SYSTEMIC MANUAL THERAPY FOR CENTRAL SENSITISATION ACROSS BODY REGIONS: A NARRATIVE EVIDENCE SYNTHESIS AND MAPPING OF SMT HALILI APPLICATIONS

Ramon Gambugge Bueno[1]

Abstract: Central sensitisation is a potential mechanism contributing to persistent and widespread pain across multiple clinical conditions. Systemic Manual Therapy Halili (SMT Halili) is a structured manual therapy approach organised into coded local, regional, and proposed systemic protocols. However, its evidence has not previously been synthesised across body regions or critically examined in relation to contemporary central sensitisation research. This narrative evidence synthesis and mapping review aimed to describe the clinical, conceptual, and methodological development of SMT Halili, examine patterns across its published applications, and identify priorities for future research. Twelve publications directly related to SMT Halili were mapped and considered alongside contextual literature on central sensitisation, nociplastic pain, assessment methods, and chronic pain conditions. The SMT literature included retrospective clinical studies, case reports, focused reviews, a theoretical model, and methodological publications concerning the Patient Identified Problem scale and the Halili Physical Therapy Statistical Analysis Tool. Applications were identified across low back, knee, shoulder, hip, pelvic, facial, respiratory, and post-COVID presentations. Most clinical publications reported improvement in regional complaints and broader patient-identified problems following combinations of local, regional, visceral, drainage, autonomic, and proposed desensitisation protocols. However, the predominance of retrospective designs, absence of randomised comparator groups, heterogeneity of interventions, limited long-term follow-up, and indirect assessment of central sensitisation restrict

1 Bacharel em Administração de Empresas – BBA (Administração)-2010, Medicina Ortomolecular-FACEAT - Faculdade Centro de Estudos Avançados e Tecnologia: São Paulo, São Paulo, BR -2020, Bacharelado em Fisioterapia- Unimetrocamp Wyden: Campinas, São Paulo, BR-2019. Mestrado em Estudos de Pesquisa - Universidade Torrens da Austrália: Adelaide, Austrália do Sul, AU-2026

causal interpretation. Current evidence therefore supports SMT Halili as a structured clinical and research framework with preliminary findings across several presentations, but it does not establish SMT as an effective treatment for central sensitisation. Prospective controlled studies, independent replication, predefined protocols, multidimensional sensory assessment, and standardised outcome reporting are required.

Keywords: systemic manual therapy; SMT Halili; central sensitisation; nociplastic pain; chronic pain; manual therapy; evidence mapping.

Introduction

Chronic pain may continue after the expected period of tissue healing and become a health condition in itself. It can affect physical function, sleep, emotional health, and quality of life. Current pain science describes three main pain mechanisms: nociceptive, neuropathic, and nociplastic. These mechanisms may overlap, which helps explain why patients with similar structural findings can report different levels of pain and disability (Dai et al., 2026).

Central sensitisation is one possible mechanism involved in persistent pain. It is commonly described as increased responsiveness of nociceptive neurons in the central nervous system to normal or low-intensity sensory input (Curatolo, 2024). This may contribute to pain that is stronger, more persistent, or more widespread than expected from local tissue findings. Common features include hyperalgesia, which is an increased response to a painful stimulus, and allodynia, which is pain caused by a stimulus that would not normally be painful.

Wind-up and neuroinflammation may help explain some aspects of this process. Wind-up occurs when repeated stimulation of C fibres produces increasing activity in spinal neurons. Temporal summation of pain is considered a related process in humans (Mendell, 2022). However, wind-up and central sensitisation are not the same. Wind-up develops quickly during repeated stimulation, while

central sensitisation may involve longer-lasting changes in pain processing.

Persistent nociceptive input may also activate microglia and astrocytes in the spinal cord and brain. These cells can release inflammatory mediators that increase excitatory signalling and reduce inhibitory control. This may support hyperalgesia, allodynia, and widespread pain, even after the original peripheral inflammation has reduced (Ji et al., 2018).

Nociplastic pain describes pain related to altered nociceptive processing when tissue damage or a lesion of the somatosensory system does not adequately explain the symptoms. Central sensitisation may contribute to nociplastic pain, but the terms are not synonyms. Central sensitisation is a proposed neurophysiological mechanism, while nociplastic pain is a clinical pain phenotype (Nijs et al., 2023).

Central sensitisation cannot be measured directly during routine clinical assessment. Clinicians therefore consider several findings together, such as widespread pain, increased sensory sensitivity, symptoms that appear disproportionate to tissue changes, fatigue, disturbed sleep, cognitive difficulties, and sensitivity to environmental stimuli. These findings should be interpreted with the patient's history, pain distribution, physical examination, sensory testing, and possible peripheral sources of nociceptive input (Curatolo, 2024; Nijs et al., 2023).

Sensitisation-related features have been reported in several conditions, including fibromyalgia, osteoarthritis, rheumatoid arthritis, spinal pain, headache, temporomandibular disorders, pelvic pain, and tendinopathies (Ji et al., 2018; Tomašević-Todorović & Spasojević, 2023). Their contribution may differ between conditions and between individual patients. This supports a transdiagnostic perspective that examines shared pain mechanisms instead of treating every painful body region as a completely separate problem.

Systemic Manual Therapy Halili is a manual therapy approach organised into coded protocols and treatment sequences. It has been applied across several body regions using local, regional, and proposed systemic protocols. Patient-reported outcomes have been monitored across repeated treatment visits, providing an initial evidence base for examining common patterns between different

clinical presentations.

This narrative evidence synthesis maps the published clinical and methodological applications of SMT Halili across body regions. It examines how its theoretical framework, protocol organisation, and outcome-monitoring methods relate to current knowledge of central sensitisation. It also identifies limitations in the existing evidence and priorities for future prospective research.

Methods

This study used a narrative evidence synthesis combined with evidence mapping. Its purpose was to organise the published SMT Halili literature, describe its applications across body regions, and compare its clinical and methodological characteristics with the wider literature on central sensitisation. A meta-analysis was not planned because the publications differed in design, population, intervention, comparator, and outcome measurement.

Two groups of evidence were examined. The primary group included publications directly related to the development, clinical application, or evaluation of SMT Halili. The contextual group included research on central sensitisation, nociplastic pain, clinical assessment, and chronic pain conditions represented in the SMT studies. These groups were kept separate because the contextual studies did not directly investigate SMT Halili.

