# Does the cognitive index of the symptom severity scale evaluate cognition? Data from subjective and objective cognitive measures in fibromyalgia

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**ABSTRACT**

**Objective.** *The current provisional diagnostic criteria for the fibromyalgia syndrome (FM) include a cognitive index score (SSS-Cog), which constitutes a part of the Symptom Severity Scale (SSS). The current study aimed at assessing the validity of the cognitive index score, by comparing this subjective measure of cognitive impairment with an objective measure of cognitive functioning, collected through comprehensive computerised cognitive testing and assessment.*

**Methods.** *50 FM patients underwent a computerised cognitive assessment battery, including testing in domains of memory, executive function, attention and information processing speed (NeuroTraxCorp.). Age and education standardised scores were computed. FM symptoms were assessed by the Fibromyalgia Impact Questionnaire (FIQ), Widespread Pain Index (WPI) and Symptom Severity Scale (SSS), a Visual Analogue Scale (VAS) of clinical pain and the Beck Depression inventory (BDI-II).*

**Results.** *The index score for subjective assessment of cognitive decline (SSS-Cog) was not correlated with any of the objective cognitive measures. However, a positive correlation was found between the SSS-Cog and the FIQ, the WPI and the VAS measures, all reflecting subjective overall functional ability.*

**Conclusion.** *No significant relationship was found between FM patients' subjective appraisal of cognitive deficit and objective cognitive scores on all computerised subtests. However, subjective appraisal of cognitive impairment was found to be strongly and significantly related to patients' functional ability. Therefore, we suggest reconsidering the definition of this index score (SSS-Cog) and propose developing novel and more accurately defined tools in order to measure cognitive impairment in FM patients, for both diagnostic and epidemiological purposes.*

## Introduction

Fibromyalgia syndrome (FM) is a multi-symptom disorder, characterised by chronic widespread pain and tenderness, chronic fatigue, disturbed sleep and prominent symptoms of cognitive impairment. Depression and anxiety are frequent comorbidities. FM is considered a prototype of a centralised pain condition, *i.e.* one in which alterations in the processing and transmission of pain within the central nervous system underlie clinical pain (1, 2).

Despite significant progress made regarding the pathogenesis of FM, the underlying aetiology remains incompletely understood and objective biomarkers for diagnosis and assessment are yet to be available. Hence, both the diagnosis and the clinical follow-up rely entirely on subjective symptoms, reported by the patients, coupled with the clinical experience and acumen of the physician. Several sets of criteria have been suggested over recent years for the classification and diagnosis of FM. The original American College of Rheumatology (ACR) classification criteria formulated in 1990, relied heavily on the presence of specific "tender points" throughout the musculoskeletal system, coupled with the presence of chronic widespread pain (3). These criteria, which failed to address the additional symptoms of FM besides pain, were eventually superseded by the 2010-2011 provisional diagnostic criteria. While dropping the tender point criterion, these criteria introduced the Widespread Pain Index (WPI), a patient-reported tool reflecting the degree of pain dispersion, as well as the Symptom Severity Scale (SSS), reflecting a sum of accompany-

ing symptoms (4). This tool was further developed (and shortened) in 2011 in order to make it more practical for utilisation in clinical practice (5). The criteria were again updated in 2016 in order to re-introduce a specific requirement for "generalised pain" (not included in the 2010 criteria) and to allow for the diagnosis of FM as a comorbidity in the presence of other pain-related disorders, such as inflammatory joint disease (6).

