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LETTER TO THE EDITOR

Challenges in researching chiropractic pediatric curricula

Michael R. Wiles, DC, EdD¹

Joel M. Stevans, DC, PhD¹

(JCCA. 2026;70(2):143-144)

KEY WORDS: chiropractic education, chiropractic geriatrics, chiropractic pediatrics, curriculum, research

Despite the fact that chiropractic care of children is a widespread and common practice, it remains a source of controversy within^{1,2} and without³ the profession. This is due to several factors, including lack of substantial research supporting the effectiveness of manual therapies in the care of children as well as the ideological issues regarding attitudes towards vaccination and other accepted public health practices.⁴

In chiropractic educational programs, pediatrics is sometimes taught as a stand-alone course or as part of a broader course, typically called “special populations”. To date (and to our knowledge), there has been no pub-

LETTRE À L'ÉDITEUR

Défis liés à la recherche sur les curriculums de la chiropratique pédiatrique

(JCCA. 2026;70(2):143-144)

MOTS CLÉS : enseignement de la chiropratique, chiropratique gériatrique, chiropratique pédiatrique, curriculums, recherche

lished work describing the current status of pediatrics curricula in chiropractic programs. For example, how is the topic taught, how much practical clinical experience do students actually get, and what supervised activities are available for students to demonstrate competency managing child patients? Such a study of chiropractic curricula would be a starting point for a larger conversation about the role of chiropractic in caring for children, and the need for research support for that role.

Geriatrics (often grouped with pediatrics in “special population” courses) has been surveyed several times for its curricular content in chiropractic programs. Hawk *et*

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*al.*⁵ studied chiropractic geriatric syllabi in 1996, with data collected from 9 of 17 programs (53% response rate), Borggren *et al.*⁶ updated this information with a study in 2009, with 14 of 18 programs reporting data (78% response rate) and Gleberzon *et al.*⁷ recently updated this information in 2025, with 24 of 34 programs responding (71% response rate), following which only 17 provided useful data for the study (50% usable response rate).

We designed a similar study of pediatric curricula (reviewed by the University of Pittsburgh IRB and deemed not to be human research), with a survey sent to 17 North American programs, yielding only 3 responses (18% response rate). As a second attempt, 27 worldwide chiropractic programs were contacted and simply asked to send their pediatric syllabi, which we were planning to analyze in the manner used by Gleberzon *et al.*⁷ That second attempt also only yielded three responses (11% response rate), and we wish to express our considerable gratitude for those taking the time to respond.

What is it about chiropractic pediatrics that suggests programs are reluctant to share information, when they are more open to sharing about chiropractic geriatrics? This lack of responsiveness does little to settle the ongoing questions about the purpose, value and safety of chiropractic care of children. We are not entirely stumped by this lack of response, however, and are now limited to surveying publicly available information on college websites (despite the variability and uncertainty of currency

of such data). In fairness to those solicited for information, it is certainly possible that survey fatigue and other administrative priorities may have impacted our response rate, notwithstanding that the same institutions responded to the geriatric survey at a much higher rate. We hope that other investigators have better luck in getting widespread cooperation on topics of (great) importance to the chiropractic profession.

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Patients, learners, and mentors as storytellers and bearers of meaning in care: a narrative reflection

Aubrianna L. Jones, DC¹

(JCCA. 2026;70(2):145-146)

KEY WORDS: chiropractic, chronic pain, mentorship, narrative, residency

I sat across from a patient, whom I will refer to here as Jane, in a fluorescent-lit clinic room. The clinic room was ordinary. White walls. A grey vinyl chair pulled too close to the exam table. A computer screen angled between us. Jane recited her history as if it had been rehearsed, or perhaps learned: onset, duration, failed treatments. The rhythm felt practiced, shaped in part by what previous clinical encounters had asked of her. As she moved through the familiar checkpoints, her body remained drawn inward. Her shoulders were slightly rounded forward, her hands intertwined and squeezed between her legs, and her gaze never met mine. Her chart was familiar,

Patients, personnes en formation et mentors comme narrateurs et porteurs de sens dans les soins: une réflexion narrative

(JACC. 2026;70(2):145-146)

MOTS CLÉS : chiropratique, douleur chronique, mentorat, récit, résidence

yet her story felt unfinished. I knew the clinical details of her chronic pain, but not its meaning in her life over the last four years. Meaning, it seemed, was absent from the patient history I had been trained to obtain.

As a chiropractor, I was trained to view illness as an inherently biomedical problem. Encounters such as this one began to unsettle that framing. Throughout my early career, I began to recognize that a patient's unspoken expression of illness often held meaning beyond the interpretive reach of biomedical frameworks. Jane's story, her embodied experience of living with chronic pain, emerged instead through the heavy silences that settled

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between her words. Those silences led me to confront the cultural meanings that shape how illness is narrated or silenced, and the unspoken space between embodied suffering and what the healthcare system is equipped to recognize. I came to understand that illness is never purely physical, nor the clinical encounter merely technical; both unfold within relational spaces shaped by uncertainty, vulnerability, and power. And yet, within those spaces, the capacity to attend to the meaning of illness is often shackled by the cadence of a predetermined system of care, shaped by both the realities of the healthcare system and, at times, the ways we are trained within chiropractic education.

My understanding of care was formed in those liminal moments where diagnosis faltered, and meaning was co-created between myself and the patient through storytelling. In these encounters, I came to understand patients as both *storytellers* and *bearers* of health and illness, carrying not only symptoms but the emotional, relational, and embodied dimensions of illness. I listened as individuals tried to make sense of suffering that disrupted their identity and that neither they nor I fully understood, despite an established diagnosis. Their stories were rarely linear; they were layered with grief, fear, and, at times, resilience. In tandem, I was confronting how my own interpretations were shaped by emotional weight, bias, and the grief of being part of a system that too often silences the very voices of those whom it aims to serve.

What I learned from patients did not resolve itself in the all-too-familiar fluorescent-lit clinic rooms. There remains an element of clinical practice that feels persistently unresolved, not as a failure of care, but perhaps as an expression of its inherent complexity. It was through mentorship during my postgraduate training that I first began to make sense of how to navigate that complexity. Across the health professions, mentorship is widely recognized as an important component of clinical training and professional development.^{1,2} In many cases, postgraduate training serves as a primary vehicle through which that mentorship is delivered. Therefore, one might consider that it is through mentorship, particularly within postgraduate training, that clinicians come to understand and practice care. Within chiropractic, however, such mentorship has historically been less formalized and less consistently integrated into training.

Within my own postgraduate training, mentorship proved just as formative to my understanding of care as the heavy silences I encountered with patients. It fostered space to sit with uncertainty, to interpret what remains unsaid, and to walk alongside patients in a way that revealed care as a fundamentally relational endeavor. The relationships formed through mentorship reflected the relational ethos of care, grounded in humility, vulnerability, and shared meaning-making. In this way, mentorship and care came to feel like parallel practices.

Through this experience, I came to understand that navigating the complexities of care is rarely only clinical in nature; rather, it is deeply shaped by how healthcare professionals are trained to listen, interpret, and respond to patient narratives. A defining value of postgraduate training is that learning unfolds through proximity, by listening to how mentors narrate clinical encounters, observing how they sit with uncertainty, and bearing witness to care as it is practiced. In this environment, learners do not simply acquire knowledge; they are learning what it means to care by observing how it is modeled and listening to how it is narrated. In doing so, we might consider that clinicians and learners alike take on the role of *storytellers* and *bearers*.

Ultimately, this unveils a tension within clinical education: are we modeling to learners a prioritization of performance and achievement, or are we meaningfully walking alongside them as they learn how to care? As I now find myself in the role of mentor within clinical spaces, I often find myself revisiting Jane's story. During my postgraduate training, I learned many things, but most importantly, I learned how to attend to meaning. As postgraduate training in the chiropractic profession becomes increasingly common, the question becomes: what are we, as a profession, trying to foster in these fluorescent-lit clinic rooms, where storytellers and bearers take shape?

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ChiroSCOPE (Chiropractic Systematic Clinical Observation of Practice Evidence): preliminary evaluation of a web application for data collection within a clinical research network: a mixed methods pilot study

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Background: *Practice-based research networks (PBRNs) face challenges including time constraints, workflow disruption, and lack of standardized data collection protocols. We evaluated the usability of “Patient Progress,” a web application designed to support PBRN data collection among Canadian chiropractors and their patients.*

Methods: *An explanatory sequential mixed-methods design was used. Ten chiropractors piloted the application over six months, collecting patient-reported outcome measures and clinical data from 60*

ChiroSCOPE (Chiropractic Systematic Clinical Observation of Practice Evidence) :  valuation pr liminaire d’une application web pour la collecte de donn es au sein d’un r seau de recherche clinique : Une  tude pilote   m thodes mixtes

Contexte: *Les r seaux de recherche ax s sur la pratique (RRAP) font face   plusieurs d fis, notamment les contraintes de temps, la perturbation des flux de travail cliniques et l’absence de protocoles standardis s de collecte de donn es. Nous avons  valu  la convivialit  de « Patient Progress », une application web*

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All procedures performed in studies involving human participants were in accordance with the UQTR Ethics Committee for Research Involving Human Beings (Approval #: CER-22-284-07.02). Informed consent was obtained from all individual participants included in the study. The data that support the findings of this study are not openly available but are available from the corresponding author upon reasonable request within six months of the manuscript publication. After that time period the data will be destroyed as specified within our ethical certification APP.

patients. Patient usability was assessed via the mHealth App Usability Questionnaire (MAUQ); chiropractor perspectives were explored through semi-structured interviews analyzed thematically.

Results: Patients rated overall usability highly (mean 6.63/7). Chiropractor interviews identified key implementation barriers: lack of integration with existing practice management software, bilingual interface issues, questionnaire length, and recruitment challenges.

Conclusion: "Patient Progress" shows promise for PBRN data collection in chiropractic practice. Wider implementation requires seamless integration with existing software systems, interface improvements, and value-added clinical features to incentivize practitioner participation.

(JCCA. 2026;70(2):147-160)

KEY WORDS: practice-based research; mobile applications; patient reported outcome measures; feasibility studies; chiropractic

Background

Canadian chiropractors hold favourable attitudes and beliefs towards evidence-based practice (EBP).^{1,2} EBP involves integrating the best research evidence, clinical expertise, and patient values and expectations to improve clinical decision-making, and patient health outcomes.³ Despite this growing commitment to EBP and the availability of evidence-based clinical practice guidelines to support clinical decision-making,⁴ a persistent gap be-

conçue pour soutenir la collecte de données au sein d'un RRAP auprès de chiropraticiens canadiens et de leurs patients.