The primary evidence group was developed from publications within the SMT Halili research programme. Reference lists were also examined to identify related studies on the Temporal Model for Central Sensitization (TMCS), the Patient Identified Problem (PIP) scale, and the Halili Physical Therapy Statistical Analysis Tool (HPTSAT).

The contextual literature was identified through a structured search using terms related to central sensitisation, central sensitization, nociplastic pain, and chronic pain. These terms were combined with low back pain, knee pain, osteoarthritis, shoulder pain, hip pain, pelvic pain, facial pain, trigeminal neuralgia, respiratory symptoms, and persistent symptoms after COVID-19.

Primary publications were eligible when they described the SMT Halili framework, a clinical protocol or sequence, an outcome measure, or a statistical method used to analyse SMT records. Focused reviews, retrospective studies, methodological studies, and case reports were accepted because the current SMT evidence base contains different study designs.

Contextual publications were included when they helped explain sensitisation mechanisms, assessment methods, pain phenotypes, or sensitisation-related features in a body region represented in the SMT literature. Duplicates, publications without sufficient information, and studies without a clear connection to the review question were excluded. Studies that discussed a relevant condition but did not investigate SMT were classified as contextual evidence.

Information was extracted into a structured evidence table. The main fields were authorship, publication year, condition, body region, sample size, study design, SMT protocols, outcome measures, follow-up, and main findings. Information about protocol standardisation, comparator groups, and possible factors affecting the results was also recorded when available.

The PIP scale was the main outcome measure in several SMT studies. Patients score individual problems from 1 to 10, and a global score represents their wider clinical presentation. The validation study reported high test–retest reliability, acceptable responsiveness, and an estimated minimum clinically important difference of 3.8 points for the global score (Halili, 2020). In this review, PIP results were interpreted as patient-reported clinical change, not as a direct measure of central sensitisation.

HPTSAT was treated as a methodological part of the SMT research programme. It uses coded clinical records to compare selected protocols or sequences with other treatments in the database. It examines the average rate of change across up to five measurements, described as ARC5. It also considers sample size, statistical significance, clinical change, and effect size when identifying potentially relevant protocols (Halili, 2021a). In this review, HPTSAT findings were used to identify comparative patterns and questions for future prospective studies.

No single instrument was considered a definitive clinical test for central sensitisation. The

Central Sensitization Inventory (CSI) was treated as a screening questionnaire for related symptoms. Pressure pain thresholds, monofilaments, and other sensory procedures were considered sources of information about sensory sensitivity. Their interpretation depends on the testing method, body site, and population (den Boer et al., 2021).

This cautious approach was supported by Schuttert et al. (2021), who identified considerable variation in definitions, assessment methods, and prevalence estimates for human-assumed central sensitisation in chronic low back pain. Central sensitisation was therefore described in this review as a possible or clinically inferred mechanism rather than a confirmed diagnosis.

The evidence was organised by body region and clinical presentation. Findings were compared across low back, knee, shoulder, hip, pelvic, facial, respiratory, and other chronic pain presentations. The synthesis examined outcome direction, repeated protocol families, assessment methods, follow-up periods, and the use of standardised or pragmatic treatment sequences.

The author is trained in SMT Halili protocols and is a member of the SMT Halili group. This experience helped with the interpretation of protocol terminology but may also create a risk of interpretive bias. To improve transparency, SMT studies were separated from contextual evidence, consistent extraction fields were used, and limitations were reported. The author reports no financial relationship with SMT Halili or its associated institutions.

TMCS and the SMT Halili Framework

The Temporal Model for Central Sensitisation (TMCS) was developed as a hypothesis to explain how normal responses to stress and sensory input may progress towards persistent central sensitisation. It also provides the theoretical basis for organising and selecting SMT Halili protocols. Instead of describing sensitisation as a single event, the model proposes that it may develop over time through repeated stressful, inflammatory, visceral, or metabolic input (Halili, 2022).

The locus coeruleus–noradrenaline system has an important role in the TMCS. This system

is connected with the brain, spinal cord, autonomic nervous system, and peripheral organs. It is involved in attention, sleep, memory, visceral function, immune regulation, stress responses, and pain modulation. The model proposes that persistent changes in this system may help connect some of the symptoms experienced by patients with chronic pain.

Locus coeruleus activity can be phasic or tonic. Phasic activity supports selective responses to relevant information, while tonic activity increases alertness and prepares the body to respond to new or threatening stimuli. Both are part of normal function. According to the TMCS, difficulties may develop when tonic activity continues after the original stimulus has reduced or disappeared.

The model describes five stages: phasic activation, response to salient stimuli, threat encoding, central sensitisation, and possible neural degeneration. The first three stages mainly represent adaptive responses. The fourth stage involves persistent tonic activation and neurological loops that may maintain sensitisation. The fifth proposes a possible relationship between long-term sensitisation and neural degeneration in susceptible individuals (Halili, 2022). This final stage remains theoretical and requires further investigation.

Progression through these stages may depend on the intensity, repetition, and duration of the input, as well as the patient's ability to recover. Anxiety, disturbed sleep, immune activation, oxidative stress, and digestive or urinary dysfunction are proposed as possible sources of continued internal input. These relationships are theoretical and should be tested through prospective research.

SMT Halili translates the TMCS into coded and organised manual therapy protocols. The system includes techniques from fascial counterstrain, visceral mobilisation, integrative manual therapy, muscle energy techniques, and other manual approaches. Approximately 50 protocols have been described and may be combined into short, medium, or long treatment sequences (Halili, 2022; Halili & Mischler, 2026).

Protocols are grouped according to their proposed clinical purpose. These groups include desensitisation, upper- and lower-limb decongestion, head drainage, spinal treatment, and protocols related to respiratory, visceral, cranial, circulatory, or autonomic presentations. Barral, GUOU, and

LAUG are associated with the possible reduction of persistent visceral input. UD and DCS are linked to proposed decongestive or autonomic effects, while CCCV is connected with cardiorespiratory circulation and the possible reduction of metabolic or oxidative stress (Halili, 2022). These proposed functions have not yet been confirmed and provide hypotheses for future testing.

SMT may be delivered through a standardised sequence or through pragmatic clinical selection. In the pragmatic approach, the clinician selects protocols according to the patient's reported problems, examination findings, and response to treatment. A standardised sequence follows a more consistent order and may therefore be easier to reproduce in research.

