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THE CENTRAL SENSITIZATION INVENTORY (CSI): ESTABLISHING CLINICALLY-SIGNIFICANT VALUES FOR IDENTIFYING CENTRAL SENSITIVITY SYNDROMES IN AN OUTPATIENT CHRONIC PAIN SAMPLE

Randy Neblett, M.A., LPC, BCB*, Howard Cohen, M.D.** , Yunhee Choi, M.A., Ph.D.*
[Candidate], Meredith Hartzell, M.S., Ph.D.* [Candidate], Mark Williams, Ph.D.* , Tom G.
Mayer, M.D.†, and Robert J. Gatchel, Ph.D., ABPP††

*PRIDE Research Foundation, Dallas, TX

**Graduate School of Nursing, The University of Texas at Arlington, and Associate Medical
Director, PRIDE, Dallas, TX

†Department of Orthopedic Surgery, University of Texas Southwestern Medical Center at Dallas,
Dallas, TX

††Department of Psychology, The University of Texas at Arlington, 313 Life Science Building,
Arlington, Texas 76019

Abstract

Central Sensitization (CS) is a proposed physiological phenomenon in which central nervous system neurons become hyper-excitabile, resulting in hypersensitivity to both noxious and non-noxious stimuli. The term Central Sensitivity Syndrome (CSS) describes a group of medically-indistinct (or nonspecific) disorders, such as fibromyalgia, chronic fatigue, and irritable bowel, for which CS may be a common etiology. In a previous study, the *Central Sensitization Inventory* (CSI) was introduced as a screening instrument for clinicians to help identify patients with a CSS. It was found to have high reliability and validity (test-retest reliability = 0.82; Cronbach's alpha = 0.88). The present study investigated a cohort of 121 patients who were referred to a multidisciplinary pain center, which specialized in the assessment and treatment of complex pain and psychophysiological disorders, including CSSs. A large percentage of patients (n = 89, 74%) met clinical criteria for one or more CSSs, and CSI scores were positively correlated with the number of diagnosed CSSs. A Receiver Operating Characteristic (ROC) analysis determined that a CSI score of 40 out of 100 best distinguished between the CSS patient group and a non-patient comparison sample (n = 129) (AUC= 0.86, Sensitivity = 81%, Specicifity = 75%).

PERSPECTIVE—The Central Sensitization Inventory (CSI) is a new self-report screening instrument to help identify patients with Central Sensitivity Syndromes, including fibromyalgia.

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Corresponding Author: Tom G. Mayer, M.D., 5701 Maple Ave. #100, Dallas, TX 75235, Phone: (214) 351-6600, Fax: (214) 351-3026, tgmayer@pridedallas.com.

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The present study investigated CSI scores in a heterogeneous pain population, with a large percentage of CSSs, and a normative non-clinical sample, to determine a clinically-relevant cutoff value.

Keywords

Central Sensitization Inventory (CSI); Central Sensitivity Syndrome; fibromyalgia; chronic widespread pain; irritable

INTRODUCTION

Central Sensitization (CS) is a proposed physiological phenomenon in which dysregulation in the central nervous system causes neuronal dysregulation and hyperexcitability, resulting in hypersensitivity to both noxious and non-noxious stimuli. The presence of CS has been demonstrated in CSS populations by comparing the pain thresholds of CSS patients to the thresholds of pain-free controls to various stimuli (such as electrical, pressure, cold, and heat). Objective measures of CS, which complement subjective self-report, include brain imaging and nociceptive spinal reflex tests^{24,25,43}, CS is associated with allodynia, hyperalgesia (excessive sensitivity to a normally-painful stimulus), expansion of the receptive field (pain extending beyond the area of peripheral nerve supply), and unusually prolonged pain after a painful stimulus has been removed (usually throbbing, burning, tingling, or numbness).⁴⁴ CS has been proposed as the root etiology for “Central Sensitivity Syndromes” (CSSs)^{15,30,41}, which refer to a group of medically-indistinct disorders for which no organic cause can be found.^{15,30,40-42} These include fibromyalgia, chronic fatigue syndrome, irritable bowel syndrome (IBS), temporomandibular joint disorder (TMD), and tension headache/migraine, among others. These CSSs are highly inter-correlated, share many common symptoms, including pain, and all demonstrate evidence of CS.^{15,42}