Méthodes: Un devis séquentiel explicatif à méthodes mixtes a été utilisé. Dix chiropraticiens ont mis à l'essai l'application pendant six mois, collectant des mesures de résultats rapportées par les patients ainsi que des données cliniques auprès de 60 patients. La convivialité de l'application pour les patients a été évaluée à l'aide du questionnaire de convivialité des applications de santé mobile (mHealth App Usability Questionnaire), tandis que les perspectives des chiropraticiens ont été explorées par le biais d'entretiens semi-dirigés analysés de façon thématique.

Résultats: Les patients ont accordé une cote globale de convivialité élevée (moyenne 6,63/7). Les entretiens avec les chiropraticiens ont mis en évidence des obstacles clés à l'implantation : l'absence d'intégration avec les logiciels de gestion de pratique existants, des problèmes liés à l'interface bilingue, la longueur des questionnaires, ainsi que des difficultés de recrutement.

Conclusion: « Patient Progress » présente un potentiel prometteur pour la collecte de données dans le cadre d'un RRAP en chiropratique. Une implantation à plus grande échelle nécessitera une intégration harmonieuse avec les systèmes logiciels existants, des améliorations de l'interface ainsi que des fonctionnalités à valeur ajoutée afin d'encourager la participation des praticiens.

(JACC. 2026;70(2):147-160)

MOTS-CLÉS: recherche axée sur la pratique; applications mobiles; mesures de résultats rapportées par les patients; études de faisabilité; chiropratique

tween current evidence and its routine implementation in practice remains a concern for political leaders, service and insurance payers, and patients seeking chiropractic care.^{1,5,6} This gap reflects not a lack of awareness of evidence, but rather the well-documented challenge of translating available research into consistent clinical behaviour: an evidence-to-practice implementation gap.

Practice-based research networks (PBRNs) represent a promising solution to bridge this implementation gap.⁷⁻⁹

PBRNs are defined as groups of ambulatory practices primarily devoted to the primary care of patients, with a common mission to investigate questions related to community-based practice.¹⁰ PBRNs can take two main forms: registries, where a group of clinicians is connected through a common patient management system, or a substudy format, where clinicians opt into ongoing research-related activities.^{11,12} These networks can collect a multitude of data from a large cohort of practitioners in routine clinical practice, enabling the establishment of a learning health system.^{13,14} The creation of PBRNs in chiropractic practice provides an opportunity to describe practice profiles, reasons for consultation, clinical impressions, care provided, adherence to good practice recommendations, and therapeutic response.^{9,15} The assessment of adherence to good practice recommendations is particularly relevant: by systematically recording clinicians' diagnostic decisions, treatment modalities, referral patterns, and therapeutic objectives for each patient encounter, PBRNs enable the comparison of documented clinical decisions against established evidence-based guidelines, providing an empirical measure of guideline adherence at the practice level.^{8,9}

Critically, PBRNs contribute to narrowing the EBP implementation gap through two complementary mechanisms. First, by conducting research in routine care environments rather than academic tertiary centres, PBRNs generate findings on treatment *effectiveness* — including real-world outcomes such as patient satisfaction, functional recovery, and long-term harms — that clinical trials often fail to capture, producing evidence that is directly applicable to clinical decision-making.^{8,9,16} Second, PBRNs support *bidirectional* knowledge translation: they not only generate new evidence but also engage practitioners as active research participants, fostering ongoing evidence uptake within a learning health system dynamic.^{7,13,17,18} In this sense, PBRNs occupy a unique position at the interface between research and quality improvement, where generating practice-based evidence and implementing evidence-based practice are mutually reinforcing processes.^{6,17}

Recent studies suggest that PBRNs may help understand clinical practice patterns and improve healthcare quality for MSK conditions associated with a significant societal burden globally.⁹ Nonetheless, PBRNs face significant challenges, particularly regarding their long-term

viability and sustainability.^{9,17,19} The main challenge is obtaining ongoing funding to ensure their sustainability,²⁰ with infrastructure costs for a basic PBRN with part-time support staff estimated at approximately \$70,000 USD annually.¹⁹ Other challenges relate to clinician engagement, data collection protocols, and integration with existing clinical workflows.^{5,9,21}

The implementation of appropriate technological tools into clinical settings can help overcome these challenges by facilitating the acquisition of clinically relevant data and reducing the logistical constraints associated with clinician participation in research. One such tool is “Patient Progress”, a web-based application (APP) designed to establish a secure communication portal between patients and their chiropractors, thereby enhancing the monitoring and continuity of patient care. The APP generates readily analyzable data in JavaScript Object Notation (JSON) format. “Patient Progress” is accessible to all users via standardized web browsers, ensuring broad accessibility. Importantly, the platform enables researchers to access anonymized patient data, thereby supporting ethically sound and privacy-compliant clinical research. The systematic data collection enabled by the APP has the potential to support the implementation of longitudinal cohort studies within chiropractic clinics participating in the PBRN. By identifying modifiable prognostic factors and predictive factors of response to treatments, the APP may contribute to improved clinical decision-making and the advancement of more personalized care for patients. Moreover, the insights generated through the use of “Patient Progress” could support the broader implementation of a learning health system within the Canadian chiropractic profession.^{13,22}

Usability encompasses three dimensions: ease of use and satisfaction, arrangement of system information, and usefulness of a technological solution.²³ The aim of this pilot study was to evaluate the usability of the “Patient Progress” APP among a group of chiropractors and their patients over the study period. Lessons learned will help refine the APP to improve the collection of clinical data in routine clinical practice.

Methods

An explanatory sequential mixed-methods approach (quantitative followed by qualitative)²⁴ was used to evaluate the usability (ease of use and satisfaction, arrangement

of system information, usefulness) of the APP among members of the chiropractic association of the province of Quebec (ACQ), Canada. In accordance with this design, the quantitative strand (MAUQ) was designated as the primary component, providing the initial assessment of APP usability. The qualitative strand was conducted subsequently to elaborate on and explain the quantitative findings. Priority was therefore assigned to the quantitative component, with the qualitative component serving an explanatory and complementary function.

Participants and recruitment

The sample size for this pilot study was determined based on feasibility considerations (convenience sample) for both clinicians and patients. ACQ's members, who were actively practicing chiropractors at the time of the study, were invited to participate via the ACQ email list and Facebook page between summer of 2022 and spring 2023. Chiropractors agreeing to participate were asked to complete a demographic questionnaire ("Chiro Preference"). The questionnaire included questions about their clinic (solo vs multidisciplinary practice, availability of on-site radiology services, as well as the number of new patients and treatments provided weekly), language generally used in practice, year of birth, academic training, and treatment modalities used.²⁵ Each chiropractor was trained and familiarized with the functionality and operation of the APP prior to the start of the study through an individual virtual "Startup" meeting.

Each chiropractor was instructed to invite ten consecutive new patients to use the APP during a six-week period. Interested patients consented to participate via the online consent form automatically sent with the first round of pre-first visit questionnaires. They were also asked to consent to their data being shared with the research team. Two weeks post APP implementation, a follow-up email was sent to each newly recruited chiropractor to inquire if they were encountering any problems or had questions related to the APP. A second meeting was scheduled for those who identified problems or had additional questions.

Data collection procedures

Quantitative data

Patient data

Patients who completed the pre-first visit questionnaires online received a link via email inviting them to open their

account in the "Patient Progress" APP. When redirected to the APP, they first completed their profile with general information and then automatically sent the "Intake" questionnaire. This questionnaire included patient identification data, sociodemographic data, reasons for consultations, painful areas of the patient's body, comorbidities, red flags if present, and health measures self-reported by the patient regarding pain intensity and disability.

Patients were then invited to complete the "Brief Pain Inventory" measuring their level of pain and interference with daily life activities,²⁶ and two additional disability questionnaires depending on the main reason for consultation identified in the "Intake" questionnaire:

For lower back pain complaints: the "Keele STarT Back Screening Tool"²⁷ and the "Oswestry Disability Questionnaire"²⁸.

For complaints of neck, upper limb or lower limb pain: the "Neck Disability Index,"²⁹ "QuickDASH Outcome Measure,"³⁰ and "Lower Extremity Functional Scale"³¹ respectively. All patients without low back pain also completed the "Modified MSK STarT Back Screening Tool," a prognostic tool for musculoskeletal problem complaints³².

Usability assessment

To assess the usability of the APP, patients were invited to follow a link to access the mHealth App Usability Questionnaire (MAUQ),²³ measuring the "Patient Progress" APP usability across three dimensions: 1) ease of use and satisfaction, 2) arrangement of system information, and 3) usefulness, at the end of the pilot study in April 2023.

Clinician data

The treating chiropractor had access to the study questionnaires completed by their patients prior to their initial visit. After this first visit, the clinician was instructed to complete an initial report of findings. The first half of the initial report of findings (ROF) was automatically pre-populated by the APP based on intake data entered by the patient, allowing the chiropractor to review and supplement this information rather than entering it from scratch, thereby reducing documentation burden. The chiropractor then indicated:

1. The data collected during the initial interview
2. The clinical diagnosis(es)

3. The treatment plan for the current episode of care by specifying:
 - Number of recommended treatments
 - Frequency of care
 - Therapeutic objectives
 - Therapeutic modalities employed
 - Activity recommendations or functional limitations
4. Whether a request for consultation or inter-professional collaboration was required and, if so, the nature and reason
5. A prognosis for the patient’s condition by specifying the overall expectation of clinical change

Clinicians were instructed to complete a re-evaluation report based on information entered in the APP during or after each re-evaluation. The report contained patient response to care, whether the patient’s condition was resolved, the total number of treatments provided from initiation of care, and the number of additional treatments (if any) recommended for the current episode of care.

Qualitative data

Individual interviews of participating chiropractors were conducted to explore their views on the usability of “Patient Progress” and the feasibility of integrating it into their private practices. All interviews were conducted virtually on the TEAMS platform, recorded and transcribed verbatim using Google’s transcription extension. The interview guide was constructed a priori to capture the experiences, including perceived advantages, disadvantages, barriers, and facilitators, of APP.