A retrospective study compared a standardised desensitisation sequence with pragmatic treatment selection. Both approaches produced clinically relevant improvement, with no significant difference in their rates of change (Halili & Mischler, 2026). These findings suggest that a standardised sequence may be practical for future controlled studies, but they do not establish equivalence or treatment effectiveness.

TMCS, SMT protocols, PIP, and HPTSAT form a connected research framework. TMCS provides the theoretical hypothesis, SMT converts it into coded treatment sequences, PIP records patient-reported change, and HPTSAT examines patterns in clinical records. This structure provides a basis for future prospective studies, independent replication, and direct testing of the proposed mechanisms.

Characteristics of the Included Studies

The primary evidence map included 12 publications directly related to SMT Halili. These consisted of clinical, conceptual, and methodological studies. Seven retrospective studies examined knee, low back, shoulder, hip, pelvic, facial, and respiratory presentations. The evidence also included one post-COVID case report, one retrospective comparison between standardised and pragmatic treatment, the TMCS theoretical model, and methodological publications about PIP and HPTSAT.

Sample sizes ranged from one patient in the post-COVID case report to 1,053 patients in the low back pain study. Most clinical studies used a similar structure: patients reported their main problems through the PIP scale, treatments were recorded using coded SMT protocols, and HPTSAT was used to examine patterns of change across repeated visits.

The studies included protocols directed towards the symptomatic region and others classified as regional, visceral, drainage, autonomic, decongestive, or desensitisation protocols. UD, DCS, CCCV, Barral, and LAUG appeared in several clinical applications.

Most studies reported improvement in the regional complaint and global PIP score. However, these findings came mainly from retrospective clinical records without random allocation or independent comparison groups. They should therefore be interpreted as preliminary clinical patterns rather than evidence of treatment effectiveness.

Table 1 presents the design, sample, protocols, outcomes, and main findings of each publication.

Table 1 - Characteristics of publications related to SMT Halili

Study	Condition and design	Sample and follow-up	Main protocol families	Outcomes	Main findings
Halili (2024b)	Knee pain; retrospective cohort analysis	467 patients; approximately 24 visits per episode	Knee-directed, regional, visceral, decongestive, and desensitisation protocols	PIP; HPTSAT/ ARC5	Knee pain improved by 1.28 points and global PIP by 8.20 points; 35 combinations met HPTSAT criteria.
Aponte and Halili (2025)	Chronic low back pain; retrospective cohort analysis	1,053 patients; multiple visits across episodes of care	Local, regional, visceral, decongestive, and desensitisation protocols	PIP; HPTSAT/ ARC5	Overall improvement was reported by 68%, and 53% improved in the specific low back complaint; 43 combinations met HPTSAT criteria.
Sato and Halili (2025)	Shoulder pain; retrospective cohort analysis	734 patients; 993 episodes; mean 15 visits over 159 days	Shoulder, spinal, drainage, and desensitisation protocols	PIP; HPTSAT/ ARC5	Shoulder pain improved in 58% and global outcomes in 70%; 41 combinations met HPTSAT criteria.
Halili (2025b)	Hip pain; retrospective comparative analysis	449 patients; 556 episodes	Joint-mechanical, decongestive, and desensitisation protocols	PIP; HPTSAT/ ARC5	Hip pain improved in approximately 63% of SMT episodes and global outcomes in 73.2%.
Halili (2026)	Nonspecific pelvic pain; retrospective cohort analysis	310 patients; multiple visits across episodes	Pelvic, mechanical, visceral, drainage, and desensitisation protocols	PIP; HPTSAT/ ARC5	Pelvic pain improved in 63% and global outcomes in 72%; 18 combinations met HPTSAT criteria.
Halili (2025a)	Facial and jaw pain associated with trigeminal neuralgia; retrospective cohort analysis	85 patients; 105 episodes; mean 18 visits over 180 days	Trigeminal-related, cranial, visceral, autonomic, and desensitisation protocols	PIP; HPTSAT/ ARC5	Facial symptoms improved in 66% and global outcomes in 76%; 13 combinations met HPTSAT criteria.
Halili (2021b)	Respiratory and thoracic presentations; retrospective cohort analysis	178 patients; repeated measurements across episodes	Respiratory, thoracic, visceral, cranial, autonomic, and decongestive protocols	PIP; HPTSAT/ ARC5	Six combinations met the criteria for respiratory outcomes and three for global improvement; CVVT appeared most frequently.
Halili (2024a)	Persistent symptoms after COVID-19-related intensive care; case report	One patient; 35 visits	Respiratory, visceral, cardiovascular, cranial, spinal, drainage, and desensitisation protocols	PIP; QuickDASH	Global PIP decreased from 52 to 11 and QuickDASH from 68 to 16.

ISSN: 2763-5724 / Vol. 06 - n 04 - ano 2026

Halili and Mischler (2026)	Central sensitisation; retrospective standardised-versus-pragmatic comparison	347 patients; outcomes examined across up to 18 visits	Standardised desensitisation sequence compared with pragmatic selection	PIP; CDSS/rate of change	Both approaches produced clinically relevant improvement, with no significant difference in their rates of change.
Halili (2022)	Focused review and theoretical model	Not applicable	Proposed TMCS desensitisation family	Conceptual synthesis	Proposed five temporal stages and a systemic framework for organising and testing SMT protocols.
Halili (2021a)	Methodological study of clinical records	Retrospective database; up to five measurements	Coded protocols and sequences	HPTSAT; ARC5; statistical and clinical criteria	Described a system for comparing protocol-related trajectories of clinical change.
Halili (2020)	PIP measurement-property study	1,466 patients; 18,747 visits	Not applicable	PIP compared with regional measures	PIP showed an ICC of .96, AUC of .78, specificity of 91.46%, sensitivity of 64.45%, and MCID of 3.8 points.

Note. Unless otherwise stated, the retrospective clinical studies used the PIP scale for outcome monitoring and HPTSAT/ARC5 for analysis. ARC5 = average rate of change across up to five measurements; CDSS = clinical decision support system; HPTSAT = Halili Physical Therapy Statistical Analysis Tool; ICC = intraclass correlation coefficient; MCID = minimum clinically important difference; PIP = Patient Identified Problem; QuickDASH = shortened Disabilities of the Arm, Shoulder and Hand questionnaire; SMT = Systemic Manual Therapy; TMCS = Temporal Model for Central Sensitisation.

