SANCHEZ-NAVARRO JP, MUNOZ MA, MARTINEZ-SELVA JM, CHIALVO D, MONTOYA P: Altered associative learning and emotional decision making in fibromyalgia. *J Psychosom Res* 2011; 70: 294-301.
12. MIRO E, LUPIANEZ J, HITA E, MARTINEZ MP, SANCHEZ AI, BUELA-CASAL G: Attentional deficits in fibromyalgia and its relationships with pain, emotional distress and sleep dysfunction complaints. *Psychol Health* 2011; 26: 765-80.
13. DICK BD, VERRIER MJ, HARKER KT, RASHIQ S: Disruption of cognitive function in fibromyalgia syndrome. *Pain* 2008; 139: 610-6.
14. GLASS J, WILLIAMS D, GRACELY R, CLAUW D: Myofascial pain and fibromyalgia: relationship of self-reported pain, tender point count, and evoked pressure pain sensitivity to cognitive function in fibromyalgia. *J Pain* 2004; 5: S38.
15. VELDHUIJZEN DS, SONDAAL SF, OOSTERMAN JM: Intact cognitive inhibition in patients with fibromyalgia but evidence of declined processing speed. *J Pain* 2012; 13: 507-15.
16. CHERRY BJ, ZETTEL-WATSON L, SHIMIZU R, ROBERSON I, RUTLEDGE DN, JONES CJ: Cognitive performance in women aged 50 years and older with and without fibromyalgia. *J Gerontol B Psychol Sci Soc Sci* 2014; 69: 199-208.
17. BERGER A, SADOSKY A, DUKES EM, EDELSBERG J, ZLATEVA G, OSTER G: Patterns of healthcare utilization and cost in patients with newly diagnosed fibromyalgia. *Am J Manag Care* 2010; 16 (Suppl.): S126-37.
18. BERGER A, DUKES E, MARTIN S, EDELSBERG J, OSTER G: Characteristics and healthcare costs of patients with fibromyalgia syndrome. *Int J Clin Pract* 2007; 61: 1498-508.
19. ALENTORN-GELI E, MORAS G, PADILLA J *et al*.: Effect of acute and chronic whole-body vibration exercise on serum insulin-like growth factor-1 levels in women with fibromyalgia. *J Altern Complement Med* 2009; 15: 573-8.
20. WOLFE F, CLAUW DJ, FITZCHARLES MA *et al*.: The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care Res* (Hoboken). 2010; 62: 600-10.
21. WOLFE F, CLAUW DJ, FITZCHARLES MA *et al*.: Fibromyalgia criteria and severity scales for clinical and epidemiological studies: a modification of the ACR Preliminary Diagnostic Criteria for Fibromyalgia. *J Rheumatol* 2011; 38: 1113-22.
22. WILLIAMS DA, ARNOLD LM: Measures of fibromyalgia: Fibromyalgia Impact Questionnaire (FIQ), Brief Pain Inventory (BPI), Multidimensional Fatigue Inventory (MFI-20), Medical Outcomes Study (MOS) Sleep Scale, and Multiple Ability Self-Report Questionnaire (MASQ). *Arthritis Care Res* (Hoboken) 2011; 63 (Suppl. 11): S86-97.
23. SEIDENBERG M, HALTINER A, TAYLOR MA, HERMANN BB, WYLER A: Development and validation of a Multiple Ability Self-Report Questionnaire. *J Clin Exp Neuropsychol* 1994; 16: 93-104.
24. CLAUW DJ, MEASE P, PALMER RH, GENDREAU RM, WANG Y: Milnacipran for the treatment of fibromyalgia in adults: a 15-week, multicenter, randomized, double-blind, placebo-controlled, multiple-dose clinical trial. *Clin Ther* 2008 Nov; 30: 1988-2004. Errata in: *Clin Ther* 2009; 31: 446. *Clin Ther* 2009; 31: 1617.
25. MEASE PJ, CLAUW DJ, GENDREAU RM *et al*.: The efficacy and safety of milnacipran for treatment of fibromyalgia: a randomized, double-blind, placebo-controlled trial. *J Rheumatol* 2009; 36: 398-409. Erratum in: *J Rheumatol* 2009; 36: 661.