Integration of the quantitative and qualitative components occurred at three levels. At the design level, the explanatory sequential structure was explicitly designed so that the qualitative phase would elaborate on and explain the quantitative findings, with interview questions informed by the MAUQ dimensions. At the methods level, interview participants were recruited as a purposive subsample from the participating chiropractors, ensuring that qualitative data were grounded in the same practice context as the quantitative data. At the interpretation and reporting level, quantitative and qualitative findings were presented and discussed contiguously, allowing direct comparison and cross-validation of results.

Protocol modifications

Due to the slow recruitment of chiropractors in the study, the study period was extended from three to six months.

Data analysis

Descriptive analyses (mean and standard deviation for continuous data and frequency and percentage for categorical data) of the study questionnaires were completed using SPSS software.³³ The feasibility of implementing an APP for collection of clinical and patient management data was measured using the three dimensions of the MAUQ, and the average time to complete the questionnaires was also assessed. The time to complete each questionnaire was automatically recorded by the APP via server-side logging of initiation and submission timestamps.

Data were coded hierarchically using thematic analysis.³⁴ Interview transcripts were independently analyzed and coded by two researchers. Consensus on coding was reached through discussion between the two researchers, without external support. Codes were then clustered into categories and draft themes were generated and finalized by the same two researchers.

Ethical considerations

This study received ethics approval from the UQTR Ethics Committee for Research Involving Human Beings (CER-22-284-07.02). Informed consent was obtained from all individual participants included in the study.^{35,36}

Results

Characteristics of participants

Participating chiropractors

We received notification of interest from 19 chiropractors, of whom 10 (53%) self-selected into the study by completing the required onboarding steps, including the demographic questionnaire and virtual ‘Startup’ meeting, within the recruitment window. The remaining nine did not proceed further after initial contact. The majority were men (70%), half (50%) practiced as solo practitioners, and nearly half (40%) had additional diplomas and/or training beyond their chiropractic degree (Table 1). Participants reported seeing an average of 3.8 (± 0.83) new patients per week and provided approximately 90.5 (± 10.45) treatments weekly.

Table 1.

Characteristics of chiropractors who participated in the pilot phase of ChiroSCOPE (n=10).

Characteristic	N(%) / Mean	Standard Deviation
Sex		
Men	7 (70%)	
Women	3 (30%)	
Other diplomas and/or training	4 (40%)	
Number of treatments per week	90.5	10.45
Number of new patients per week	3.8	0.83
Radiology service offered in the clinic	4 (40%)	
Type of practice		
Solo practice	5 (50%)	
Clinic with other chiropractors	2 (20%)	
Clinic with other health care professionals	3 (30%)	

Participating patients

A total of 82 patients recorded their profiles within the APP, and 60 patients (73%) agreed to share their data for the purpose of our pilot study (Table 2). Men and women were represented in nearly equal proportions (51.7% men, 48.3% women). Most patients reported French as their first language (88.3%) and were employed full-time (63.3%). Over half of patients (53.3%) reported having a family physician, and most had previously consulted a healthcare professional for their current presenting complaint, primarily osteopaths (13.3%), medical doctors (11.7%), chiropractors (10.0%), and physiotherapists (8.4%). However, approximately one-third (31.7%) reported not having consulted anyone beforehand. Patients took an average of 20.61 (± 3.09) minutes to complete the initial questionnaires (as automatically recorded by the APP).

Table 2.

Characteristics of patients who participated in the pilot phase of ChiroSCOPE (n=60).

Characteristic	N(%) / Mean	Standard Deviation
Sex		
Men	31 (51.7%)	
Women	29 (48.3%)	
First language		
French	53 (88.3%)	
English	7 (11.7%)	
Employment status		

Characteristic	N(%) / Mean	Standard Deviation
Part-time work	4 (6.7%)	
Full-time work	38 (63.3%)	
Temporary layoff	1 (1.7%)	
Student	2 (3.3%)	
On leave due to illness	1 (1.7%)	
Retired	5 (8.4%)	
Maternity/paternity leave	1 (1.7%)	
Missing	8 (13.3%)	
Family physician		
Yes	32 (53.3%)	
No	20 (33.4%)	
Missing	8 (13.3%)	
Health professional consulted before*		
Acupuncturist	1 (1.7%)	
Other	1 (1.7%)	
Chiropractor	6 (10.0%)	
Massage therapist	5 (8.4%)	
Medical doctor	7 (11.7%)	
Osteopath	8 (13.3%)	
Physiotherapist	5 (8.4%)	
None	19 (31.7%)	
Average time to complete questionnaires (minutes)	20.61	3.09

*Subjects might have chosen more than one answer

Patient pain and disability metrics

The mean pain score reported on the Brief Pain Inventory (BPI) on a scale from 0 to 10, for average pain, was 4.28 (± 0.36), with worst pain at 6.22 (± 0.37) and least pain at 2.39 (± 0.31) (Table 3). The average time to complete the BPI was 2.12 (± 0.27) minutes. Activity (4.37 ± 0.44) and sleep (3.85 ± 0.45) were the pain interference domains most affected.

Table 3.

Patient's BPI Scores and time to complete.

Pain level (0-10)	Mean	Standard Deviation
Time to complete (minutes)	2.12	1.99
Worst	6.22	2.71
Least	2.39	2.25
Average	4.28	2.66
Now	3.44	2.70
Activity	4.37	3.21
Mood	3.76	2.90
Walking	2.69	3.10
Work	3.22	3.15

Pain level (0-10)	Mean	Standard Deviation
Relations	2.06	2.44
Sleep	3.85	3.29
Enjoyment	3.31	3.28
Brief Pain Inventory (BPI) Scores Interpretation		
Measurement of pain interference on daily activities	3.32	2.44
Measurement of pain severity	4.08	2.26

Application usability

Quantitative usability assessment

Of the 60 patients using the APP, six completed the MAUQ. The low response rate likely reflects the fact that participating chiropractors did not automatically send the follow-up questionnaire through the APP; the research team subsequently distributed it directly to patients. For many patients, their episode of care had resolved several weeks prior to receiving the questionnaire, which may partly explain our low response rate, although we cannot confirm this definitively without systematic data on non-response. Patients rated all aspects of the APP highly, with overall mean scores exceeding 6.5 out of 7 across all categories (Table 4). The highest-rated statements were related to navigation consistency between screens (Q3, 6.83/7) and willingness to use the APP again (Q10, 6.83/7). The lowest-rated statement concerned the time required to use the APP (Q9, 6.33/7).

Table 4.

MAUQ Ratings for each statement (completed n=6).

Questions	Mean / N(%)	Standard Deviation
Q1 The app was easy to use.	6.67	0.52
Q2 It was easy for me to learn how to use the app.	6.67	0.52
Q3 The navigation was consistent when moving between screens.	6.83	0.41
Q4 The interface of the app allowed me to use all the functions (such as entering information, responding to reminders, viewing information) offered by the app.	6.67	0.52
Q5 Whenever I made a mistake using the app, I could recover easily and quickly.	6.50	0.84
Q6 I like the interface of the app.	6.67	0.52
Q7 The information in the app was well organized, so I could easily find the information I needed.	6.67	0.52

Questions	Mean / N(%)	Standard Deviation
Q8 The app adequately acknowledged and provided information to let me know the progress of my actions.	6.50	0.55
Q9 The amount of time involved in using the app has been fitting for me.	6.33	0.82
Q10 I would use this app again.	6.83	0.41
Q11 Overall, I am satisfied with this app.	6.67	0.52
Q12 The app would be useful for my health and well-being.	6.50	0.55
Q13 The app improved my access to health care services.	6.67	0.52
Q14 The app helped me manage my health effectively.	6.67	0.52
Q15 This app has all the functions and capabilities I expect it to have.	6.50	0.55
Q16 The "Patient Progress" app provides an acceptable way of receiving healthcare services, such as accessing educational materials, tracking my own activities, and completing a self-assessment.	6.67	0.52
Comments or additional items to add related to your experience using the app:		
None or "No comment"	4 (66.67%)	
"Perfect"	2 (33.33%)	
Combined Ratings		
Ease-of-use	6.67	0.12
Interface and satisfaction	6.61	0.17
Usefulness	6.61	0.10
Overall	6.63	0.13

Qualitative usability assessment

Despite repeated efforts to recruit chiropractors for interviews, only four agreed to participate. Six main themes emerged from transcript analysis. These themes included: interface and ease of use; content and functionalities; integration into clinical practice; desired functionalities; considerations for research and professional development; consent and confidentiality.

Theme 1: Interface and ease of use

While chiropractors found sending questionnaires to patients generally straightforward, they identified several limitations. These included uncertainty about whether questionnaires had been successfully sent, difficulty in finding patient records, and problems with the bilingual interface for English-speaking patients:

"[...] when I was sending the questionnaire, I wasn't sure if it had been sent or not. [...] The ques-

tionnaire has been sent or there was no confirmation, so I remember the first time I sent them all twice because I really wasn't sure.” (DC_A)

“We have many, many English speakers. And the APP, when we send an invitation to an English speaker, they have to take an extra step to access the English questionnaire, and that extra step doesn't work at all [...]” (DC_B)

Theme 2: Content and functionalities

Practitioners appreciated the comprehensive summary report of the patient's conditions generated by the APP:

“I liked that it gives us a fairly complete view of the patient's condition without it being really difficult.” (DC_A)

However, they suggested improvements related to pain mapping, visual representation of symptoms, and refinement of the classification system for red flags:

“In the improvements, I would have a good pain mapping, but visual [...] the location of the pain that is, that is visually, let's say it would be red in such a place with the quality of the pain and then the intensity.” (DC_A)

Theme 3: Integration into clinical practice

The most significant barrier to implementation was the duplication of work with existing clinical management systems. Chiropractors emphasized that integration with their current systems would be essential for wider adoption:

“[...] it would really need to be an APP integrated with the system that is already in use because otherwise it makes things too duplicative. That's really the main thing because the rest is actually interesting, and it was quite comprehensive, there was a lot of information, for me it was really the fact that it was done twice by patients [...]” (DC_C)

The additional time required to use the APP was also mentioned as a limiting factor:

“Well, it's the time it takes. I think, that's it, it takes quite a lot of time, it's relative. If it were integrated, it would help, it really comes down to integration with the system we already use, and especially not having to do it twice.” (DC_C)