ISSN: 2763-5724 / Vol. 06 - n 04 - ano 2026

Evidence Across Body Regions

Central sensitisation-related features have been studied across several pain conditions and body regions. Although these conditions are different, some patients show common features such as widespread sensitivity, reduced pain inhibition, fatigue, sleep disturbance, and pain that appears greater than expected from structural findings. SMT Halili follows a transdiagnostic approach by combining protocols directed towards the symptomatic region with protocols proposed to address wider clinical factors.

Chronic low back pain

Chronic low back pain has the largest contextual evidence base included in this review. Schuttert et al. (2021) identified 34 studies that used different definitions and methods to assess human-assumed central sensitisation. No accepted reference standard was found, supporting the use of combined clinical assessment instead of one measurement alone.

Some patients with chronic low back pain show lower pressure pain thresholds, reduced conditioned pain modulation, psychological distress, and higher CSI scores (Aoyagi et al., 2020; Akeda et al., 2021). Sensory profiles and dynamic testing may also help identify subgroups and describe symptom severity (de la Coba et al., 2026; Gräper et al., 2024). These findings suggest that chronic low back pain may involve interactions between biological, sensory, and psychological factors (Opara et al., 2025).

The SMT study included 1,053 patients. Improvement was reported by 53% for the specific low back complaint and by 68% for the global presentation. Forty-three protocol combinations met HPTSAT criteria (Aponte & Halili, 2025). These combinations included local, regional, visceral, circulatory, cranial, and desensitisation protocols. This pattern is consistent with the systemic structure of SMT, but controlled studies are required to determine treatment effects.

Exercise provides a useful comparator for future research. High-intensity training has been associated with reduced CSI scores in chronic nonspecific low back pain, particularly among participants with higher baseline scores (Verbrugghe et al., 2023). Future studies could compare SMT, exercise, and combined care.

Knee pain and osteoarthritis

Knee osteoarthritis can involve joint degeneration, inflammation, mechanical stress, and changes in pain processing. Structural changes do not always match the severity of pain. Persistent peripheral input may increase spinal excitability and contribute to central sensitisation (Ohashi et al., 2023).

Higher CSI scores have been associated with greater pain, disability, and psychological distress. Lower pressure pain thresholds have also been found at the knee and at distant sites, suggesting that sensitivity may extend beyond the affected joint (Dahmani et al., 2023; Kılıçaslan et al., 2022). Neuroimaging and PainDETECT findings further suggest that different pain profiles may influence outcomes after knee arthroplasty (Soni et al., 2019).

The SMT knee study included 467 patients. Knee pain improved by an average of 1.28 points, while global PIP improved by 8.20 points. Thirty-five combinations met HPTSAT criteria (Halili, 2024b). They included knee-directed, lower-limb, peripheral nerve, periosteal, visceral, and desensitisation protocols. The use of protocols outside the knee supports investigation of the systemic treatment hypothesis but does not confirm the proposed mechanisms.

Shoulder pain

Shoulder pain may involve local tissues, joint changes, cervical structures, neural structures, and altered pain processing. In patients with shoulder pain, the CSI and Pain Sensitivity Questionnaire

were associated with some aspects of widespread pain sensitivity. However, these questionnaires measure different dimensions from controlled sensory testing (Coronado & George, 2018).

Sato and Halili (2025) examined 734 patients and 993 episodes of care. Shoulder pain improved in 58% of patients, while global improvement was reported by 70%. The 41 combinations that met HPTSAT criteria included upper-extremity, spinal, thoracic, drainage, and desensitisation protocols. This shows that favourable combinations were not limited to the symptomatic shoulder. Prospective comparison of local, systemic, and combined sequences is needed.

Hip pain

Hip pain may involve osteoarthritis, soft-tissue conditions, referred pain, joint mechanics, and sensitisation. Osteoarthritis research suggests that inflammatory mediators and continuing nociceptive input may connect peripheral and central pain processes (Ohashi et al., 2023). Widespread sensitivity, fatigue, sleep problems, and pain disproportionate to structural findings may also be present in some musculoskeletal conditions (Hladkykh et al., 2026; Tomašević-Todorović & Spasojević, 2023).

The SMT hip study examined 449 patients and 556 episodes. Hip pain improved in approximately 63% of episodes, while global improvement was reported in 73.2%. Thirteen favourable protocols were classified as joint-mechanical, decongestive, or desensitisation approaches (Halili, 2025b).

Evidence specifically connecting central sensitisation with hip pain was limited in this review. Future studies should use hip-specific functional outcomes with PIP, CSI, and local and remote sensory testing.

Pelvic pain

Pelvic pain may involve reproductive, urinary, gastrointestinal, musculoskeletal, vascular,

neural, or pelvic-floor factors. Endometriosis research shows how continuing local input may contribute to peripheral sensitisation and wider pain processing. Cross-sensitisation may also occur because sensory input from pelvic organs and musculoskeletal structures can converge within related spinal regions (Zheng et al., 2019).

The SMT pelvic study included 310 patients. Improvement was reported by 63% for pelvic pain and 72% for the global presentation. Eighteen combinations met HPTSAT criteria (Halili, 2026). They included pelvic, mechanical, neural, drainage, visceral, and desensitisation protocols. DCS and CCCV were of particular interest because they were applied away from the pelvis.

The broad category of nonspecific pelvic pain may include clinically different groups. Future research should classify participants more clearly, including pelvic-floor, bladder-related, bowel-related, and endometriosis-associated presentations.

Facial pain and trigeminal neuralgia

Facial pain and trigeminal neuralgia may involve peripheral nerves, vascular structures, brainstem pathways, and central pain processing. Possible mechanisms include increased excitatory signalling, reduced inhibition, and neuroinflammatory activity (Curatolo, 2024; Ji et al., 2018). Clinical assessment may also consider allodynia, pain distribution, sleep, fatigue, emotional health, and overlapping symptoms (Williams, 2018).

The SMT facial pain study included 85 patients and 105 episodes of care. Facial symptoms improved in 66%, while global improvement was reported in 76%. Thirteen combinations met HPTSAT criteria (Halili, 2025a). These included cranial, trigeminal-related, visceral, autonomic, and desensitisation protocols. Some protocols had a possible regional relationship with the trigeminal system, while others were anatomically distant. These preliminary patterns require comparison with usual medical management and other rehabilitation approaches.

Respiratory and post-COVID presentations

Respiratory and post-COVID studies extend SMT beyond common musculoskeletal presentations. In a retrospective study of 178 patients, respiratory protocols were grouped into decongestive, mechanical, neurogenic, and immunoregulatory categories. Six combinations met HPTSAT criteria for respiratory outcomes and three for global improvement. CVVT appeared most often, followed by UD, CCCV, VTCP, and DCS (Halili, 2021b).