In addition to these previously mentioned “core” CSSs, other pain-related disorders, often viewed as peripheral pain disorders, may also fit into the CSS family or share some degree of CS. For instance, although myofascial pain syndrome is less interrelated with other CSSs, and peripheral pain mechanisms have been implicated, reduced pain thresholds to a variety of stimuli (suggesting the presence of CS) have been identified in this populations in a number of studies.^{7, 11, 21, 42} The presence of CS, and associations with other CSSs, have also been found in other disorders in which pain is not a primary symptom, such as restless leg syndrome^{2, 33} and post-traumatic stress disorder (PTSD).^{5, 26} A list of proposed CSSs^{15,42}, which were analyzed in the current study, is presented in Table 1.

Recently, a new comprehensive self-report inventory, the *Central Sensitization Inventory* (CSI), was developed to assess the overlapping symptom dimensions of CSSs¹⁸ This measure is intended as a screening instrument to help identify the presence of a CSS, and to alert clinicians that presenting symptoms may be related to CS.³⁵ Time, effort, and resources are often spent on superfluous diagnostic testing (such as colonoscopy, cardiac catheterizations, or imaging) and surgical procedures or implantable devices for patients with CSSs, when less expensive, alternative interventions (such as cognitive/behavioral and physical therapies) may be more effective for this population.^{13,16,37,39} Part A of the CSI assesses 25 health-related symptoms that are common to CSS, with total scores ranging from 0-100. Part B (which is not scored) asks if one has previously been diagnosed with one or more specific disorders, including seven separate CSSs. In its initial comprehensive evaluation¹⁸, the CSI was found to be psychometrically-sound, with a high degree of test-retest reliability and internal consistency (Pearson’s $r = 0.817$; Cronbach’s $\alpha = 0.879$). Evaluation of the construct validity of the CSI in four samples (three within a work-related injury population and one non-clinical normative sample) confirmed that fibromyalgia

patients (with increased tenderness to palpation, suggesting the most CS) scored the highest on the CSI; chronic widespread pain patients, without FM (with less tenderness to palpation, suggesting less CS), and chronic low back pain patients (without chronic widespread pain, suggesting less CS) scored somewhat lower; and the non-clinical normative population (with presumably minimal to no CS) scored the lowest ($p<.05$).

The goals of the present study were three-fold: (1) to determine if CSI scores are associated with the presence of one or more CSS in a group of patients seeking outpatient multidisciplinary pain management treatment; (2) to determine if the self-reported diagnoses on Part B of the CSI correspond with actual physician diagnosis; and (3) to establish a clinically-relevant cut-off score for predicting the presence of a CSS, using a Receiver Operating Characteristic (ROC) analysis.

MATERIALS AND METHODS

Subjects

Data were collected from 268 consecutive patients referred to an interdisciplinary pain clinic, specializing in the assessment and treatment of complex pain and psychophysiological disorders, including CSSs. Eighteen patients were eliminated from the total sample based on the following exclusion criteria: 1) age over 70; and/or 2) diagnosis of specific medical conditions that can negatively affect the central nervous system, including cancer, brain or spinal cord injury, neurological disease or injury, and multiple sclerosis. The remaining 250-subject total sample was then randomly assigned to two groups of 121 and 129 subjects, utilizing the “approximately 50% of all cases” function in SPSS v. 18. The first group of 121 subjects was used in this study to establish a clinically relevant cutoff score for the CSI, and the second group of 129 subjects was used in another study. Of the 121 subjects used in the current study, 89 (74%) were diagnosed with one or more CSSs.

Upon arrival at the initial appointment, all patients completed a self-administered Central Sensitization Inventory (CSI) as well as self-reported documentation of current and past symptoms and disorders. It should be noted that, because all the data used in the present study were part of the patients’ standard medical files, the study was granted exemption from IRB review. A comprehensive interview was conducted by a single psychiatrist with extensive experience and training in the diagnosis of mental illness, chronic pain conditions, and CSSs. Specifically, subjects were evaluated for presenting complaints, current and past medications, medical and psychiatric history, and current medical and psychiatric diagnosis, based upon all available diagnostic tests and referring physician notes. The presence or absence of a psychiatric disorder was determined by the DSM_IV-TR¹.