26. WHIPPLE MO, MCALLISTER SJ, OH TH,

LUEDTKE CA, TOUSSAINT LL, VINCENT A: Construction of a US fibromyalgia registry using the Fibromyalgia Research Survey criteria. *Clin Transl Sci* 2013; 6: 398-9.
27. BRANCO JC, ZACHRISSON O, PERROT S, MAINGUY Y; MULTINATIONAL COORDINATOR STUDY GROUP: A European multicenter randomized double-blind placebo-controlled monotherapy clinical trial of milnacipran in treatment of fibromyalgia. *J Rheumatol* 2010; 37: 851-9.
28. CLEELAND CS, RYAN KM: Pain assessment: global use of the Brief Pain Inventory. *Ann Acad Med Singapore* 1994 Mar; 23: 129-38.
29. SMETS EM, GARSSEN B, BONKE B, DE HAES JC: The Multidimensional Fatigue Inventory (MFI) psychometric qualities of an instrument to assess fatigue. *J Psychosom Res* 1995; 39: 315-25.
30. CAPPELLERI JC, BUSHMAKIN AG, MCDERMOTT AM *et al*.: Measurement properties of the Medical Outcomes Study Sleep Scale in patients with fibromyalgia. *Sleep Med* 2009; 10: 766-70.
31. MCNAIR DM, LORR M, DROPPLEMAN LF: EdITS manual for the profile of mood states. San Diego (CA): Educational and Industrial Testing Service, 1992.
32. BOURGEOIS A, LEUNES A, MEYERS M: Full-scale and short-form of the profile of mood states: a factor analytic comparison. *J Sport Behavior* 2010; 33: 355-76.
33. SLETTEN DM, SUAREZ GA, LOW PA, MANDREKAR J, SINGER W: COMPASS 31: a refined and abbreviated Composite Autonomic Symptom Score. *Mayo Clin Proc* 2012; 87: 1196-201.
34. WARE JE JR: SF-36 health survey update. *Spine* (Phila Pa 1976). 2000; 25: 3130-9.
35. DA COSTA D, DOBKIN PL, FITZCHARLES MA *et al*.: Determinants of health status in fibromyalgia: a comparative study with systemic lupus erythematosus. *J Rheumatol* 2000; 27: 365-72.
36. BENNETT RM, BUSHMAKIN AG, CAPPELLERI JC, ZLATEVA G, SADOSKY AB: Minimal clinically important difference in the fibromyalgia impact questionnaire. *J Rheumatol* 2009; 36: 1304-11.
37. KATZ RS, HEARD AR, MILLS M, LEAVITT F: The prevalence and clinical impact of reported cognitive difficulties (fibrofog) in patients with rheumatic disease with and without fibromyalgia. *J Clin Rheumatol* 2004; 10: 53-8.
38. DA CUNHA RIBEIRO RP, ROSCHEL H, ARTIOLI GG *et al*.: Cardiac autonomic impairment and chronotropic incompetence in fibromyalgia. *Arthritis Res Ther* 2011; 13: R190.
39. VINCENT A, MCALLISTER SJ, SINGER W *et al*.: A report of the autonomic symptom profile in patients with fibromyalgia. *J Clin Rheumatol* 2014; 20: 106-8.
40. REYES DEL PASO GA, GARRIDO S, PULGAR A, DUSCHEK S: Autonomic cardiovascular control and responses to experimental pain stimulation in fibromyalgia syndrome. *J Psychosom Res* 2011; 70: 125-34.
41. WIKLUND U, OLOFSSON BO, FRANKLIN K, BLOM H, BJERLE P, NIKLASSON U: Autonomic cardiovascular regulation in patients with obstructive sleep apnoea: a study based on spectral analysis of heart rate variability. *Clin Physiol* 2000; 20: 234-41.
42. COHEN H, NEUMANN L, KOTLER M, BUSKILA D: Autonomic nervous system derangement in fibromyalgia syndrome and related disorders. *Isr Med Assoc J* 2001; 3: 755-60.
43. LOW PA: Autonomic nervous system function. *J Clin Neurophysiol* 1993; 10: 14-27.
44. HARRIS PA, TAYLOR R, THIELKE R, PAYNE J, GONZALEZ N, CONDE JG: Research electronic data capture (REDCap): a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009; 42: 377-81.