A post-COVID case report described one patient treated over 35 visits after a prolonged intensive care admission. Global PIP decreased from 52 to 11, and QuickDASH decreased from 68 to 16 (Halili, 2024a). The treatment included respiratory, cardiovascular, visceral, cranial, spinal, drainage, and desensitisation protocols.

Central sensitisation has been proposed as one possible contributor to persistent post-COVID pain, fatigue, sleep difficulties, and cognitive symptoms (Goudman et al., 2021). However, conclusions cannot be drawn from one case. Larger studies should include respiratory, functional, neurological, and autonomic outcomes.

Wider transdiagnostic context

Sensitisation-related features have also been reported in fibromyalgia, complex regional pain syndrome, spinal cord injury, and rheumatoid arthritis. Proposed mechanisms include altered descending pain modulation, neuroimmune activity, continuing peripheral input, sympathetic dysfunction, and changes in excitatory and inhibitory signalling (Cao et al., 2020; Martínez-Lavín, 2022; Hladkykh et al., 2026).

Research has also examined widespread sensory changes, temporal summation, body awareness, and differences in sensitisation responses between women and men (Colgan et al., 2022; De Schoenmacker et al., 2023; Guekos et al., 2024; Lütolf et al., 2023). These findings show that pain

processing can be influenced by several interacting factors.

The contextual studies did not investigate SMT Halili directly. They show that sensitisation-related features may occur across different diagnoses and body regions. This provides a reason to investigate SMT as a transdiagnostic framework, but it does not provide evidence for its effectiveness or confirm its proposed mechanisms.

Cross-Study Synthesis

Most SMT Halili studies used the same basic structure: retrospective clinical records, coded treatment protocols, repeated PIP scores, and HPTSAT analysis. This consistency allows patterns to be compared across body regions. However, it also means that similar limitations are repeated across the evidence base.

Table 2 - Relationship between SMT Halili applications and contextual evidence

Region or condition	SMT Halili study	Main SMT evidence	Contextual evidence
Chronic low back pain	Aponte and Halili (2025)	Local, regional, visceral, decongestive, and desensitisation protocols	Definitions, assessment methods, sensory profiles, psychological factors, and exercise
Knee pain and osteoarthritis	Halili (2024b)	Knee-directed, lower-limb, peripheral nerve, periosteal, visceral, and desensitisation protocols	Pain, disability, psychological distress, pressure pain thresholds, CSI, PainDETECT, neuroimaging, and osteoarthritis mechanisms
Shoulder and upper quadrant	Sato and Halili (2025)	Shoulder, upper-extremity, spinal, thoracic, drainage, and desensitisation protocols	CSI, questionnaire validity, and widespread pain sensitivity
Hip pain	Halili (2025b)	Joint-mechanical, decongestive, and desensitisation protocols	Nociplastic pain, osteoarthritis mechanisms, peripheral input, and wider musculoskeletal sensitisation-related features
Pelvic pain	Halili (2026)	Pelvic, mechanical, neural, visceral, drainage, and desensitisation protocols	Peripheral sensitisation, central sensitisation, visceral pain, and cross-sensitisation

Facial pain and trigeminal neuralgia	Halili (2025a)	Trigeminal-related, cranial, visceral, autonomic, and desensitisation protocols	Central sensitisation, neuroinflammation, pain phenotyping, allodynia, and wider chronic pain features
Respiratory and post-COVID presentations	Halili (2021b, 2024a)	Respiratory analysis and one post-COVID case report involving respiratory, cardiovascular, visceral, cranial, spinal, drainage, and desensitisation protocols	Central sensitisation as a possible contributor to persistent post-COVID pain, fatigue, sleep difficulties, cognitive symptoms, and reduced function
General SMT framework	Halili (2020, 2021a, 2022); Halili and Mischler (2026)	TMCS, coded SMT protocols, PIP, HPTSAT, and standardised and pragmatic treatment sequences	Pain mechanisms, terminology, clinical features, central sensitisation assessment, nociplastic pain, and transdiagnostic clinical phenotyping

Note. CSI = Central Sensitization Inventory; HPTSAT = Halili Physical Therapy Statistical Analysis Tool; PIP = Patient Identified Problem scale; SMT = Systemic Manual Therapy; TMCS = Temporal Model for Central Sensitisation. Contextual evidence describes related pain mechanisms and assessment methods but does not directly test SMT Halili.

Regional and global outcomes generally improved across the SMT studies. Specific improvement was reported by 53% of patients with low back pain, 58% with shoulder pain, approximately 63% with hip or pelvic pain, and 66% with facial pain. Global improvement ranged from 68% in low back pain to 76% in facial pain. The knee study used a different format and reported average changes of 1.28 points for knee pain and 8.20 points for global PIP.

These results cannot be directly compared as treatment effects because the studies differed in population, follow-up, treatment combinations, and outcome reporting. The lack of randomised control groups also means that improvement cannot be attributed only to SMT.

A clearer cross-study pattern was the repeated use of both local and non-local protocols. UD, DCS, CCCV, Barral, and LAUG appeared across several body regions. GUOU was present in some applications, while VTCP and CVVT appeared more often in facial, thoracic, respiratory, and cardiovascular presentations.

Within the TMCS, these protocols have different proposed purposes. Barral, LAUG, and GUOU are linked to the possible reduction of persistent visceral input. UD and DCS are associated with decongestive or autonomic purposes. CCCV is connected with cardiorespiratory circulation and the possible reduction of metabolic or oxidative stress (Halili, 2022). These explanations remain theoretical and should not be interpreted as confirmed physiological effects.

The anatomical relationship between a protocol and the main complaint also changed between conditions. For example, LAUG and Barral may have a regional relationship with pelvic pain but are distant from the shoulder. DCS and CCCV may have regional relevance in facial presentations but are distant from the knee and pelvis. At the same time, local and regional protocols directed towards peripheral nerves, joints, drainage, the spine, thorax, and extremities were also common.

This suggests that SMT is not organised as a choice between local and systemic treatment. Instead, favourable combinations often included protocols with different proposed targets. In the shoulder study, for example, local, spinal, drainage, and desensitisation protocols appeared together (Sato & Halili, 2025). This combined pattern is one of the main findings of the evidence map, but it requires prospective testing.