The component symptoms of the SSS include fatigue, waking unrefreshed, cognitive symptoms as well as a six-month history of headache, abdominal pain, depression and other symptoms. Thus, cognitive symptoms, which were originally unrecognised by the 1990 criteria, have gained recognition as a valid diagnostic feature of FM. Notably, FM patients will frequently report the occurrence of cognitive symptoms [often referred to as "fibrofog" (7)] as being responsible for particularly severe functional and occupational impairment (8). Previous research has identified several areas of cognitive impairment in FM patients, including working memory, executive function and attention, especially when presented with competing stimuli or distractors (9-12). Previous studies regarding the correlation between subjective and objective cognitive impairment in FM patients have not been entirely consistent. Thus, Gelonch *et al*. have recently reported that although much of the executive dysfunction could be explained by mood disturbances, impairment in working-memory and inhibition (presented in the interference effect of the Stroop Test) correlated with subjective report (13). The results of "objective" cognitive evaluation in FM patients have also recently been shown to be significantly effort-dependent (14), further complicating the assessment of the relationship between patient-reported cognitive impairment and objective findings.

In view of this background, in the current study we have attempted to evaluate the correlation between the patient-reported cognitive sub-scale of the SSS ("SSS-Cog") and a battery of computerised normalised cognitive tests. We thus aimed at evaluating whether the SSS diagnostic scale truly captures cognitive impairment (as implicitly assumed), and if not, what other features of the syndrome are reflected by a patient reporting a high score on the SSS-cog.

## Methods

*Participants*

Detailed methods of this study have been previously published (14). In short, data was obtained from a specialised FM clinic at the Tel Aviv Sourasky Medical Centre, Israel. Inclusion criteria for participants included age over 18 and a diagnosis of FM according to the 2010/2011 ACR diagnostic criteria. These criteria require a WPI score above 7 combined with a SSS score above 5, or a WPI between 3 and 5 with an SSS score above 9. Patients suffering from "secondary" FM, *i.e*. diagnosed with another disease capable of causing chronic pain, were excluded. The study was approved by the institutional ethics review board and all participants gave written informed consent. 50 FM patients were recruited. The sample included 43 women (86%) and 7 men (14%). Average age was 42.2 years (Table I).

*Research tools*

NeuroTrax™ computerised cognitive assessment battery was used for evaluation of cognitive function. The construct validity of this tool has been demonstrated in patients with movement disorders (15) and the battery has been validated in the assessment of mild cognitive impairment (MCI) and difficulties in attention and concentration, both for clinical as well as for research purposes (16, 17). The battery utilises standard neuro-psychological tests adapted for computerised delivery, with the participant responding using the computer mouse or key-board numbers. The test results are automatically uploaded onto a central server, on which the raw outcome parameter data is corrected for age and education. The correction is performed with the use of a pool of individuals with no neurological, cognitive or psychiatric impairment. The corrected scores are adjusted to a standardised IQ scale (mean = 100, SD=15) and index scores are computed for average performance of individuals with similar cognitive performance. The entire test is 45–60 min long and has been validated in English, Hebrew, Russian, and Spanish (http://www.neurotrax.com). The index scores which were focused upon in the current study included: memory, speed of information processing, executive function and attention.

The following tasks were included in these scales:

a. Verbal memory (memory).
b. Non-verbal memory (memory).
c. Go-no-go response inhibition (attention + executive function).
d. Stroop interference (attention + executive function).
e. Staged information processing speed (attention + speed of processing).

Outcome parameters include average accuracy across trials, average response time across trials and its standard deviation and a composite score, computed as average accuracy divided by average response time.

FM symptoms questionnaire: Fibromyalgia impact questionnaire (FIQ), widespread pain index (WPI) and Symptom severity scale (SSS).

The WPI is a score calculated by documenting the number of sites where the patient has felt pain over the last week, from a total of 19 specific-predesignated sites. The score ranges between 0 and 19.

The SSS is a score measuring symptoms of fatigue, (on a scale of 0-3), unrefreshing sleep (scale of 0-3) and cognitive symptoms (scale of 0-3); the scale also includes points given for the presence of the following symptoms: headache, lower abdominal pain and depression, over the last six months (1 point for each symptom). The total SSS score ranges between 0 and 12.