Theme 4: Desired functionalities

Participants suggested several enhancements that would increase the APP's value.³⁷ These included:

A personalized dashboard showing treatment outcomes for specific conditions:

“[...] for such conditions, such age group, well usually, it takes one visit to have a significant improvement. Yes, that can be interesting. [...] I think that to convince the patient that it's worth starting care, that, that can be interesting. And also guide us towards what type of approach works best, yes.” (DC_B)

The inclusion of specific evidence-based recommendations:

“[...] exercise programs or treatment recommendations based on the diagnosis. According to the evidence. That's fun, uh, to remind me that: Oh yes, if I did such a thing, it's true that for that condition, it works well so that's fun.” (DC_B)

The availability of patient educational resources:

“I dream of an informative video on practice adapted to Quebec with a French version and an English version, you could introduce it in your video in your APP.” (DC_B)

Theme 5: Considerations for research and professional development

Participants valued the research potential of the APP and its ability to provide insights into treatment effectiveness:

“The concept appeals to me in the sense that I find it fun to collect data for research.” (DC_B)

“[...] for such type of patients. Well, we did such type of intervention. And here's what the patient

reports as a result, so we could more easily specify which technique or which approach has better results for a type of patients XYZ.” (DC_A)

To increase practitioner participation, interviewees suggested targeting groups of chiropractors who practice similar techniques:

“To engage a group of chiropractors who practice the same kind of treatment. [...] It could be much easier, to test the APP. Because the chiropractor could extract the outcomes of patients and validate the treatment according to certain conditions.” (DC_A)

Theme 6: Consent and confidentiality

Participants expressed concerns about the consent process, suggesting that patients might provide more informed consent after establishing a relationship with the practitioner:

“[...] once he has met with the practitioner in question. A questionnaire will be sent to him. To fill out the consent because I think having an influence from the patient, from the practitioner. It would be a bit tweaking things. And I don’t think it would necessarily be free consent.” (DC_D)

“I think that theoretically, it should be the patient, once he has met me [...] I think it should, it should be done once the patient has met the chiropractor so that there is a kind of bond of trust that is established [...]” (DC_D)

Discussion

The findings of this pilot study demonstrate that ‘Patient Progress’ is technically usable from a patient perspective, yet faces substantial implementation barriers at the clinician level that must be addressed before PBRN integration can succeed. Our findings highlight both the potential benefits and challenges of implementing this technology within a practice-based research network. Overall, while the quantitative assessment indicated high user satisfaction among patients who completed the questionnaire, clinician interviews highlighted several key areas for

improvement that would facilitate broader implementation in clinical practice, particularly regarding integration with existing systems, interface refinements, and additional functionalities to increase value for practitioners.

Usability assessment

Among patients who completed the MAUQ, usability ratings were positive across all usability dimensions. The low MAUQ response rate likely reflects the logistical limitations of distributing the questionnaire outside the APP workflow, combined with the elapsed time since episode resolution, a finding that underscores the need for automated patient follow-up functionality. The APP could be enhanced with automated patient follow-up according to a predetermined schedule (e.g., 2 weeks, 1 month, 3 months, 6 months post-treatment). This would reduce the administrative burden on both practitioners and researchers while ensuring more consistent data collection timing. The high scores for navigation consistency and willingness to use the APP again suggest that responding patients found the core experience satisfactory. However, the slightly lower rating for time involvement aligns with the chiropractors’ concerns about questionnaire length. This finding is consistent with previous research by Parmanto *et al.*,³⁸ who found that completion time is often a limiting factor in the adoption of mHealth APPs, particularly for initial assessments that require more comprehensive data collection.

The qualitative feedback received from the chiropractors during the interviews revealed more nuanced usability considerations that would not have been captured through quantitative assessment alone. Integration of the APP with existing clinical workflow emerged as the most significant barrier to implementation—a challenge commonly reported in health information technology adoption studies.^{39,40} The need for duplicate data entry creates an additional burden for clinicians already constrained by time limitations in busy practice settings. This finding aligns with the results of Lalji *et al.*,⁹ who identified challenges related to clinician engagement and data collection protocols as barriers to successful PBRN implementation.

This divergence represents the study’s most salient point of triangulation: patients who completed the MAUQ rated the APP highly across all usability dimensions, whereas chiropractors identified substantial barriers to its implementation in clinical practice. This contrast, access-

ible to us only through the integration of quantitative and qualitative methods, reveals that patient-facing usability does not necessarily translate into clinician-facing feasibility. Quantitative assessment alone would have produced an overly optimistic picture of the APP's readiness for broader implementation, while qualitative data alone would have lacked the standardised usability benchmarks provided by the MAUQ. The integration of both strands was therefore essential to capturing the full complexity of the implementation context.

Considerations for practice-based research networks

Our findings have important implications for the development and sustainability of PBRNs in chiropractic practice. The difficulty in recruiting chiropractors for this pilot study—requiring an extension from three to six months—reflects the challenges outlined by Davis et al.¹⁹ regarding the long-term viability of PBRNs. Time constraints and workflow disruption present significant barriers to practitioner engagement, suggesting that future PBRN initiatives must offer clear value propositions to incentivize participation.

Interestingly, participating chiropractors recognized the research potential of the APP despite implementation challenges. Their suggestions for features such as personalized dashboards, evidence-based recommendations, and aggregate outcomes data indicate a desire for tools that not only facilitate research but also provide immediate clinical value. This finding supports Menear et al.'s framework for value-creating learning health systems, which emphasizes the importance of bidirectional knowledge flow between research and practice.¹³

Technical and design considerations

Several technical issues emerged that require attention in future APP development. The bilingual interface problems represent a particularly significant barrier in the Canadian context, where both French and English are official languages. Similarly, the lack of confirmation messages when sending questionnaires created uncertainty among clinicians. The study highlights the importance of robust pilot testing prior to implementation.

The concerns regarding pain mapping and visualization tools reflect practitioners' desire for more intuitive data representation. As Bach *et al.* demonstrated in their

clinician dashboard development work, visual representation of pain patterns can significantly enhance clinical decision-making.⁴¹ Incorporating such features could increase the APP's utility and appeal to practitioners.

Ethical and procedural considerations

The chiropractors' concerns about the timing of consent procedures raise important ethical considerations. Their suggestion that consent might be more appropriately obtained after establishing a patient-practitioner relationship merits careful consideration. While pre-visit consent aligns with research ethics principles of obtaining consent before data collection begins, it may create barriers to participation if patients lack context about the purpose and value of the research. This also applies to secondary use of data that involves informed consent from patients for the storage and use of their data to answer future research questions. A balanced approach that provides adequate information while building on established trust relationships may be optimal.

Limitations

This study has several limitations. First, the sample of chiropractors was small (n=10) and consisted of practitioners who had previously expressed interest in research participation, potentially creating selection bias toward more research-engaged clinicians. Only four agreed to participate in qualitative interviews, which limits the breadth of perspectives captured in the qualitative component. Second, the patient response rate for the mHealth App Usability Questionnaire was low, introducing response bias toward those with more positive experiences and compromising the primacy of the quantitative strand as intended by the explanatory sequential design. As a result, the qualitative findings assumed a greater influence on the conclusions, which should be interpreted with caution given the small interview sample. Third, the extension of the study period from three to six months due to recruitment challenges may have influenced the results, as early adopters might differ from those recruited later. Fourth, data saturation cannot be claimed given the small interview sample; it is possible that additional perspectives would have emerged with a larger sample.

The integration of quantitative and qualitative methods also introduced specific limitations. The extensive quantitative reporting burden placed on chiropractors during

the pilot may have contributed to fatigue and reduced willingness to participate in subsequent qualitative interviews.

Future directions

Based on our findings, several recommendations emerged for future development and research. First, integration capabilities with existing practice management systems should be prioritized to minimize duplicate data entry. Second, user interface improvements—particularly regarding confirmation messages, patient search functionality, and bilingual support—are needed to enhance usability. Third, adding value-creating features such as personalized dashboards and evidence-based recommendations could increase practitioner engagement. Finally, larger-scale studies involving diverse practice settings and patient populations are needed to evaluate the scalability and sustainability of the APP within a broader PBRN context.

Future research should also explore the impact of the APP on clinical outcomes, practitioner behaviour change, and research productivity. Longitudinal studies examining the APP's role in facilitating evidence-based practice and contributing to a learning health system would be particularly valuable.

Conclusion

This pilot study evaluated the usability of the “Patient Progress” APP for data collection within a chiropractic practice-based research network. While limited in sample size, patient feedback on usability was positive, and the APP demonstrated feasibility for systematic clinical data collection in a real-world chiropractic context. Chiropractors identified several implementation barriers (workflow integration, time constraints, and language) that must be addressed before broader deployment. The findings highlight a fundamental tension in PBRN research tools: they must balance research utility with clinical relevance to ensure practitioner adoption, and seamless integration into existing workflows is a prerequisite rather than an enhancement.

“Patient Progress” shows potential as a foundation for a learning health system within the Canadian chiropractic profession, supporting both the generation of practice-based evidence and the implementation of evidence-based practice. Realizing this potential will require technical refinements and larger-scale evaluations.

Authors contributions: FH, MAB, SM and AB conceived and designed this study. DH and RH performed the data collection under the supervision of MAB and FH. Data analysis was performed by RH, DH, MAB and FH. Interpretation of the results was done by FH, RH and MAB. FH, RH and MAB performed the first draft of the manuscript. All authors have reviewed drafts and the final version of the manuscript and have agreed to its publication.

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Appendix 1. Interview guide

Interviewer Introduction

Hello, my name is XXXXX, I have been given the mandate to explore improvements to the “PatientProgress” application that would facilitate its use and implementation.

Advantages and Disadvantages of the Application

Main Questions	Supplementary Questions	Clarification Questions
Can you tell me about the advantages you have observed with the application?	What advantages would you like to have with the application? • From your point of view? • From your patients’ point of view? • From your assistant’s point of view?	• Can you tell me a little more? • Can you tell me more? • Can you give me examples?
Based on your experience, what are the disadvantages related to using the application?	• From your point of view? • From your patients’ point of view? • From your assistant’s point of view?	
What information would you like to have? What functions would you like to have?	• For your patients? • For your practice? • In a dashboard?	