The comparison between standardised and pragmatic treatment is also relevant. In pragmatic care, clinicians selected protocols according to the patient's problems, examination findings, and response. The standardised group received a consistent desensitisation sequence. Both groups showed clinically relevant improvement, with no significant difference in their rates of change (Halili & Mischler, 2026). This suggests that a standardised sequence may be suitable for future trials, although the retrospective design does not confirm that the approaches are equivalent.

The studies used different tools to describe clinical change and pain processing. PIP records patient-identified problems and produces a global score. CSI screens for symptoms associated with central sensitivity syndromes. Quantitative sensory testing examines responses such as hyperalgesia, temporal summation, and conditioned pain modulation. Pressure pain thresholds can be measured at local and remote sites, while PainDETECT identifies neuropathic-like features.

These tools provide different types of information and should not be treated as interchangeable. A practical assessment model for future studies could combine clinical history, pain distribution, PIP, CSI, a condition-specific functional measure, and selected sensory tests when possible (den Boer et al., 2021; Schuttert et al., 2021).

Overall, the SMT literature shows a repeated pattern of combining local, regional, and non-local protocols across different clinical presentations. This is consistent with the transdiagnostic structure of the TMCS. However, the current evidence supports the SMT framework as a testable research model, not as confirmed treatment for central sensitisation.

Methodological Considerations and Future Development

The SMT Halili literature represents a developing clinical research programme across several body regions. Most studies used retrospective records collected during routine clinical care. This approach made it possible to examine large samples, repeated measurements, and real-world treatment patterns. It has provided an important first step in identifying protocols and combinations that may be suitable for more focused investigation.

As expected in retrospective clinical research, treatment selection was guided by the patient's reported problems, examination findings, previous responses, and clinical judgement. This reflects the pragmatic nature of SMT practice. Future prospective studies could build on these findings by using predefined treatment sequences and more comparable participant groups.

Blinding in manual therapy research can be difficult because clinicians and patients normally know when treatment is being delivered. However, future studies may strengthen the research process through concealed allocation, blinded outcome assessment, and independent statistical analysis when practical.

SMT protocols are often used in combinations during an episode of care. This reflects the systemic and individualised structure of the approach, but it can make the contribution of each

protocol difficult to examine separately. HPTSAT provides a structured method for exploring repeated measurements and identifying promising clinical patterns. These patterns can now guide prospective studies using predefined sequences.

The PIP scale is another strength of the SMT research programme. It allows several patient-identified problems to be monitored and produces a global score for the wider clinical presentation. The scale has shown excellent test–retest reliability and acceptable responsiveness (Halili, 2020). Because PIP measures patient-reported clinical change rather than central sensitisation directly, future studies could combine it with a predefined primary outcome and a condition-specific functional measure.

The assessment of central sensitisation remains challenging across pain research. Direct measurement of central nociceptive neuronal responsiveness is not normally available in clinical settings. Researchers therefore use combinations of pain distribution, questionnaires, pressure pain thresholds, temporal summation, conditioned pain modulation, and neuroimaging. Definitions and assessment methods continue to vary between studies (Schuttert et al., 2021).

The CSI, pressure pain thresholds, and monofilaments have been suggested as practical clinical tools (den Boer et al., 2021). These measures provide different types of information and may be most useful when interpreted together with the patient's history and physical examination. Future SMT studies could use this combined approach to describe participant profiles more clearly.

Clinical factors such as sleep, psychological health, medication use, physical activity, previous surgery, symptom duration, sex, and comorbidities may also influence symptoms and treatment response (Guekos et al., 2024; Opara et al., 2025). Including these factors may help researchers understand which patients are more likely to respond to different protocol sequences.

The TMCS also offers several testable questions for future research. Studies may examine whether clinical improvement is accompanied by changes in sensory responses, autonomic function, pain modulation, inflammatory markers, or other physiological measures. These investigations could help clarify the relationship between the proposed model and observed clinical outcomes.

Most SMT publications have been developed within the same research programme. This has

created consistency in terminology, protocol coding, outcome monitoring, and statistical analysis. The next stage may include collaboration with other clinics and independent research groups to examine whether similar patterns are found in different populations and healthcare settings.

Overall, the existing literature provides a structured foundation for continued research. Prospective designs, clearer participant profiles, predefined protocol sequences, active comparators, independent assessment, and longer follow-up may help extend the current findings and support a wider scientific evaluation of SMT Halili.

Implications for Research and Clinical Practice

The current SMT Halili literature provides a structured starting point for future research. TMCS offers testable hypotheses, SMT protocols provide an organised intervention system, PIP records patient-identified change, and HPTSAT identifies patterns within clinical records. The next stage may include prospective studies planned before participant recruitment.

Future studies should clearly describe eligibility criteria, participant characteristics, symptom duration, protocol codes, treatment order, session frequency, clinician training, outcome timing, adverse events, and follow-up. Registering the research protocol and defining the primary outcome, comparator, sample size, and analysis in advance would improve transparency and reproducibility.

SMT protocols also need clear descriptions for wider and international use. A protocol code alone may not provide enough information for another researcher or clinician to reproduce the intervention. Studies could describe the body regions addressed, treatment sequence, patient position, approximate duration, progression criteria, and permitted variations. It would also be helpful to separate the physical content of each protocol from its proposed purpose and mechanism (Halili, 2022).

Central sensitisation assessment should use more than one source of information. A practical model could combine clinical history, pain distribution, the CSI, and selected sensory tests. Local and

remote pressure pain thresholds, temporal summation, monofilaments, or conditioned pain modulation could be added when practical (den Boer et al., 2021; Schuttert et al., 2021).

A common outcome set would make comparisons between body regions easier. PIP may remain useful because it records the main complaint and wider patient presentation (Halili, 2020). It could be combined with pain intensity, a condition-specific functional measure, CSI, sleep, fatigue, psychological distress, medication use, patient global impression of change, and short- and long-term follow-up.

Both standardised and pragmatic treatment models may have value. Standardisation supports reproducibility, while pragmatic selection reflects routine clinical reasoning. A semi-standardised model may provide a useful balance: all participants could receive a core sequence, with additional protocols selected through predefined clinical criteria.

An important next step may be an independently conducted randomised trial. Chronic low back pain or knee osteoarthritis could be suitable initial conditions because established functional measures and sensitisation assessment methods are available. A standardised SMT sequence could be compared with usual care, exercise-based rehabilitation, or another credible intervention. Random allocation, concealed allocation, blinded outcome assessment, and follow-up beyond the treatment period would strengthen the study.