The 11 disorders listed in Table 1 have been shown in previous studies to have a CS component, and have been included in the CSS family by other authors.^{15,42,45} The presence or absence of each CSS in Table 1 was determined by symptom complaints and physical examination, using established clinical diagnostic criteria, including tender-point evaluations for subjects with chronic widespread pain to diagnose fibromyalgia. Subjects with PTSD were divided into two groups: those who developed PTSD as an adult (adult onset); and those with childhood onset, as research suggests that those with childhood PTSD onset may develop more CS due to developmental changes in the brain and the increased length of time that CS has to develop from childhood to adulthood.^{12,19}

A non-patient comparison sample included undergraduate students at The University of Texas at Arlington who were not currently in treatment for chronic pain. All non-patient subjects provided written informed consent, approved by the Institutional Review Board at The University of Texas at Arlington. The initial non-patient sample had 131 subjects. Two

subjects were excluded because they failed to respond to 3 or more items on the CSI, resulting in a total sample of 129 participants.

Measures

Part A of the CSI assesses 25 health-related symptoms common to CSSs. Responses are recorded about the frequency of each symptom, with a Likert scale from 0 (never) to 4 (always), resulting in a total possible score of 100. Higher scores are associated with a higher degree of self-reported symptomology. Part B asks if one has previously been diagnosed with one or more specific diagnoses, including seven CSSs (tension headaches/migraines, fibromyalgia, irritable bowel syndrome, restless leg syndrome, temporomandibular joint disorder, chronic fatigue syndrome, and multiple chemical sensitivities) and three CSS-related related disorders (depression, anxiety/panic attacks, and neck injury). Subjects are asked: 1) if they have previously been diagnosed by a doctor with each of the disorders; and 2) what year they were diagnosed.

Total scores from CSI Part A and self-reported diagnosis from CSI Part B were collected from all patient and non-patient comparison subjects. In addition, the presence or absence of all CSS diagnoses was recorded for each patient.

Statistical Methods

The data were analyzed using SPSS v. 18. Pearson's correlation was used to determine correlations between the number of CSS diagnoses and CSI scores, and between different CSSs. Kappa was calculated as a measure of agreement between the CSI Part B and the CSS diagnoses. To develop a clinically relevant cutoff point, Receiver Operating Characteristic (ROC) analyses⁴⁷ were conducted, using both the patient sample (only those that had a CSS) and the non-patient comparison sample. The area under the curve (AUC) was used to examine the ability of the CSI to discriminate between the CSS patient and non-patient groups. The AUC is useful in: 1) evaluating the discriminatory ability of a test to correctly identify a disease and non-disease state; and 2) determining an optimal cut-off point to discriminate the disease with non-disease patients. As has been recommended previously⁴⁶, interpretation of the AUC ranges from 0.5 (for a test that shows no ability to discriminate between subject groups) to 1.0 (for a test which discriminates perfectly between subject groups), with a general satisfactory level of 0.7. Finally, the sensitivity (the proportion of true positives that are correctly identified) and specificity (the proportion the true negatives correctly identified) were used to determine an ideal cut-off value for the CSI. The sensitivity and specificity are dependent on the cut-off value used, and there is a "trade-off" between sensitivity and specificity. The higher the sensitivity, the lower the specificity, and vice versa. A minimum acceptable level for both sensitivity and specificity is 75%.³¹ The cut-off value in this study was determined at the point that maximized sensitivity, and maintaining a minimum specificity of 75%.

RESULTS

Prevalence of CSSs

The prevalence rates and mean CSI scores of all 11 CSSs are presented in Table 1. Of the total 121 patient sample, 74% (n = 89) were diagnosed with a CSS by the physician. The most frequent CSSs diagnosed were tension headaches/migraines and myofascial pain syndrome (39%), followed by fibromyalgia (31%), IBS (15%), and TMD and PTSD (12%). Of the 89 CSS patients, 46 (51%) had more than one CSS diagnosis. Of the 43 patients with a sole CSS diagnosis, a high percentage had myofascial pain syndrome (n = 20). Subjects with myofascial pain syndrome had the lowest CSI scores (M = 50), and subjects with chronic fatigue syndrome had the highest CSI scores (M = 67). Because 51% of CSS subject

were diagnosed with more than one CSS, these data do not allow one to determine clearly which individual CSSs were associated with higher and lower CSI scores.