Barriers and Facilitators

Main Questions	Supplementary Questions	Clarification Questions
In general, what are the barriers to using the application?	• From your point of view? • From your patients’ point of view? • From your assistant’s point of view?	• Can you tell me a little more? • Can you tell me more? • Can you give me examples?
What elements would facilitate the use of the application?		
What improvements would you like in the next version of the application?		

Closing

Is there anything else we haven’t addressed that seems concerning to you?

OR

Do you have anything else to add concerning the application?

Grille d'entretien

Présentation de l'intervieweur Bonjour, j'ai reçu le mandat d'explorer les améliorations de l'application «PatientProgress» qui permettraient de faciliter son utilisation et implantation. Au cours de l'entretien, j'aimerais que nous abordions les thèmes suivants : la criminalité et la victimation, le désordre et les incivilités (nuisances), la perception de la sécurité ou le sentiment de sécurité et l'appréciation des services à la population. En ayant ces thèmes en tête...
--

Avantages et inconvénients de l'application

☐ Pouvez-vous me parler des avantages que vous avez constaté avec l'application? ☐ Quels sont les avantages que vous aimeriez avoir avec l'application?	☐ Selon votre point de vue? ☐ Selon le point de vue de vos patients? ☐ Selon le point de vue de votre assistante?	☐ Pouvez-vous m'en dire un peu plus ? ☐ Pouvez-vous m'en dire davantage ?
☐ D'après votre expérience, quels sont les inconvénients liés à l'utilisation de l'application?	☐ Selon votre point de vue? ☐ Selon le point de vue de vos patients? ☐ Selon le point de vue de votre assistante?	☐ Pouvez-vous me donner des exemples ?
☐ Quelles informations aimeriez-vous avoirs ? ☐ Quelles fonctions aimeriez-vous avoir?	☐ Pour vos patients? ☐ Pour votre pratique? ☐ Dans un tableau de bord?	

Barrières et facilitateurs

☐ En général, quelles sont les barrières à l'utilisation de l'application? ☐ Quels éléments faciliteraient l'utilisation de l'application? ☐ Quelles améliorations aimeriez-vous dans la prochaine version de l'application?	☐ Selon votre point de vue? ☐ Selon le point de vue de vos patients? ☐ Selon le point de vue de votre assistante?	☐ Pouvez-vous m'en dire un peu plus ? ☐ Pouvez-vous m'en dire davantage ?
☐ Est-ce qu'il y a d'autres éléments que nous n'avons pas abordés et qui vous semblent préoccupants ? OU ☐ Avez-vous quelque chose d'autre à ajouter concernant l'application ?		☐ Pouvez-vous me donner des exemples ?

The consistency of reporting adverse events associated with dry needling: a narrative review

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Julie Frost, M.Appl.Sci³

Evgenios Vlachos, PhD^{4,5}

Dry needling interventions are associated with disabling and potentially life-threatening events. Presently, undesired treatment effects are not reported consistently across the literature and as such, the degree of risk to and impact on patients cannot be clearly articulated.

To systematically summarise available literature and capture trends in the reporting of undesired treatment effects occurring during and after dry needling, we searched Scopus, PubMed, Cochrane, CINAHL, Sports Medicine and Education Index and Web of Science.

In total, 130 adverse events were reported synthesized into 31 general categories. Synthesis and risk categorisation identified “pneumothorax (bilateral)” as the only potentially life-threatening adverse event, while “acute spinal epidural haematoma”, “dysautonomia”, “nerve injury”, “pneumothorax” and “pneumothorax (self-limiting)” were reported as severe.

Uniformité du signalement des événements indésirables associés à la puncture physiothérapique avec aiguilles sèches: une revue narrative

Les interventions de puncture physiothérapique avec aiguilles sèches sont associées à des événements invalidants susceptibles de mettre en jeu le pronostic vital. À l'heure actuelle, les effets indésirables du traitement ne sont pas signalés de façon uniforme dans la littérature; il est donc impossible de caractériser clairement le niveau de risque auquel les patients sont exposés et les répercussions de ces effets sur ceux-ci.

Afin de résumer systématiquement les publications disponibles et de dégager les tendances en matière de signalement des effets indésirables survenant pendant ou après une intervention de puncture physiothérapique avec aiguilles sèches, nous avons effectué des recherches dans Scopus, PubMed, Cochrane, CINAHL, Sports Medicine & Education Index et Web of Science.

Au total, 130 événements indésirables ont été recensés et regroupés en 31 catégories générales. La synthèse des

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Adverse events resulting in more than mild, transient symptoms during or after dry needling are rare. However, the occurrence of pneumothorax and peripheral nerve injury remain of greatest concern as they are, at least in part, ascribable to clinician error.

(JCCA. 2026;70(2):161-183)

KEY WORDS: myofascial pain syndrome, myofascial trigger points, dry needling, data reporting, narrative review, adverse events.

Introduction

Informed patient consent forms a cornerstone of ethical standards in modern health care¹ and a clear articulation of intervention risk and benefits is integral to this process². And whilst sufficient and appropriate information is essential³, such information requires delivery in a nuanced manner, so as not to cause undue patient distress. Therefore, clarity and distinction between transient (and expected) versus serious (and unexpected) intervention complications are helpful in negotiating management plans in provider-patient partnerships.⁴

Dry needling (DN), the insertion of monofilament needles into irritable soft tissue structures, is widely utilized across manual medicine practice.⁵ The intervention is supported by a substantial body of literature, including multiple systematic reviews, indicating clinical effectiveness for pain relief, improved function and general quality-of-life outcomes.^{6,7}

DN is considered as minimally invasive⁸ with undesired treatment effects mostly limited to mild and tran-

données et la classification des risques ont permis de déterminer que le « pneumothorax (bilatéral) » était le seul événement susceptible de mettre en jeu le pronostic vital, tandis que l'« hématome épidural rachidien aigu », la « dysautonomie », la « lésion nerveuse », le « pneumothorax » et le « pneumothorax (spontanément résolutif) » étaient classés comme des événements graves.

Les événements indésirables entraînant des symptômes autres que légers et transitoires pendant ou après une intervention de puncture physiothérapique avec aiguilles sèches sont rares. Toutefois, le pneumothorax et les lésions des nerfs périphériques demeurent les principales sources de préoccupation, puisqu'ils sont, du moins en partie, imputables à une erreur du clinicien.

(JACC. 2026;70(2):161-183)

MOTS CLÉS: syndrome douloureux myofascial, points gâchettes myofasciaux, puncture physiothérapique avec aiguilles sèches, présentation des données, revue narrative, événements indésirables

sient bruising, bleeding and pain⁹. However, rare disabling and potentially life-threatening events such as nerve injury and pneumothorax do occur.^{10,11}

Recently, the quality of reporting of DN interventions has come under scrutiny with investigators highlighting inconsistency as an issue that undermines intervention fidelity and transparency.^{7,12,13} This issue, appears to extend to the reporting of undesired treatment effects with current levels of reporting making it difficult to appraise relative risk and patient impact across different events.

At present, a shared common framework for presenting deleterious DN effects does not exist and one point of departure to address this issue, is through the use of standardised terminology. A preliminary scoping of available literature indicates that undesired treatment effects of DN appear to be described through a number of terms such as 'negative effects,' 'complications', 'adverse events' and 'adverse reactions'. Similarly, the level of impact of undesired treatment effects appear inconsistently categorised.^{7,9,14}

Our aim in this investigation was to summarise available literature describing undesired effects associated with DN, in order to identify common parlance. We furthermore attempted to categorise the types and severity of phenomena encountered. Additionally, we explored touchpoints for consistent clinical communication and future avenues of enquiry.

Methods

Search strategy

Our narrative review was constructed in accordance with the PRISMA checklist and explanation for scoping reviews.^{15, 16} Four keywords and their synonyms were identified from the research question to create the search query; *unintended, non-therapeutic, effect* and *dry needling*. Based on these a search strategy was created with the assistance of an expert librarian and searches performed in six search engines, namely: Scopus, Cochrane, CINAHL, Sports Medicine & Education Index, Web of Science and PubMed. The search was performed during October 2023 and updated in January 2026.

Eligibility criteria

Based on manageability and project scope considerations, we included contemporary literature published between 2013 and 2025 reporting undesired treatment effects or debates within DN. As such we included human Randomised Trials, cohort studies, clinical trials, case reports, case series, book chapters, surveys, and interview designs.

Data management and extraction

EndNote 20.6 was used for managing retrieved reports and screening titles and abstracts. Included studies were subsequently moved to Covidence for full text screening and inclusion.¹⁷ Two reviewers (MSP and JF) independently screened titles and abstracts according to standardised decision rules (see figure 1). In case of disagreement, a third screener (CM) stood as referee.

Due to delays in publication review process, we updated our search to include relevant studies in the period 2023-2025. This search was performed in January 2026. In this regard, CM and EV screened search results manually after which papers were included through consensus. From the included reports, we extracted details regarding the undesired treatment effects. These included the

term(s) used to describe the event, the symptoms/signs experienced.

Data analysis and synthesis

By adapting the Rheumatology Common Toxicity Criteria to our context, we attempted a classification of undesired treatment effects.¹⁸ To be considered mild, the patient must be asymptomatic or produce transient symptoms. Additionally, the effect must last less than a week, not alter the person's lifestyle and/or only require over-the-counter medication to resolve. Moderate undesired treatment effects are symptomatic, they last 1-2 weeks, only occasionally alter lifestyle and/or relieved by medication. Severe undesired treatment effects trigger prolonged reversible symptoms, result in major functional impairment and/or hospitalisation for less than 24 hours. Lastly, potentially life-threatening undesired treatment effects place the patient at risk of death and result substantial and/or potentially permanent disability or hospitalised for more than 24 hours. For the categorisation of undesired effects, we included only those studies reporting sufficient clinical data.

Results

The search resulted in including 87 articles for consideration and analysis from the 8909 articles that were screened: 3381 from Scopus, 1215 from Cochrane, 370 from CINAHL, 799 from Sports Medicine and Education Index, 2636 from Web of Science and 508 from PubMed. The PRISMA flow diagram of the search strategy is presented in Figure 1.

Terms used to describe unique undesired treatment effects

Adverse event (AE) was the most common term used to describe undesired treatment effects, although *adverse effects* and *adverse events* appear to have been used interchangeably. In addition, terms such as *side effects*, *complications* and *adverse reactions* were also reported (see Table 1). Finally, 11 studies omitted reporting any term. A descriptive table of included studies including details on the design, purpose, descriptive terms, recorded undesired treatment effects and intervention target can be found in Appendix 1.