The FIQ is a self-report instrument which includes 19 items relating to function, general effect and symptoms. The first question lists 10 activities of daily living; the ability to engage in each activity is reported on a 4-point Likert scale. The FIQ also contains seven 100mm visual analogue scales (VAS), designed to measure fatigue, sleep quality, stiffness, pain, work in-

**Table I.** General demographics and group outcomes on self-report questionnaires.

| Variable | M (SD) n=50 | Range |
|---|---|---|
| Age (years) | 42.2 (13.5) | |
| Education (years) | 14.2 (2.9) | 15 |
| Gender | | |
| Female (%) | 86 | |
| Male (%) | 14 | |
| Widespread Pain Index (WPI) | 12.1 (4.3) | 19 |
| Symptom Severity Scale (SSS) | 9.2 (1.8) | 12 |
| Pain (Visual Analogue Scale) | 5.8 (2.2) | 10 |
| Fatigue (Visual Analogue Scale) | 7.8 (2) | 10 |
| Beck Depression Inventory (BDI-II) | 18.7 (10) | 63 |
| Fibromyalgia Impact Questionnaire (FIQ) | 61.26 (18.4) | 100 |

terference, anxiety and depression. The FIQ has high internal validity, with a Cronbach's alpha value of 0.95 and a test-retest consistency which ranges between 0.56 for the pain score and 0.95 for the function score (18). A validated Hebrew translation of the FIQ was used, based on Buskila & Neumann (19).

The pain VAS is a continuous scale for measuring pain intensity, which consists of a 100 mm vertical line on which the participant is requested to mark current levels of pain ranging between 0 (no pain at all) and 100 (unbearable pain). It has been repeatedly used on different populations, including patients suffering from rheumatic disorders (20), showing a high test-retest validity, mainly among literate individuals (r=0.93) (21).

- *Beck Depression Inventory (BDI)-II*: This self-report instrument includes 21 items, intended to assess severity of depressive symptoms including cognitive, behavioural, affective and emotional domains. The total BDI-II score ranges between 0 and 63. A result between 10 and 19 indicates mild depression, 20 and 25 moderate depression and a result above 25 severe depression (22). The BDI-II has high internal consistency, with a Cronbach's alpha value of 0.94 (23).

- *Test of Memory Malingering (TOMM)*: The TOMM is a forced-choice task consisting of 50 pictures of everyday objects. The TOMM consists of two learning trials and a retention trial. A result of 45 or less has been shown to have a sensitivity of 100% in identifying malingering (24).

*Study procedure*

FM patients were recruited during clinical follow up meetings at the fibromyalgia clinic and were offered to participate in a study of cognitive functioning. After providing informed consent and demographic information, patients filled out the study questionnaires. Participants were subsequently given the first two TOMM trials and then the battery of cognitive tests. About 20 minutes after starting the computerised cognitive testing, a break was taken during which the third TOMM trial was performed. The total length of the session was about 90 min and participants were then offered feedback regarding the results of the computerised cognitive tests. No identified documentation was provided regarding the results.

*Data analysis and statistics*

A Spearman correlation coefficient was used to asses if the Symptom severity sub-scale score for cognitive symptoms (0–3, SSS-Cog, part of the SSS score) correlated with performance on the computerised cognition tests. Following the results, further correlations, using Spearman coefficient calculations were performed on the SSS-Cog, in relation to other questioners used in the study (WPI, FIQ, BDI-II). SPSS 22.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for analysis.

## Results

General demographic information and clinical characteristics of FM patients participating in the current study are presented in Table I, showing means (M), standard deviations (SD) and range of variables.

In our sample, patients scored moderately high on the widespread pain index (WPI) mean score 12.1 (SD=4.3) and the symptom severity scale (SSS) mean score 9.2 (SD=1.8). The Fibromyalgia Impact Questionnaire (FIQ) showed the impact of disease to be moderate in patients, mean score 61.26 (SD=18.4). When asked to rate their current level of pain on the visual analogue scale (VAS), patients indicated in general a moderate level of pain, mean score 5.8 (SD=2.2). Levels of fatigue were moderately high, as indicated by the VAS incorporated in the FIQ, mean score 7.8 (SD=2). Finally, Beck Depression Inventory (BDI-II) showed mild levels of depression on average with notable disparity in affect among patients, mean score 18.7 (SD=10).