Comparison Among the CSS Patient Group, No CSS Patient Group, and Non-patient Comparison Group

As shown in Table 2, significant demographic differences were found among the CSS patient group, the no-CSS patient group, and the non-patient comparison group. The CSS patient group was more likely to be Caucasian and had a significantly higher mean age than the non-patient comparison group ($p < .001$). There was no race or age difference between patient groups. The CSS patient group was significantly more likely to be female than both the no-CSS patient group and the non-patient comparison group ($p < .001$). In addition, the CSS patient group exhibited significantly higher mean CSI scores than the no-CSS patient group and the non-patient comparison group ($p < .001$), and the no-CSS patient group had a significantly higher mean CSI score than the non-patient comparison group ($p < .001$).

Of the total 121 patient sample, 89 (74 %) were diagnosed with 1 or more CSSs (see Table 3). Patients with multiple CSS diagnoses scored higher on the CSI than those with fewer CSS diagnoses. The number of CSS diagnoses and the CSI scores were significantly correlated, $r = .51$, ($p < .001$), with a large effect size ($r^2 = .26$). Although the non-patient comparison subjects were not evaluated by a physician for CSSs in this study, it should be noted that 19% ($N = 24$ of 129) of these subjects reported one or more CSSs on the CSI Part B. The great majority of the reported CSSs were headache ($N = 19$) followed by IBS ($N = 6$), restless leg syndrome ($N = 3$), chronic fatigue syndrome ($N = 2$), and TMD ($N = 2$). None of the non-patient comparison subjects reported fibromyalgia or multiple chemical sensitivities.

Inter-correlations Among CSSs

There were significant correlations among many of the CSS diagnoses, as seen in Table 4. No single CSS diagnosis correlated with more than seven other diagnoses. IBS, TMD, fibromyalgia, chronic fatigue syndrome, and restless leg syndrome correlated well together. Interstitial cystitis and multiple chemical sensitivities were somewhat less correlated with the other CSSs (5 and 4 correlations, respectively). Myofascial pain syndrome and PTSD with childhood onset had few correlations (3 and 2, respectively). Chronic regional pain syndrome and PTSD with adult onset did not significantly correlate with any other CSS diagnoses.

Agreement between Physician Diagnoses and CSI PART B Diagnoses

Among the 89 CSS patients, 19 patients failed to answer all 10 CSI Part B diagnoses. In general, agreement between the physician's diagnosis of CSS and the patient self-report on the CSI Part B was good. Agreement was considered present when the diagnosis made by the physician and the self-reported Part B diagnosis were the same for a particular patient. Prevalence of CSI self-reported diagnosis, kappa values, and significance levels, with agreement between self-report and physician diagnoses, are presented in Table 5. Fibromyalgia (Kappa = .70), tension headaches/migraines (Kappa = .71), and IBS (Kappa = .71) all had good agreement. Restless leg syndrome and TMD had moderate agreement (Kappa = .42 and .44, respectively). Chronic fatigue syndrome showed poor agreement (Kappa = .19) and multiple chemical sensitivities showed no agreement (Kappa = .00) between the physician's diagnosis and the CSI Part B. However, only one CSS patient reported multiple chemical sensitivities, and only one multiple chemical sensitivities diagnosis was made by the physician (on a different patient).

Identification of a Clinically Significant Cut-off Value

The ROC analysis compared the CSS patient group (n=89) with the non-patient comparison group (n=129). Only patients with one or more CSSs were included in this analysis. The AUC and standard errors for the CSI were 0.86 and 0.03, with a significance level of 0.05. As shown in Table 6, the sensitivity (the proportion of true positives, or correctly identifying patients with a CSS) and specificity (the proportion of true negatives, or correctly identifying non-patient comparison subjects) were dependent on the cut-off scores used. The optimal CSI value of 40 was identified as showing the highest sensitivity level (81%) with an acceptable level of specificity (75%). The lower cut-off scores increased the sensitivity but decreased the specificity (below 75%). Conversely, the higher cut-off scores increased the specificity but decreased the sensitivity. As noted previously, a subset of the non-patient comparison subject (N= 24 of 129 subjects) reported a CSS on CSI Part B. When those subjects were removed from the analysis, in an attempt to create a more homogeneous sample, the specificity increased to 79% from 75%, while the sensitivity remained at 81%, using the same cutoff score of 40.