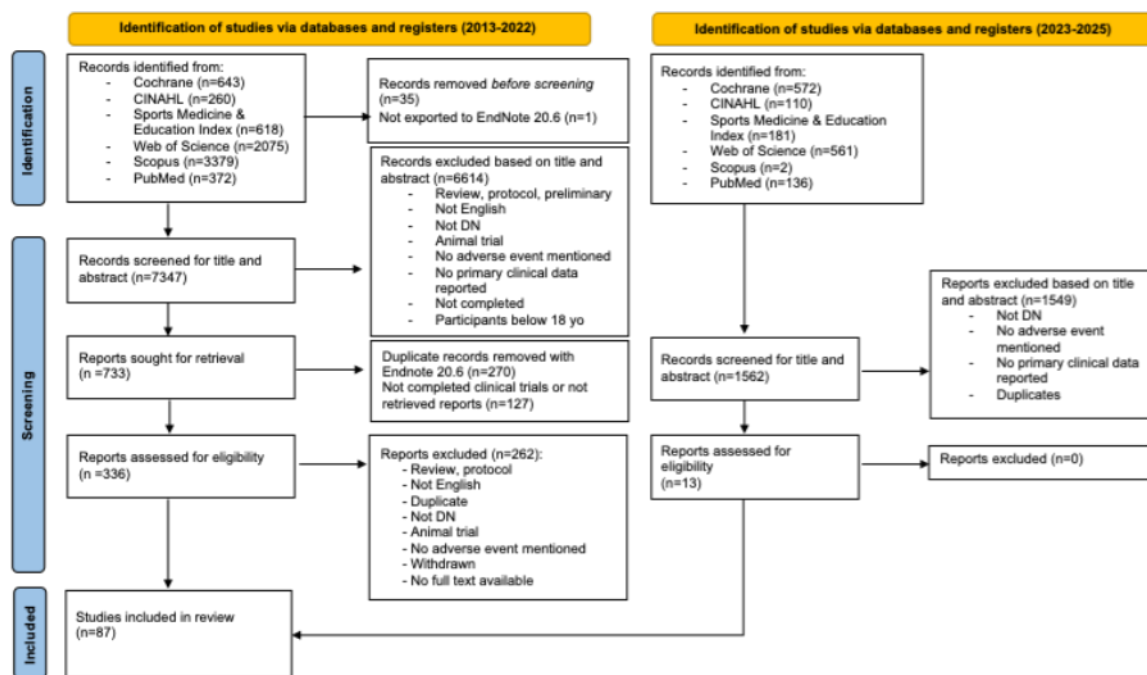


Figure 1.

PRISMA flow diagram illustrating the search strategy, including the initial and the updated searches.

Frequency of undesired treatment effects

A total of 130 undesired intervention effects were reported with “post-needling pain and soreness” (n:44), “bleeding or bruising” (n:18), and “pain during treatment” (n:14) constituting the most frequent ones (see Figure 2). We attempted to group similar AE types together, where possible, in order to limit redundancy. For example, events like “haematoma”, “slight bruising”, “local hematoma”, or “minimal localised bruising” were grouped under the umbrella term “Bleeding or bruising”. This process resulted in 31 distinct AEs.

Categorisation of undesired treatment effects identified across available literature

Inspired by the Rheumatology Common Toxicity Criteria,

16 AEs met the criteria of “Mild to moderate”, five AEs were categorised as “Severe” and only one AE was identified as “Potentially life-threatening”, with eight AEs having insufficient details reported thus not categorized by severity. “Pneumothorax (self-limiting)”, “Pneumothorax”, “Dysautonomia”, “Nerve injury”, and “Acute spinal epidural haematoma” were reported as severe AEs, while the only potentially life-threatening AE reported was “Pneumothorax (bilateral)”. The details of the categorisation are presented in Figure 2.

In eight instances no data on the effects were reported, and in four instances the severity of the effects reported could not be completed due to missing data (see also Appendix 1).

Table 1.
Adverse events by frequency of recording

Term used	Adverse event	Adverse effect	Side effect	Complication	Adverse reaction	Adverse symptom	Negative effect	Treatment reaction
Frequency	48	22	9	5	2	1	1	1

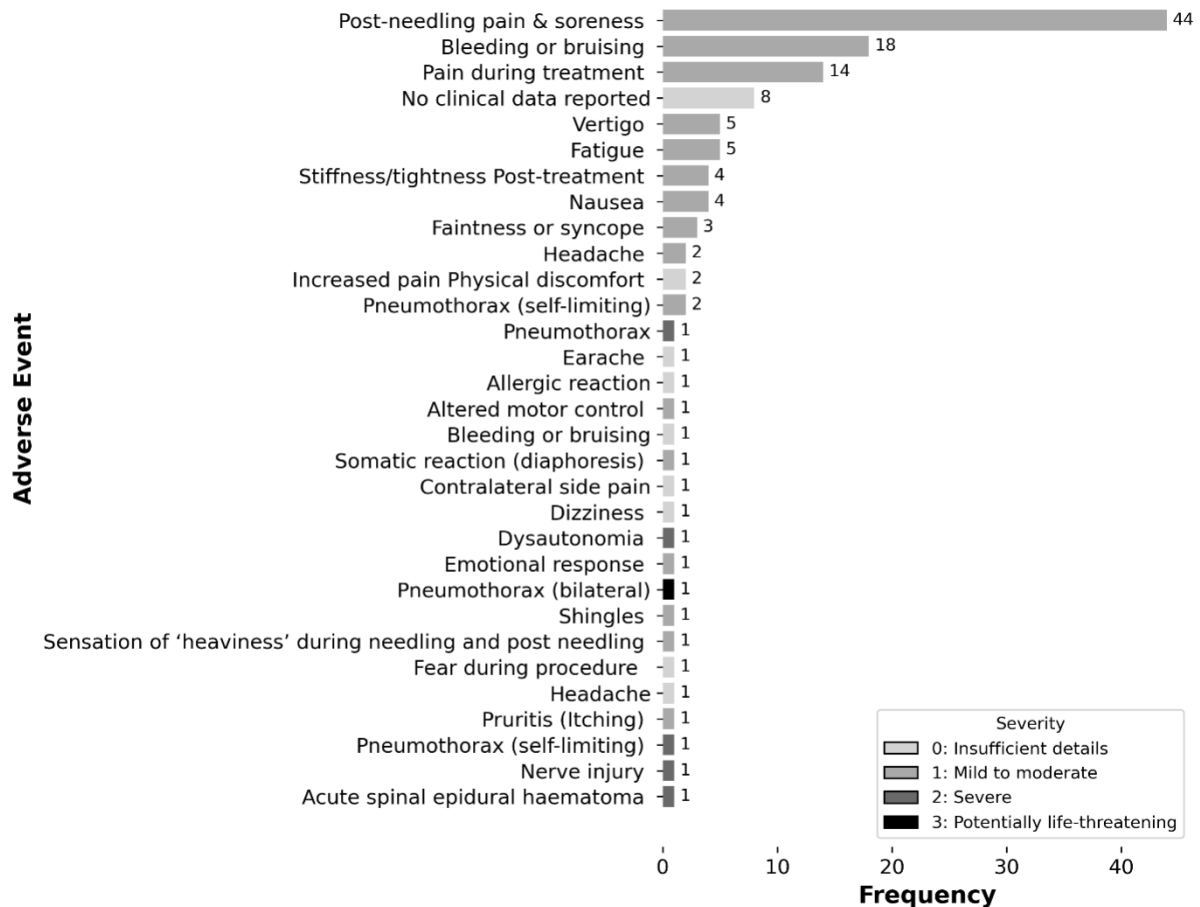


Figure 2.
Frequency and severity of AEs reported in RCTs.

Discussion

Our study supports current literature highlighting common AEs and their substantive under reporting in randomised controlled trials using DN^{12, 14, 19}. Additionally, though, our investigation provides novel insights relevant to the development of a common framework for reporting AEs. In this regard, we offer selected examples from our observed data for consideration.

Pneumothorax-Variable term, variable impact

It has previously been argued that, in order to be of use in clinical management, reporting of untoward treatment effects should not only elucidate both potential risk and severity, but also actual impact on the patient.^{20, 21}

In our study, the occurrence of a pneumothorax was categorised as a severe adverse event¹⁰, a potentially life-threatening adverse effect^{22, 23}, and a mild to moderate complication^{22, 24}. These results highlight the variable impact of a pneumothorax, despite the seriousness of its occurrence. However, it additionally highlights that the descriptive terms themselves do not carry equivalence in the literature. For example, in the case of adverse event versus effect, the former infers no causality between the DN intervention and observed phenomenon, whereas the latter does.²⁵

Peripheral nerve injury- impact and operator error

Current reporting offers little insight into the likelihood

of clinician error in relation to observed harmful effects.²⁶ This is an important consideration as severe and life-threatening harmful effects appear, at least in part, associated with operator error. A case in point is the issue of peripheral nerve injury. We identified only a single instance of nerve injury-related AE.²⁷ However, it resulted in permanent disability and occurred immediately post needle insertion. The position of vulnerable peripheral nerves, in this instance the radial nerve, can be predicted via the use of anatomical landmarks, however, this requires a high level of clinical anatomical competency and as such increases procedure risk.²⁸

Post-needle soreness- AE or not?

Post-needle pain and soreness represents almost 34% of all AEs recorded in the literature and is uniformly observed as 'mild'. However, an important question remains unresolved with respect to this phenomenon. In brief, the conventional view espoused is that post-needle soreness results as a result of a micro-injury inflammatory response induced by DN insertion.⁵ This view is essentially grounded in observations of a positive correlation between needle insertion frequency and patient reported soreness. However, a key clinical sign of a clinically effective DN intervention is the appearance of the so-called local twitch response (LTR), which is interpreted as the stimulation of hyperexcitable, dysfunctional skeletal muscle motor endplates. The removal of which, by means of repeated DN insertion, sets in motion normalisation of the muscle excitation-contraction apparatus, resulting in pain reduction and eventual function.²⁹ Although, beyond the scope of this investigation resolve, it would be prudent to pose the question whether low level post-needle soreness meets the definition of an AE, as it can reasonably be argued to be an injection site reaction occurring as part of a pre-planned procedure.³⁰

Future research

By resolving the concerns regarding internal validity in research protocols utilizing DN and satisfying patient safety standards, two significant stumbling blocks for greater inclusion of DN in treatment guidelines can be removed. It is therefore imperative that the state-of-the-art is moved forward through further conceptual clarification followed by consensus processes such as Delphi protocols.^{13,31} Areas of focus might include:

- An extension of the CONSORT guidelines governing the reporting of dry needling interventions,³²
- terminology used to describe AEs and,
- standardisation of AE reporting, for example the adopting of severity grading scales³³.