**Table II.** Subjective (SSS-Cog) and objective (Mindstreams™ computerised testing) assessment. Descriptive statistics.

| Variable | M (SD) n=50 |
|---|---|
| *Subjective:* | |
| SSS Cognitive | 2.04 (.9) |
| *Objective:* | |
| Global Cognitive Score | 94.586 (13.0) |
| *Objective: Computerised Sub-tests:* | |
| Memory Index Score | 91.502 (17.2) |
| Executive Function Index Score | 97.33 (15.1) |
| Attention Index Score | 92.238 (15.6) |
| Information Processing Speed Index Score | 91.952 (17.0) |
| Motor Skills | 92.166 (22.0) |
| Verbal Function | 94.89 (20.1) |
| Visual Spatial Index (n=49) | 97.732 (22.4) |
| Go No Go Accuracy Rate Norm | 97.280 (20.7) |
| Go No Go Response Time Rate Norm | 94.534 (20.0) |

Table II presents results of objective and subjective cognitive assessments scores, of the study participants.

Based on data collected and analysed by Kalfon *et al*. (14), cognitive index scores of FM patients participating in the study were significantly lower than average, in comparison with data from healthy controls. The following cognitive domains were found to be impaired: memory, attention and speed of information processing. Executive function was in the norm.

*Correlation between the SSS-Cog and computerised cognitive assessment*

Notably, the SSS-Cog, a subjective

self-measure of cognitive decline (rated on an ordinal scale from 0–3), did not correlate with performance scores, collected through the NeuroTrax™ computerised cognitive assessment battery (Table III). A non-significant Spearman correlation was obtained between SSS-Cog and the global cognitive score ($r_s$=-0.132, $p$=0.361) and with all other sub-tests ($p$>0.05).

*Relationship between SSS-Cog, cognitive performance, FIQ, WPI and VAS*

Our hypothesis that subjective and objective measures of cognitive decline would be correlated was thus rejected. Instead, a significant positive correlation was found between the SSS-Cog ratings and the FIQ ($r_s$=0.438, $p$=0.001). A smaller yet significant positive correlation was found between the SSS-Cog and the pain measures used in the study, VAS-pain, ($r_s$=0.304, $p$=0.032) and WPI, ($r_s$=.333, $p$=0.018) (Table IV).

The strongest correlation found in the study was between SSS-Cog and an item of the FIQ, indicating amount of days during the last week that the subject felt good ($r_s$=0.562, $p$=0.000). This subscale was recoded into the data and the scale was reversed, to match the direction of severity with other subscales in the FIQ. Therefore, the higher a participant rated his/her level of cognitive decline, the fewer days he/she felt well in the preceding week (prior to the study).

Further analysis of data, based on Spearman coefficient calculations, found the following correlations between the SSS-Cog and the corresponding FIQ, WPI and VAS.A significant positive correlation was observed with "FIQ experience of symptoms" (a subscale in the FIQ) regarding the level of interference of pain or other FMS symptoms during the last week ($r_s$=0.356, $p$=0.012). A significant positive correlation was also found with "FIQ Stiffness" (a subscale in the FIQ) regarding the level of rigidity and stiffness, experienced during the last week ($r_s$=0.427, $p$=0.002). List of correlations with SSS-Cog are shown in Table IV.

*Additional analysis of data*

In order to rule out alternative explanations of our results, we conducted the following calculations: the SSS-Cog is a subscale of the SSS, therefore we checked if the overall score of the SSS tool would correlate with the cognitive performance on the NeuroTrax™ computerised battery of tests. Using Pearson coefficient calculation, no significant correlation was found between the SSS and cognitive performance scores (r=-0.263, $p$=0.065).