SMT may also be examined as part of multimodal care. Exercise, education, sleep management, psychological support, and body-awareness strategies may address different parts of chronic pain. Exercise has been associated with reduced CSI scores in chronic low back pain, while adaptive body awareness has been associated with fewer sensitisation-related symptoms (Colgan et al., 2022; Verbrugghe et al., 2023).

For clinical practice, SMT Halili can be described as a structured manual therapy approach with preliminary evidence across several clinical presentations. Current findings may support careful clinical use and further investigation, but they do not yet establish SMT as a confirmed treatment for central sensitisation.

Conclusion

This narrative evidence synthesis mapped the clinical, conceptual, and methodological development of SMT Halili across different body regions. The studies showed a repeated pattern of combining local, regional, visceral, drainage, autonomic, and proposed desensitisation protocols. Improvement was reported in regional complaints and wider patient-identified problems, although most evidence came from retrospective clinical records.

The main contribution of SMT Halili is its connected research structure. TMCS provides a theoretical model, coded SMT protocols organise treatment, PIP records patient-reported change, and HPTSAT identifies patterns across repeated clinical data. Together, these components provide a foundation for more focused research.

The current evidence does not confirm that SMT treats central sensitisation or that its proposed physiological mechanisms are correct. However, it identifies consistent clinical patterns and clear questions for prospective testing. Future collaboration, independent replication, standardised reporting, and controlled trials may help determine the clinical value and mechanisms of SMT Halili across different pain presentations.

References

Akeda, K., Takegami, N., Yamada, J., Fujiwara, T., Nishimura, A., & Sudo, A. (2021). Central sensitization in chronic low back pain: A population-based study of a Japanese mountain village. Journal of Pain Research, 14, 1271–1280. https://doi.org/10.2147/JPR.S301924

Aoyagi, K., He, J., Nicol, A. L., Clauw, D. J., Kluding, P. M., Jernigan, S., & Sharma, N. K. (2020). A subgroup of chronic low back pain patients with central sensitization. The Clinical Journal of Pain, 36(11), 869–879. https://doi.org/10.1097/AJP.0000000000000755

Aponte, A., & Halili, A. (2025). Treatment for the central sensitization component of lower back pain using systemic manual therapy. Journal of Bodywork and Movement Therapies, 42, 500–505. https://doi.org/10.1016/j.jbmt.2025.01.016

Cao, Y., Fan, D., & Yin, Y. (2020). Pain mechanism in rheumatoid arthritis: From cytokines to central sensitization. Mediators of Inflammation, 2020, Article 2076328. https://doi.org/10.1155/2020/2076328

Colgan, D. D., Eddy, A., Green, K., & Oken, B. S. (2022). Adaptive body awareness predicts fewer central sensitization-related symptoms and explains the relationship between central sensitization-related symptoms and pain intensity: A cross-sectional study among individuals with chronic pain. Pain Practice, 22(2), 222–232. https://doi.org/10.1111/papr.13083

Coronado, R. A., & George, S. Z. (2018). The Central Sensitization Inventory and Pain Sensitivity Questionnaire: An exploration of construct validity and associations with widespread pain sensitivity among individuals with shoulder pain. Musculoskeletal Science and Practice, 36, 61–67. https://doi.org/10.1016/j.msksp.2018.04.009

Curatolo, M. (2024). Central sensitization and pain: Pathophysiologic and clinical insights. Current Neuropharmacology, 22(1), 15–22. https://doi.org/10.2174/1570159X20666221012112725

Dahmani, D., Taik, F. Z., Berrichi, I., Fourtassi, M., & Abourazzak, F. E. (2023). Impact of central sensitization on pain, disability and psychological distress in patients with knee osteoarthritis and chronic low back pain. BMC Musculoskeletal Disorders, 24, Article 974. https://doi.org/10.1186/s12891-023-07019-z

Dai, X., Wang, C., Jiang, P., & Mei, X. (2026). Unraveling chronic pain: From mechanisms and risks to diagnosis and treatment. MedComm, 7(4), Article e70685. https://doi.org/10.1002/mco2.70685

de la Coba, P., Garcia-Hernandez, A., Aranda-Villalobos, P., Andrade-Ortega, J. A., & Reyes del Paso, G. A. (2026). Assessment of central pain sensitization in chronic low back pain and its utility in diagnosis and prediction of clinical severity. Scientific Reports, 16, Article 33514. https://doi.org/10.1038/s41598-025-33514-5

De Schoenmacker, I., Goudman, L., Moens, M., Putman, K., Buyl, R., & Nijs, J. (2023). Central sensitization in complex regional pain syndrome patients with widespread pain: A cross-sectional

study. Pain Medicine, 24(8), 974–984. https://doi.org/10.1093/pm/pnad040

den Boer, C., Terluin, B., van der Wouden, J. C., Blankenstein, A. H., & van der Horst, H. E. (2021). Tests for central sensitization in general practice: A Delphi study. BMC Family Practice, 22, Article 194. https://doi.org/10.1186/s12875-021-01539-0

Goudman, L., De Smedt, A., Noppen, M., & Moens, M. (2021). Is central sensitisation the missing link of persisting symptoms after COVID-19 infection? Journal of Clinical Medicine, 10(23), Article 5594. https://doi.org/10.3390/jcm10235594

Gräper, P. J., Scafoglieri, A., Clark, J. R., & Hallegraeff, J. M. (2024). Sensory profiles predict symptoms of central sensitization in low back pain: A predictive model research study. Journal of Clinical Medicine, 13(16), Article 4677. https://doi.org/10.3390/jcm13164677

Guekos, A., Larsen, D. B., Vase, L., & Petersen, K. K. (2024). Healthy women show more experimentally induced central sensitization compared with men. Pain, 165(6), 1413–1424. https://doi.org/10.1097/j.pain.0000000000003144

Halili, A. (2020). Patient Identified Problem (PIP) scale: Validity, reliability, responsiveness, likelihood ratio, and minimal clinically important difference. Physical Therapy and Rehabilitation, 7(1), Article 4. https://doi.org/10.7243/2055-2386-7-4

Halili, A. (2021a). Control of internal validity threats in a modified adaptive platform design using Halili Physical Therapy Statistical Analysis Tool (HPTSAT). MethodsX, 8, Article 101232. https://doi.org/10.1016/j.mex.2021.101232