For the clinician

An acupuncture qualification may allow a practitioner to offer DN as part of their scope of practice. However, procedurally speaking DN and acupuncture are clearly distinct. As such, we would not encourage practitioners to rely on competency overlap, but rather to undergo specific DN instruction. In this way practitioners can better satisfy scrutiny regarding psychomotor skills and clinical competencies required to minimize risk, whilst optimising clinically effectiveness. With regards to psychomotor skills, applied anatomy plays a key role and we would therefore encourage visualisation of procedures through, for example, the use of diagnostic ultrasound.^{33, 34} With regards to clinical competency, focus on patient risk assessment and seeking informed consent are encouraged. Risk assessment should be integrated as a standard component of patient journals where DN is considered as a treatment option. Moreover, it should minimally include patient-related factors (e.g. medication, allergies, needle anxiety), procedure-related factors (e.g. number and location of trigger points) and potential impact (e.g. work, leisure/sport). With respect to informed consent, rare but severe AEs should be disclosed when relevant.

In the interim, and as a means of assisting clinicians and researchers, we offer a common sense guideline of the AE landscape in the following infographic (see Figure 3, below):

Strengths

This investigation used a novel methodology to systematically describe and appraise AEs using a number of search engines and therefore including a variety of source data. This approach made it possible to descriptively report on current data, but also to specifically highlight areas where reporting can be improved.

Limitations

We adapted a rheumatology guideline for the reporting of AEs. As this tool has a focus on DN-related AEs and its sequela, an argument can be made that the instrument was

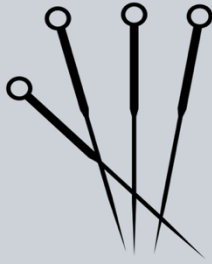
Future research	For the Clinician
 • Consort Guidelines Extension- Standardised reporting of DN interventions • AE Terminology- Unified language for describing adverse events across studies • AE severity Grading Scales- Adoption of standardised adverse event reporting and classification	 • Psychomotor skills training- Dry needle specific • Risk Assessment- Patient-related, Procedure-related, Post-intervention impact

Figure 3.
A common sense guideline of the AE landscape.

not a perfect fit for a manual intervention setting. However, as previously argued the instrument's function was to highlight variances in reporting, which did not require a customized tool. Our paper aimed to capture trends in the reporting of undesired treatment effects, rather than an exhaustive synthesis of AE reporting presenting precise incidences of reported incidences.

Conclusion

We observed a substantial variance in the parlance used to describe undesired treatment effects associated with DN across a variety of current literature. The term 'adverse event' is most commonly used across existing literature, but other terms such as 'adverse effect', 'side effect' and 'complication' also appear frequently. These terms appear to be used interchangeably. More nuanced reporting is required in order to clarify potential risk and actual impact of any particular adverse event. Additionally, terms denoting potential clinical error require consideration. Consistently adopting the term AE would be a helpful first step to address the status quo, however, consensus-gen-

erating investigations are urgently required to standardise reporting of AEs in intervention studies, enhance patient safety and to support shared decision-making practices. The occurrence of pneumothorax and peripheral nerve injury are the AEs of greatest concern in DN, with the latter perhaps being the most difficult to avoid.

CRedit authorship contribution statement

CM: Conception and design of the work, interpretation of data for the work, drafting the work and revising it critically for important intellectual content.

MSP: Conception and design of the work, data acquisition, drafting the work and revising it critically for important intellectual content.

JF: Conception and design of the work, data acquisition.

EV: Conception and design of the work, revising the work critically for important intellectual content.

All authors approved the final manuscript. CM is study guarantor.

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Appendix 1.

Descriptive table of included studies by design, purpose, descriptive terms, recorded undesired treatment effects and intervention target.

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
1.	³⁵ <i>Dry needling.</i>	Clinical round table	Gain insight in how clinicians use dry needling.	Negative effect	No clinical data reported
2.	³⁶ <i>The effect of dry needling on gastrocnemius muscle stiffness and strength in participants with latent trigger points.</i>	RCT	The study assessed the short-term effect of two sessions of dry needling on muscle stiffness in individuals with latent myofascial trigger points in the gastrocnemius muscle.	Adverse event	Bleeding or bruising (Mild) Post needling pain & soreness (Mild)
3.	³⁷ <i>Comparing two dry needling interventions for plantar heel pain: a randomised controlled trial</i>	RCT	To compare the effectiveness of dry needling versus percutaneous needle electrolysis for improving the level of pain, function, and quality of life of patients suffering from plantar heel pain caused by myofascial trigger points.	Adverse event and adverse effect	Bleeding or bruising (Mild) Pain during treatment (Mild)
4.	³⁸ <i>Multidermatomal Shingles Occurrence Post-therapeutic Dry Needling (TDN) in a Saudi Woman</i>	Case report	We present a case of shingles following TDN.	No term reported	Pain during treatment (Mild) Bleeding or bruising (Mild) Shingles (Moderate)
5.	³⁹ <i>Short-Term Effects of Dry Needling with a Standard Exercise Program on Pain and Quality of Life in Patients with Chronic Mechanical Neck Pain</i>	RCT	To determine the short-term effects of dry needling with a standardised exercise program on pain and quality of life in patients with chronic mechanical neck pain.	Significant adverse event and mild adverse effect	Bleeding or bruising (Mild) Post needling pain & soreness (Mild)
6.	⁴⁰ <i>Effect of fascia dry needling on non-specific thoracic pain – A proposed dry needling grading system</i>	Case report	This case report describes the physical therapy management of a patient with fascia restriction using DN, posture education, and exercise therapy.	No term reported	Sensation of ‘heaviness’ during needling and post needling (Mild)
7.	⁴¹ <i>Effects of Kinesio Taping on Post-Needling Induced Pain After Dry Needling of Active Trigger Point in Individuals With Mechanical Neck Pain</i>	RCT	To determine the effectiveness of the application of kinesio taping on reducing induced pain after dry needling of active trigger points in the upper trapezius muscle in individuals with mechanical neck pain.	Adverse event	Post needling pain & soreness (Mild)
8.	⁴² <i>Effects of dry needling of active trigger points in the scalene muscles in individuals with mechanical neck pain: a randomized clinical trial</i>	RCT	To compare the effects of dry needling versus pressure release over scalene muscle trigger points on pain, related disability, and inspiratory vital capacity in individuals with neck pain.	Adverse event Adverse effect	Post needling pain & soreness (Mild)
9.	⁴³ <i>Inclusion of trigger point dry needling in a multimodal physical therapy program for postoperative shoulder pain: A randomized clinical trial</i>	RCT	The purpose of this study was to evaluate the effects of including one session of trigger point dry needling into a multimodal physiotherapy treatment on pain and function in postoperative shoulder pain.	Adverse event Adverse effect	Post needling pain & soreness (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
10.	⁴⁴ <i>Localization of Muscle Edema and Changes on Muscle Contractility after Dry Needling of Latent Trigger Points in the Gastrocnemius Muscle.</i>	Between-group design	To identify the presence of muscle edema after the application of dry needling and to investigate if the identified muscle edema was associated with changes in muscle contractile properties and soreness.	No term reported	Post needling pain & soreness (Mild)
11.	⁴⁵ <i>Effectiveness of deep dry needling vs ischemic compression in the latent myofascial trigger points of the shortened triceps surae from triathletes on ankle dorsiflexion, dynamic, and static plantar pressure distribution: a clinical trial.</i>	RCT	To determine the immediate efficacy of a single session of deep dry needling versus ischemic compression in a latent myofascial trigger point of the shortened triceps surae from triathletes for ankle dorsiflexion and redistribution of plantar pressures and stability.	Adverse effect	Bleeding or bruising (Mild)
12.	⁴⁶ <i>Acute spinal epidural hematoma as a complication of dry needling: A case report</i>	Case report	Describes the complication of epidural hematoma induced by dry needling.	Adverse event	Acute spinal epidural haematoma (Severe)
13.	¹⁴ <i>Adverse events associated with therapeutic dry needling.</i>	Prospective questionnaire design.	Survey to determine the adverse effects in DN	Major and minor adverse event	No clinical data reported
14.	⁹ <i>Adverse events following trigger point dry needling: A prospective survey of chartered physiotherapists</i>	Prospective questionnaire design	To determine the incidence of adverse events associated with the use of trigger point dry needling as practiced by a sample of physiotherapists with David G Simons Academy training in Ireland.	Common and uncommon adverse event	No clinical data reported
15.	⁴⁷ <i>Rate and maintenance of improvement of myofascial pain with dry needling alone vs. dry needling with intramuscular electrical stimulation: a randomized controlled trial.</i>	RCT	To determine the difference in rate and maintenance of improvement of pain and disability for dry needling compared to dry needling with intramuscular electrical stimulation in myofascial pain syndrome.	Adverse event	Faintness or syncope (Mild)
16.	⁴⁸ <i>A Systematic Dry-Needling Treatment to Support Recovery Post training for Division Ice Hockey Athletes: An Exploration Case Series.</i>	Case series	To explore the use of a systematic dry needling lower extremity protocol in healthy collegiate ice hockey athletes to promote recovery post-exercise	Adverse reaction	Pain during treatment (Mild)
17.	⁴⁹ <i>Dry Needling on the Infraspinatus Latent and Active Myofascial Trigger Points in Older Adults with Nonspecific Shoulder Pain: A Randomized Clinical Trial.</i>	RCT	To demonstrate that only one intervention on one latent trigger point with dry needling of the infraspinatus can improve motor function and reduce the nociceptive input, in nonspecific shoulder pain and in the satellite trigger point located in the referred pain area in older adults, when added to the treatment of the key active trigger point.	Adverse effect	Bleeding or bruising (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
18.	⁵⁰ Short-term improvement following dry needle stimulation of tender points in fibromyalgia.	RCT	To investigate the efficacy of dry needling as a complementary treatment of severely affected Fibromyalgia patients. To establish whether this procedure might still yield some clinical improvement 6 weeks post-intervention.	Adverse effect	Increased pain Physical discomfort Insufficient details reported
19.	⁵¹ The effects of dry needling to the thoracolumbar junction multifidi on measures of regional and remote flexibility and pain sensitivity: A randomized controlled trial.	RCT	To describe the effects of dry needling applied to the T12 and L1 multifidi on regional and remote flexibility.	Adverse event	Post needling pain & soreness (Mild)
20.	⁵² Effectiveness of trigger point dry needling for plantar heel pain: A randomized controlled trial.	RCT	To evaluate the effectiveness of trigger point dry needling for treatment of plantar heel pain	Adverse event	Post needling pain & soreness (Mild) Bleeding or bruising (Mild)
21.	⁵³ Effectiveness of dry needling for upper extremity spasticity, quality of life and function in subacute phase stroke patients.	Non randomized single-centre study	To evaluate the effectiveness of deep dry needling on affected arm functionality throughout 8 weeks of treatment in patients with stroke in the subacute phase.	Adverse effect Adverse event	Bleeding or bruising (Mild)
22.	¹⁰ Pneumothorax complication of deep dry needling demonstration.	Case report	Reports a case of a 55-year-old female experiencing a pneumothorax after deep dry needling of the Iliocostalis muscle.	Adverse event	Pneumothorax (self-limiting) (Severe)
23.	²³ “Acupuncture-D” – Bilateral Pneumothoraces Following Dry Needling.	Case report	Reports a case of a 24-year-old female presenting with bilateral pneumothoraces following dry needling.	Adverse effect	Pneumothorax (bilateral) (Life threatening)
24.	¹¹ Efficacy of exercise on postneedling soreness: a randomized controlled trial.	RCT	To investigate the efficacy of concentric, eccentric, and isometric exercise protocols on the post-needling soreness after the dry needling of latent myofascial trigger points in the medial gastrocnemius muscle.	Adverse effect	Post needling pain & soreness (Mild)
25.	⁵⁴ Dry needling and upper cervical spinal manipulation in patients with temporomandibular disorder: A multi-center randomized clinical trial.	RCT	To compare the effects of dry needling and upper cervical spinal manipulation with interocclusal splint therapy, diclofenac, and temporomandibular joint mobilization in patients with temporomandibular disorder.	Adverse event	Post needling pain & soreness (Mild) Bleeding or bruising (Mild) Fatigue (Mild) Headache (Mild) Nausea (Mild)
26.	⁵⁵ Effectiveness of Inclusion of Dry Needling in a Multimodal Therapy Program for Patellofemoral Pain: A Randomized Parallel-Group Trial.	RCT	To compare the effects of adding trigger point dry needling to a manual therapy and exercise program on pain, function, and disability in individuals with patellofemoral pain.	Adverse event	Post-needling pain & soreness (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
27.	⁵⁶ <i>The Effect of Combining Spinal Manipulation and Dry Needling in Individuals With Nonspecific Low Back Pain.</i>	RCT	To evaluate physiologic and clinical outcomes, and exercise adherence in patients with LBP after receiving a combination of DN and SMT...	Side effect	Stiffness Post-treatment (Mild) Fatigue Post-treatment (Mild) Muscle tightness Post-treatment (Mild) Vertigo (Mild)
28.	⁵⁷ <i>Effects of previous experience with dry needling therapy on blinding effectiveness and pain outcomes in people with neck pain: A preliminary sham-controlled study.</i>	RCT	To explore whether previous experience of dry needling could influence blinding effectiveness and clinical outcomes, including pain and self-perceived improvement, in people with neck pain.	Adverse event	Post-needling pain & soreness (Mild)
29.	⁵⁸ <i>Efficacy of dry needling with the fascial winding technique in reducing the percentage of surgery in carpal tunnel syndrome: A randomized clinical trial.</i>	RCT	To determine the proportion of wrists with CTS in which the application of DN avoids surgery.	Adverse effect	Pain during treatment (Mild)
30.	⁵⁹ <i>A survey of American physical therapists' current practice of dry needling: Practice patterns and adverse events.</i>	Cross-sectional observational survey	To estimate the proportion of physical therapists currently performing dry needling and report current practices patterns. Secondary aims were to report the numbers of minor and major adverse events and determine if these adverse events were related to therapist characteristics.	Adverse event	No clinical data reported
31.	⁶⁰ <i>Effectiveness of dry needling of rectus abdominis trigger points for the treatment of primary dysmenorrhoea: A randomised parallel-group trial.</i>	RCT	To compare the effectiveness of trigger point dry needling versus placebo needling, relative to an untreated control group, on pain and quality of life in primary dysmenorrhoea.	Adverse event	Post-needling pain & soreness (Mild)
32.	⁶¹ <i>A randomized trial of trigger point dry needling versus sham needling for chronic tension-type headache.</i>	RCT	To explore the effectiveness of trigger point dry needling in patients with chronic tension-type headache in reducing headache frequency, intensity and duration, and improvement of health-related quality of life.	Adverse effect	Pain and fear during procedure Insufficient details reported
33.	⁶² <i>Trigger point injections for myofascial pain in terminal cancer: a randomized trial.</i>	RCT	The efficacy and safety of a single TPI of a local anesthetic in hospitalized patients with incurable cancer and MPS-related pain.	Adverse event	Nausea (Mild) Fatigue (Mild) Bleeding or bruising (Mild)
34.	¹³ <i>Identifying which adverse events associated with dry needling should be included for informed consent: A modified e-Delphi study</i>	Delphi	To identify which AEs should be included in a risk statement for IC.	Adverse event	No clinical data reported