Additional ROC analyses were also performed in an attempt to increase the screening accuracy of the CSI. It was observed that a relatively large number of patients diagnosed with myofascial pain syndrome had a sole diagnosis (n=20 out of 47, or 43%) of myofascial pain syndrome. Mean CSI scores for those subjects with a sole diagnosis of myofascial pain syndrome (M=39.7) were similar to patients without a CSS (M=40.9), and significantly lower than patients with both myofascial pain syndrome and one or more additional CSS diagnosis (CSI M=57.0). When patients with a sole diagnosis of myofascial pain syndrome were excluded from the analysis, the AUC increased to 0.91 (SE = 0.02), and the sensitivity increased up to 91% with the cut-off value of 40. The specificity remained at 79%.

DISCUSSION

As reviewed earlier, the *Central Sensitization Inventory* (CSI) is a self-report scale designed to alert healthcare providers that presenting symptoms may be related to CS and, thus, that the possibility of a CSS should be considered.³⁵ Part A of the CSI assesses 25 health-related symptoms common to CSSs, with total scores ranging from 0-100. Part B asks about previous diagnoses, including seven separate CSSs. In a previous study, the construct validity of the CSI was evaluated in three clinical samples within a work-related injury population and one normative sample.¹⁸ Fibromyalgia patients (with presumably the most CS) scored the highest on the CSI; chronic widespread pain patients, without fibromyalgia, and chronic low back pain patients (both with presumably less CS) scored somewhat lower; and a non-clinical normative sample (with presumably minimal to no CS) scored the lowest (p<.05).

The present study further investigated the construct validity of the CSI in a sample of patients referred to a multidisciplinary pain center, specializing in the assessment and treatment of complex pain and psychophysiological disorders, including CSSs. Most of the 121 subjects studied (74%) met criteria for at least one CSS and, of those, 38% met criteria for more than one CSS, which is similar to previous studies.^{39,42,44} There were significantly more female subjects in the CSS group, which also confirms previous studies that have found female gender to be a risk factor for many CSSs.^{10,20,28,32,36} Of those patients diagnosed with a CSS, the most frequent diagnoses were tension headaches/migraines (39%), myofascial pain syndrome (39%), fibromyalgia (31%), IBS (15%), TMD (12%), PTSD (12%), and restless leg syndrome (8%). Chronic fatigue syndrome (4%), interstitial cystitis (4%), chronic regional pain syndrome (2%), and multiple chemical sensitivities (1%) were diagnosed relatively infrequently. Patients with multiple CSS diagnoses scored higher on the CSI than those with fewer CSS diagnoses. The number of CSS diagnoses per patient,

and the CSI scores, were also highly correlated, indicating support for the construct validity of the CSI.

In order to identify a clinically meaningful cutoff score, CSI scores were compared between the CSS patient group (n=89) and a non-patient comparison group (n =129), using a Receiver Operating Characteristic (ROC) analysis. A cut-off score of “40” on the CSI yielded good sensitivity (correctly identifying CSS subjects) and specificity (correctly identifying the non-patient comparison subjects). Although a physician assessment for CSSs was not available for the non-patient comparison group, it was noted that a subset of non-patient subjects (N= 24 of 129) reported a CSS on the CSI Part B. When these patients were removed from the ROC analysis, specificity increased from 75% to 79%, and sensitivity remained at 81%, with the same “40” cut-off score.

There was good agreement between the patient self-report on CSI Part B and the physician’s diagnosis of fibromyalgia, tension headaches/migraines, and IBS, and moderate agreement with restless leg syndrome and TMD. There was poor agreement between patients and the physician on chronic fatigue syndrome. This disorder may be unfamiliar to patients, and it may be endorsed due to symptoms of general fatigue, as fatigue is a common symptom of CSSs.