Halili, A. (2021b). Physical therapy for the treatment of respiratory issues using Systemic Manual Therapy protocols. Journal of Bodywork and Movement Therapies, 27, 113–126. https://doi.org/10.1016/j.jbmt.2021.02.009

Halili, A. (2022). Temporal model for central sensitization: A hypothesis for mechanism and treatment using systemic manual therapy, a focused review. MethodsX, 10, Article 101942. https://doi.org/10.1016/j.mex.2022.101942

Halili, A. (2024a). Systemic manual therapy to treat long-term residuals following COVID-19-related

ICU stay: A case report. Journal of Bodywork and Movement Therapies, 37, 131–135. https://doi.org/10.1016/j.jbmt.2023.11.031

Halili, A. (2024b). Treatment for the central sensitization component of knee pain using systemic manual therapy. Douleurs: Évaluation–Diagnostic–Traitement, 25(2), 72–80. https://doi.org/10.1016/j.douler.2024.01.002

Halili, A. (2025a). Physical therapy treatment for facial and jaw pain associated with trigeminal neuralgia using Systemic Manual Therapy (SMT). Advances in Integrative Medicine, 12(2), Article 100449. https://doi.org/10.1016/j.aimed.2024.12.009

Halili, A. (2025b). Systemic manual therapy is better than exercises for hip pain: Does it really matter? Journal of Bodywork and Movement Therapies, 42, 1052–1056. https://doi.org/10.1016/j.jbmt.2025.03.014

Halili, A. (2026). Treatment of pelvic pain using systemic manual therapy. Journal of Physical Medicine and Rehabilitation, 8(1), 25–30.

Halili, A., & Mischler, J. (2026). A retrospective CDSS analysis to compare standardized and non-standardized treatment for central sensitization using systemic manual therapy. Journal of Physical Medicine and Rehabilitation, 8(1), 94–102.

Hladkykh, F., Liadova, T., Matvieienko, M., Komorovsky, R., Smiyan, S., & Student, V. (2026). Central sensitization and nociplastic pain: Shared mechanisms in fibromyalgia, osteoarthritis, and inflammatory arthritis. Journal of Pain Research, 19, 1–36. https://doi.org/10.2147/JPR.S571311

Ji, R.-R., Nackley, A., Huh, Y., Terrando, N., & Maixner, W. (2018). Neuroinflammation and central sensitization in chronic and widespread pain. Anesthesiology, 129(2), 343–366. https://doi.org/10.1097/ALN.0000000000002130

Kılıçaslan, H. Ö., Genç, A., & Tuncer, S. (2022). Central sensitization in osteoarthritic knee pain: A cross-sectional study. Turkish Journal of Physical Medicine and Rehabilitation, 69(1), 89–96. https://doi.org/10.5606/tftrd.2023.10470

Lütolf, R., Rosner, J., Curt, A., & Hubli, M. (2023). Indication of central sensitization in chronic

neuropathic pain after spinal cord injury. European Journal of Pain, 27(5), 613–626. https://doi.org/10.1002/ejp.2028

Martínez-Lavín, M. (2022). Centralized nociplastic pain causing fibromyalgia: An emperor with no clothes? Clinical Rheumatology, 41(12), 3915–3917. https://doi.org/10.1007/s10067-022-06407-5

Mendell, L. M. (2022). The path to discovery of windup and central sensitization. Frontiers in Pain Research, 3, Article 833104. https://doi.org/10.3389/fpain.2022.833104

Nijs, J., Malfliet, A., & Nishigami, T. (2023). Nociplastic pain and central sensitization in patients with chronic pain conditions: A terminology update for clinicians. Brazilian Journal of Physical Therapy, 27(3), Article 100518. https://doi.org/10.1016/j.bjpt.2023.100518

Ohashi, Y., Uchida, K., Fukushima, K., Inoue, G., & Takaso, M. (2023). Mechanisms of peripheral and central sensitization in osteoarthritis pain. Cureus, 15(2), Article e35331. https://doi.org/10.7759/cureus.35331

Opara, J. A., Saulicz, E., Szczygieł, J. W., & Szczygieł, K. (2025). Is the central sensitization in chronic nonspecific low back pain a structural phenomenon or psychological reaction? A narrative review. Journal of Clinical Medicine, 14(2), Article 577. https://doi.org/10.3390/jcm14020577

Sato, G. T., & Halili, A. (2025). Treatment for central sensitization and shoulder pain using Systemic Manual Therapy (SMT). Journal of Physical Medicine and Rehabilitation, 7(1), 98–105. https://doi.org/10.33696/rehabilitation.7.051

Schuttert, I., Timmerman, H., Petersen, K. K., McPhee, M. E., Arendt-Nielsen, L., Reneman, M. F., & Wolff, A. P. (2021). The definition, assessment, and prevalence of (human assumed) central sensitisation in patients with chronic low back pain: A systematic review. Journal of Clinical Medicine, 10(24), Article 5931. https://doi.org/10.3390/jcm10245931

Soni, A., Wanigasekera, V., Mezue, M., Cooper, C., Javaid, M. K., Price, A. J., & Tracey, I. (2019). Central sensitization in knee osteoarthritis: Relating presurgical brainstem neuroimaging and PainDETECT-based patient stratification to arthroplasty outcome. Arthritis & Rheumatology, 71(4), 550–560. https://doi.org/10.1002/art.40749

Tomašević-Todorović, S., & Spasojević, G. (2023). Central sensitization in patients with chronic musculoskeletal pain. Acta Clinica Croatica, 62(Supplement 4). https://doi.org/10.20471/acc.2023.62.s4.15

Verbrugghe, J., Agten, A., Stevens, S., Vandenabeele, F., Roussel, N., Verbunt, J., Goossens, N., & Timmermans, A. (2023). High intensity training improves symptoms of central sensitization at six-month follow-up in persons with chronic nonspecific low back pain: Secondary analysis of a randomized controlled trial. Brazilian Journal of Physical Therapy, 27, Article 100496. https://doi.org/10.1016/j.bjpt.2023.100496

Williams, D. A. (2018). Phenotypic features of central sensitization. Journal of Applied Biobehavioral Research, 23(2), Article e12135. https://doi.org/10.1111/jabr.12135

Zheng, P., Zhang, W., Leng, J., & Lang, J. (2019). Research on central sensitization of endometriosis-associated pain: A systematic review of the literature. Journal of Pain Research, 12, 1447–1456. https://doi.org/10.2147/JPR.S197667