*Participants classified as "low effort" in comparison with other participants*

As described above, the current study is based on data collected in our prior research. To rule out the possibility that no correlation was found between the SSS-Cog and objective cognitive performance as a result of effort, we examined whether the lack of correlation would persist while running the same calculations excluding the low-effort group of participants (n=8, scoring 45 or lower on the TOMM test). No significant effect was found ($r_s$=-0.144, $p$=0.364, n=42).

*Ruling out age and depression as possible confounding variables*

In order to rule out the possibility of age influencing subjective report on the FIQ and SSS, Pearson coefficient calcula-

**Table III.** Relationship between the SSS-Cog and performance on the Mindstreams™ computerised testing of different cognitive domains.

| Variable | SSS Cog | | |
|---|---|---|---|
| | Spearman correlation | Sig. (2 tailed) | N |
| *Computerised Sub-tests:* | | | |
| Global cognitive score | -.132 | .361 | 50 |
| Memory index score | .023 | .873 | 50 |
| Executive function index score | -.099 | .494 | 50 |
| Attention index score | -.066 | .647 | 50 |
| Information processing speed index score | -.1 | .492 | 50 |
| Motor skills | -.081 | .577 | 50 |
| Verbal function | -.146 | .312 | 50 |
| Visual spatial index | -.144 | .325 | 49 |
| Problem solving | .110 | .446 | 50 |
| Go No Go accuracy rate | -.138 | .340 | 50 |

**Table IV.** Relationship between SSS-Cog and other self-report symptomatic questionnaires: FIQ, WPI, VAS and BDI-II.

| Variable | SSS Cog | | |
|---|---|---|---|
| | Spearman correlation | Sig. (2 tailed) | N |
| Wide Pain Index (WPI) | .333* | .018 | 50 |
| Fibromyalgia Impact Questionnaire (FIQ) | .438** | .001 | 50 |
| FIQ- physical function | .227 | .116 | 49 |
| FIQ days feeling good | .562** | .000 | 49 |
| FIQ work days missed | .262 | .069 | 49 |
| FIQ experience of symptoms | .356* | .012 | 49 |
| FIQ Pain | .231 | .110 | 49 |
| FIQ Fatigue | .249 | .081 | 50 |
| FIQ Rested | .233 | .108 | 49 |
| FIQ Stiffness | .427** | .002 | 49 |
| FIQ Anxiety | .258 | .074 | 49 |
| FIQ Depression | .255 | .077 | 49 |
| VAS | .337* | .017 | 50 |
| BDI-II | .240 | .093 | 50 |

*$p$<0.05. **$p$<0.01.

Item numbers in the FIQ: 1) physical function, 2) days feeling good, 3) work days missed, 1-3) Function, 4) experience of symptoms, 5) Pain, 6) Fatigue, 7) Rested, 8) Stiffness, 9) Anxiety, 10) Depression. The subscale of the FIQ- "days feeling good", was reversed when converted into SPSS data-meaning that a higher value on the subscale, reflected less days out of the week where a patient felt good.

tions were performed; no significant correlation was found (FIQ: r=0.015, *p*=0.920, SSS: r=0.509, *p*=-0.096). In addition, a Spearman coefficient calculation was performed to determine if there was a correlation between age and the SSS-Cog ($r_s$=0.007, *p*=0.959); no correlation was found.

A correlation analysis was performed between the SSS-Cog and the BDI-II (depression) scores, of each patient in the study and found no significant Spearman correlation ($r_s$=0.240, *p*=0.093). This finding demonstrates that participants in the study did not rate their level of depression, while filling in the SSS-Cog.