Most CSS diagnoses in this study population were significantly correlated with multiple other CSSs, as has been demonstrated in other previous studies.^{15,42} The “core” CSSs, including IBS, TMD, fibromyalgia, and chronic fatigue syndrome (as well as restless leg syndrome), correlated well with each other, and had the highest number of correlations with other CSSs (six or more correlations each). Interstitial cystitis and multiple chemical sensitivities were somewhat less correlated with other CSSs (4-5 correlations each), although the number of subjects with these diagnoses was relatively low. Myofascial pain syndrome and PTSD (childhood-onset) had few correlations (2-3 each). Chronic regional pain syndrome and PTSD with adulthood onset did not significantly correlate with any other CSS diagnoses. .

Though the number of subjects was small, childhood onset PTSD (N = 4) had higher CSI scores (CSI M = 64.0) and more correlations with other CSS in this sample than subjects with adult onset PTSD (N = 10; CSI M = 52.8). It is possible that subjects with childhood PTSD onset may develop more CS due to developmental changes in the brain and the increased length of time that CS has to develop from childhood to adulthood.^{12,19} There is evidence that childhood abuse can cause long-lasting neurobiological changes, especially affecting hypothalamic-pituitary-adrenal (HPA) regulation.^{12, 22} Several studies link childhood psychosocial trauma to the development of a CSS (specifically fibromyalgia)^{17,19,27,34,38}, although this association is complex²³, and the quality of previous studies weaken these conclusions.⁹

Some controversy exists about whether myofascial pain syndrome^{6,7,11,21} and chronic regional pain syndrome^{3,4,8,29} are caused by peripheral or central mechanisms, and this may explain why those disorders correlated less with other CSSs. In particular, myofascial pain syndrome seemed to differ from other CSSs in this study. A relatively large number of patients diagnosed with myofascial pain syndrome had a sole diagnosis of myofascial pain syndrome (43% of the myofascial pain syndrome sample). Myofascial pain syndrome correlated poorly with other CSSs, and mean CSI scores for subjects with a sole diagnosis of myofascial pain syndrome (CSI M=39) were similar to patients without a CSS (M=40.9), and significantly lower than myofascial pain syndrome patients with one or more additional CSS diagnosis (CSI M=57.0). Eliminating those patients with a sole diagnosis of myofascial pain syndrome from the ROC analysis increased sensitivity from 81% to 91% without

decreasing specificity. Although myofascial pain syndrome has previously been classified as a CSS⁴², subjects in this study with a sole diagnosis of myofascial pain syndrome appeared more similar to patients without a CSS. As noted earlier, peripheral pain mechanisms are clearly implicated in myofascial pain syndrome.^{7,11,21} As with low back pain¹⁴, for instance, perhaps myofascial pain syndrome is primarily a peripheral disorder that may develop CS over time. It is possible that some proportion of patients with a sole diagnosis of myofascial pain syndrome in the current study developed minimal CS and associated symptoms, explaining why removal of this subgroup increased sensitivity.

As in most clinical studies of this type, there were some limitations. First, a single physician diagnosed all patients. Although standard criteria were used to determine CSS diagnosis, additional physician confirmation was not performed. Second, there may have been differences in the degree of CS associated with each CSS diagnosis in the present sample. However, specific tests of CS were not performed in this study. Third, while the total number of patients in the CSS group (n=89) yielded sufficient power for analysis, some CSSs were not well represented in this sample. Fourth, CSS diagnosis data from non-patient control subjects, collected from the CSI Part B, was self-report only, and did not represent all possible CSSs or include a physician evaluation. It is unknown whether a physician would have confirmed the self-reported CSS diagnoses, or would have made additional CSS diagnoses, within the non-patient comparison sample. Finally, since results of this study are based on one patient sample in an interdisciplinary pain clinic, these findings may not generalize to other CSS patient samples, and cutoff scores may differ.

In conclusion, most CSS diagnoses in this study significantly correlated with other CSSs, providing further support for the inter-relatedness of these disorders and the probability that they are related to a common etiology. CSI scores were highly associated with the presence of a diagnosed CSS, and the presence of increased numbers of CSSs was correlated with higher CSI scores. Separately, CSS diagnoses on the CSI Part B corresponded well between patient self-report and physician diagnoses. Good sensitivity (81%) and specificity (79%) values were found, with a cut-off score of 40,” indicating that 81% of CSS patients were correctly identified as having a CSS, and 79% of the non-clinical comparison sample were correctly identified as lacking a CSS. Removing those subjects with a sole diagnosis of MPS raised the sensitivity to 91%. Some false positives were identified (non-CSS subjects who were identified as having a CSS), and it should be noted that the mean CSI score for non-CSS patients was 40.9, which is slightly higher than the 40-point cutoff score that best distinguished between the CSS patients (CSI mean = 52.4) and control subjects (CSI mean = 30.9). Although non-CSS patients in this were not diagnosed with a CSS, they did have chronic pain, were seeking treatment for their pain, and reported more symptoms on the CSI than the non-patient controls. Although the CSI cut-off score of 40 distinguished well between CSS patients and non-patient comparison subjects in this study, it is unknown if it will distinguish between CSS and non-CSS chronic pain subjects well. A follow-up study by our group, with a similar cohort of chronic pain patients, will analyze the ability of the CSI to identify patients with a CSS, and to distinguish patients without a CSS, using the 40-point cutoff score. Nevertheless, overall, the current study provides evidence that the CSI is a valid screener for CSSs, and that a cutoff score of “40” provides a clinically-relevant guide to alert healthcare professionals of the possibility that a patient’s symptom presentation may indicate the presence of a CSS. These important clinical findings warrant future replication with a larger sample size and multiple physicians’ diagnoses.

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Table 1

Prevalence of CSSs (Diagnosed by a Physician) and CSI Scores in the CSS Patient Sample (N = 89)

Diagnosis	*N (%)	CSI M (SD)
<u>CSS (n=89, 73.6%)</u>		
Tension Headache/Migraines	47 (39%)	55.6 (13.1)
Myofascial Pain Syndrome	47 (39%)	49.6 (15.8)
Fibromyalgia	38 (31%)	57.7 (13.0)
Irritable Bowel Syndrome	18 (15%)	60.7 (13.6)
Temporomandibular Joint Disorder	14 (12%)	66.1 (12.9)
Posttraumatic Stress Disorder	14 (12%)	56.0 (14.7)
Adult onset	10 (8.3%)	52.8 (13.3)
Childhood onset	4 (3.3%)	64.0 (17.0)
Restless Leg Syndrome	10 (8%)	53.9 (12.9)
Chronic Fatigue Syndrome	5 (4%)	66.8 (15.0)
Interstitial Cystitis	5 (4%)	55.0 (17.1)
Complex Regional Pain Syndrome	3 (2%)	66.3 (11.4)
Multiple Chemical Sensitivity	1 (1%)	75 (–)

* note: 46 of these 89 patients had more than 1 CSS diagnosis

Table 2

Demographics

Variables	Patient Sample (n=121)		Non-Patient Comparison Sample (n = 129)
	CSS Patient Sample (n = 89)	Non-CSS Patient Sample (n = 32)	
CSI score – M (SD) **	52.4 (14.3)	40.9 (13.5)	30.9 (12.3)
Age in years (SD) **	44.7 (13.3)	45.6 (12.2)	20.5 (3.6)
Gender [n Female (%)] **	64 (72%)	12 (38%)	91 (77%)
Ethnicity [n (%)] **			
Caucasian	74 (83%)	28 (90%)	42 (34%)
African American	9 (10%)	2 (7%)	19 (15%)
Hispanic	5 (6%)	1 (3%)	27 (22%)
Others	1 (1%)	0 (0%)	35 (28%)
Insurance Type			
Worker's Compensation	8 (10%)	5 (13%)	N/A
Private Insurance	58 (71%)	22 (56%)	
Medicare	16 (20%)	12 (31%)	
Employment Status			N/A
Unemployed	28 (34%)	10 (27%)	
Employed	26 (32%)	16 (43%)	
Disability	24 (29%)	10 (27%)	
Retired	4 (5%)	1 (3%)	

**
significant at the $p = .05$ level

Table 3

Number of CSSs and their CSI Scores in the Total Patient Sample (N=121)

Number of CSS	N (%)	CSI scores	
		M (SD)	Range
0	32 (26%)	40.9 (13.5)	19-71
1	43 (36%)	45.1 (13.2)	14-73
2	16 (13%)	51.3 (10.4)	24-67
3	8 (7%)	57.0 (12.6)	37-72
4	14 (12%)	61.8 (12.8)	41-79
5	2 (2%)	58.5 (4.9)	55-62
6	5 (4%)	61.4 (19.4)	39-84
7	1 (0%)	75.0 (N/A)	N/A

Table 4
Correlation Among CSS Diagnoses and CSS-Relevant Diagnoses in the CSS Patient Sample.