## Discussion

Two major findings arise from the results of the current study. The first is a dis-correlation between SSS-Cog, a subscale of the fibromyalgia diagnostic criteria Symptom Severity Scale (SSS), meant to subjectively evaluate cognitive impairment of FM patients, and objective cognitive performance, as assessed by numerous cognitive domains, through a computerised battery of tests. The second important finding is a positive correlation between SSS-Cog and the FIQ, which includes items relating to function, general impact and symptoms, as well as a moderate (yet significant) positive correlation with the WPI and VAS, both measures of perceived pain. These findings raise fundamental questions regarding the validity of the SSS as a tool for assessing cognitive impairment and reflect on the current application of this tool for the diagnosis of FM. In the current study 74% of participants (37/50 patients) rated a high severity level of cognitive dysfunction, either 2 or 3 (on an ordinal scale ranging from 0–3). Previous studies, which have correlated cognitive dysfunction with other known FM symptoms, have found associated features such as pain, mood disorders (including depression and anxiety), disturbed sleep and fatigue to be contributing factors in explaining cognitive impairment, experienced by FM patients. As pointed out by Torta *et al*. in their recent review of so-called Fibro-fog (9), the interaction between pain and dyscognition in FM may be related to the observed involvement of cognitive brain areas in pain processing and control, implying a possible competition for brain resources. The broad spectrum of symptoms occurring in FM may partially explain and contribute to cognitive deficits experienced by patients, but they do not appear to offer a whole explanation for the phenomenon, as reviewed by Kravitz *et al*. (25).

What does the self-reported cognitive impairment, encountered in FM diagnosis procedure, reflect?

The fibromyalgia survey criteria, comprising the sum of the SSS and the WPI, as introduced in 2010 for the diagnosis of FM, were developed and evaluated as an improved diagnostic tool compared to the previous set of tender-point based classification criteria, originally adopted by the ACR. Subsequently these criteria have been increasingly accepted for diagnosis and research; nonetheless some major controversy persists regarding the true nature of these criteria and what qualities they are apt to capture. Thus, Wolfe has described the combined criteria as representing a Polysymptomatic distress scale (PSD), or in other words a "measure of physical and psychological symptom intensity (distress) that can be applied to subjects regardless of disease" (26). According to this description, higher PSD (WPI+SSS) scores reflect more severe and extensive symptoms, including not only pain but also comorbid anxiety, depression and overall physical and functional difficulty (27). From this perspective of the PSD, the discrepancy between subjective report of cognitive impairment and results of objective testing, as demonstrated in our results, could be interpreted as being consistent with the assumption that the PSD reflects general subjective distress and functional impairment, rather than a specific trait such as dyscognition. In contrast with Wolf's conceptualisation of the survey criteria as being a reflection of distress (PSD), Clauw *et al*. have extensively studied these scores as representing the biological quality of central sensitisation (or "pain centralisation") which is proposed as an underlying pathogenetic mechanism of FM and other overlapping functional disorders (28, 29). In this line of research, which is supported inter alia by multiple functional neuroimaging studies (30), the FM survey criteria are considered to be a useful, easily ascertainable and clinically based tool, which can be used to capture the extent of pain centralisation. This tool has been shown to act as a continuous trait, highly relevant even for patients who do not meet the threshold for a diagnosis of FM, and capable of predicting clinical outcomes such as the post-operative pain and response to analgesia (31). Viewed within this perspective, our results could be interpreted as implying that patients fulfilling the FM survey criteria actually appear to be reporting on levels of centralised pain [a.k.a "fibromyalgianess" (32)], rather than directly reflecting levels of cognitive impairment.

Previous studies of cognition in FM have met with mixed results. Several studies have found FM patients to perform similarly to healthy controls on cognitive testing (33, 34), while our results have shown decreased levels of cognitive performance, despite the lack of correlation with subjective complaints. Notably, cognitive symptoms such as "fibrofog" are frequently described by patients as among the most severe symptoms of FM (25, 35). Of interest, similar discrepancies between subjective and objective cognitive decline have previously been reported in other fields, such as the cognitive impairment frequently observed among cancer patient's following chemotherapy ("chemo-fog") (36). Several explanations have previously been suggested for such discrepancies. Thus, subjective report may reflect a patient's comparison between pre-treatment higher cognitive performance and current relative discognition, even if overall levels remain within the normal range. Alternatively, laboratory-based testing may fail to capture aspects of cognitive performance which are more salient for real-life function and performance. Lastly, affective aspects, such as anxiety and mood may have more serious consequences for everyday life and functioning than for performing in the structured environment of the laboratory.

In view of this background, the results

of the current study appear to imply a basic limitation of the SSS-cog scale. Evidently this tool, while proving to be useful both as part of the FMS survey criteria and as a tool for assessing pain centralisation, does not accurately reflect cognitive impairment, the symptoms which it was designed to quantify. Previous attempts have been made to validate the internal consistency and acceptance of the SSS (37) however to our knowledge, objective validation of the cognitive subscale of the SSS (SSS-cog), as performed in the current study, has not been previously undertaken. In view of our results, we propose that further research should be directed at the development of novel tools for assessing cognitive impairment in FM, which might eventually modify or replace the current SSS, in order to more adequately capture the true nature of cognitive impairment among patients suffering from FM. Several previous attempts have been made to apply alternative tools to the evaluation of cognitive impairment in these patients. The Mental Clutter Scale, developed by Leavitt *et al*. (38) used factor analysis in order to identify two major domains of importance among FM patients: attention/memory (cognition) and mental clarity (or mental clutter). The scale, which included feature such as fogginess, haziness, confusion, cluttered thinking and information overload, has a high internal consistency and good test-retest reliability and thus appears to capture some non-classical cognitive aspects of FM.

In a recent study by Tesio *et al*. (39), another alternative subjective self-measure of cognitive impairment was used on a sample of FM patients and healthy controls, the Functional Assessment of Cancer Therapy cognition scale (FACT-Cog 2), originally used to measure "chemo-fog" symptoms. The FACT-Cog 2, does not contain specific wording relating to oncologic pathology or chemotherapy and therefore can be used to assess cognitive deficits in other illnesses. This tool attempts to minimise the impact of distress by using behavioural examples of cognitive dysfunction, and referring to concrete time periods. It reflects patient's experience in areas such as mental acuity, verbal fluency, and functional interference due to cognitive deficits (40). Interestingly, positive correlations were found between the FACT-COG and objective cognitive testing, but also with the FIQ. Should we consider replacing or altering the SSS Cog? While our results do not detract from the importance and utility of the SSS tool as discussed above, replacing the SSS-cog with a set of alternative items, better reflecting cognitive impairment should be considered. Focusing on real-life aspects of cognitive function might constitute one possible direction. Additionally, revising the current SSS-cog to include a more detailed range of responses (*e.g.* 0–5 instead of 0–3) may provide superior results. Specific domains of discognition which appear to be clinically relevant, such as tasks of distraction (*e.g.* a stroop test) and assessment of word-retrieval speed may be considered.

A number of limitations of the current study must be pointed out. As participants were recruited in a consecutive manner, as volunteers, and were informed in advance that they would undergo computerised neurocognitive testing, some bias may have been caused towards patients with self-perceived cognitive impairment. In addition, the study focused on a sample of FM patients, without recruiting a control group. Nevertheless The NeuroTrax™ computerised cognitive assessment battery, is based on a wide database of normal responders, thus allowing to compare the participant results with normal values without the use a control group.

## Conclusions

The current study demonstrates a strong correlation between FM patient's subjective evaluations of cognitive impairment and self-measures of daily functioning, symptom intensity and experienced pain. However, a notable lack of correlation was found between patient's self-reported cognitive impairment, as reflected by the SSS-Cog, and objective cognitive scores.

These findings highlight the need for development of an alternative tool, in assessing cognitive impairment in FM patients, which might take into consideration aspects of real-life environment, such as daily chores involving cognitive skills. Such measures may prove to outperform the current tool, which uses the somewhat abstract terms of memory and concentration. Future validation of such alternative tools must meet the challenge of bridging the gap between objective laboratory-based assessment of cognition and the real-life experience of cognitive-related functional disability.

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