	MPS	TH/M	F	IBS	TMD	PTSD ^C	PTSD ^A	RLS	CRPS	CFS	IC	MCS
MPS	-											
TH/M	.20*	-										
F	-.03	.45**	-									
IBS	.19*	.48**	.37**	-								
TMD	.19*	.35**	.20*	.43**	-							
PTSD ^C	-.06	.14	.07	.05	.24**	-						
PTSD ^A	-.06	-.11	-.14	-.13	.10	-						
RLS	.13	.25**	.19*	.30**	.17	-.06	.02	-				
CRPS	-.02	-.02	.01	.08	.11	-.03	.14	-.05	-			
CFS	.01	.26**	.31**	.03	.44**	.19*	-.06	.24**	-.03	-		
IC	.09	.26**	.22*	.26**	.19*	-.04	.09	.19*	-.03	-.04	-	
MCS	-.07	.12	.14	.22*	.25**	-.02	-.03	.30**	-.02	.44**	-.02	-

Note: Significant level:

MPS (Myofascial Pain Syndrome); TH/M (Tension Headaches/Migraines); F (Fibromyalgia); IBS (Irritable Bowel Syndrome); TMD (Temporomandibular joint disorder); PTSD (Post Traumatic Stress Disorder: C = childhood onset, A = adult onset); RLS (Restless Leg Syndrome); CRPS (Complex Regional Pain Syndrome); CFS (Chronic Fatigue Syndrome); IC (Interstitial Cystitis); MCS (Multiple Chemical Sensitivity).

<.001

*
<.05

Table 5

Agreement Between CSI Part B Self-Report Within the CSS Patient Sample (N = 70 [†]) and CSS Diagnosis by Physician

CSS	CSI Part B N (%)	Agreement (Kappa) *	p - value
Restless Leg Syndrome	19 (16%)	.42	.00
Chronic Fatigue Syndrome	12 (11%)	.19	.03
Fibromyalgia	35 (30%)	.70	.00
TMD	17 (15%)	.44	.00
Tension Headaches / Migraines	45 (39%)	.71	.00
Irritable Bowel Syndrome	25 (22%)	.71	.00
Multiple Chemical Sensitivities	1 (1%)	.00	.92

*Kappa value: poor 0-0.19; fair 0.20- 0.39; moderate 0.40-0.59; good .60-.79; excellent .80-1.00

[†] 19 of the 89 total CSS subjects failed to complete CSI Part B

* Kappa is a measure of agreement between two variables

Table 6

CSI cut-off scores, comparing patients diagnosed with a CSS (N=89) and non-patient comparison subjects (N=129)

Cut-off scores	Sensitivity [*]	Specificity ^a	Area under the curve ^b
39	83%	74%	.86** [81-91]
40	81%	75%	
41	80%	76%	
42	76%	78%	
43	76%	81%	
44	73%	81%	

Cut-off scores	Sensitivity [*]	Specificity ^a	Area under the curve ^b
37	87%	73%	.87** [.82-.92]
38	85%	75%	
39	83%	78%	
40	81%	79%	
41	80%	80%	
42	76%	82%	

CSI cut-off scores, comparing patients diagnosed with a CSS (N=89) and non-patient comparison subjects, excluding those who reported a CSS on CSI part B (N=105)

^aSensitivity: The proportion of actual positives which are correctly identified

^bSpecificity: The proportion of negatives which are correctly identified

^cArea under the curve: Excellent: 0.90-1.00/ Good: 0.80-0.90/ Fair: 0.70-0.80/ Poor: 0.60-0.70/ Fail: 0.50-0.60