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
35.	⁶³ <i>Dry needling in clinical practice: A survey of Australian Physiotherapists</i>	Survey	The primary aim was to enhance understanding of why Australian physiotherapists use dry needling in clinical practice. Secondary aim was to explore Australian physiotherapists experiences with adverse events caused by dry needling.	Adverse event	No clinical data reported
36.	⁶⁴ <i>Effects of Dry Needling on Biomechanical Properties of the Myofascial Trigger Points Measured by Myotonometry: A Randomized Controlled Trial.</i>	RCT	To examine the effect of dry needling on the biomechanical properties of a latent medial myofascial trigger point of the soleus muscle compared with an adjacent point within the taut band measured by myotonometry.	Adverse event Adverse effect	Post-needling pain & soreness (Mild)
37.	⁶⁵ <i>Comparison of the effectiveness between dry needling with and without needle retention in myofascial trigger points in upper trapezius muscle: A randomized comparative trial.</i>	RCT	To compare the effect between dry needling with and without needle retention in the treatment of myofascial trigger points in the upper trapezius muscle	Complication	Post-needling pain & soreness (Mild)
38.	⁶⁶ <i>Baseline examination factors associated with clinical improvement after dry needling in individuals with low back pain.</i>	Quasi-experiment	To explore for associations between demographic, patient history, and physical examination variables and short-term improvement in self-reported disability following dry needling therapy performed on individuals with low back pain.	Adverse event	Fatigue (Mild) Vertigo (Mild) Nausea (Mild)
39.	⁶⁷ <i>Effect of dry needling on lumbar muscle stiffness in patients with low back pain: A double blind, randomized controlled trial using shear wave elastography.</i>	RCT	To compare the effects of dry needling to sham dry needling on lumbar muscle stiffness in individuals with low back pain (LBP) using SWE	Adverse event and side effect	Pain during treatment (Mild) Vertigo (Mild) Emotional response (Mild)
40.	⁶⁸ <i>Effect of dry-needling and exercise treatment on myofascial trigger point: a single-blind randomized controlled trial.</i>	RCT	To investigate the effectiveness of dry needling together with exercise therapy on pain, ultrasonographic parameters of myofascial trigger points, and upper trapezius muscles, and neck disability in patients with myofascial pain syndrome.	No term reported	Allergic reaction Insufficient details reported
41.	⁶⁹ <i>Comparing The Effects of Compression Contrast Therapy and Dry Needling on Muscle Functionality, Pressure Pain Threshold, and Perfusion after Isometric Fatigue in Forearm Muscles of Combat Sports Athletes: ...</i>	RCT	The acute effects of CT and DN on muscle tension, muscle strength, pressure pain threshold, and perfusion after isometric fatigue of forearm muscles	Side effect	Pain during treatment (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
42.	⁷⁰ Comparison of the short-term outcomes between trigger point dry needling and trigger point manual therapy for the management of chronic mechanical neck pain: A randomized clinical trial.	RCT	To compare the effects of trigger point dry needling and manual therapy on pain, function, pressure pain sensitivity, and cervical range of motion in subjects with chronic mechanical neck pain.	Adverse event	Post-needling pain & soreness (Mild)
43.	⁷¹ Postneedling soreness and tenderness after different dosages of dry needling of an active myofascial trigger point in patients with neck pain: A randomized controlled trial	RCT	To compare the prevalence, intensity, and duration of post-needling soreness and tenderness after different dosages of deep dry needling and analyze the influence on post-needling soreness of psychological factors and other factors involved in the deep dry needling process.	No term reported	Post-needling pain & soreness (Mild)
44.	⁷² Postneedling Soreness and Tenderness After Different Dosages of Dry Needling of an Active Myofascial Trigger Point in Patients With Neck Pain: A Randomized Controlled Trial	RCT	To investigate the effect of ischemic compression versus placebo and control on reducing post-needling soreness of one latent myofascial trigger point and on improving cervical range of motion in asymptomatic subjects.	Adverse effect	Post-needling pain & soreness (Mild)
45.	⁷³ Postneedling soreness after deep dry needling of a latent myofascial trigger point in the upper trapezius muscle: Characteristics, sex differences and associated factors.	RCT	To assess the intensity and duration of post-needling soreness and tenderness after deep dry needling of a trapezius latent myofascial trigger point, to evaluate the possible differences in post-needling soreness between sexes and to analyze the influence on post-needling soreness of factors involved in the dry needling process.	No term reported	Post-needling pain & soreness (Mild)
46.	⁷⁴ Effects of spray and stretch on postneedling soreness and sensitivity after dry needling of a latent myofascial trigger point.	RCT	To investigate the effect of spray and stretch versus control on reducing post needling soreness of one latent myofascial trigger point and whether higher levels of psychological distress are associated with increased post-needling pain intensity.	No term reported	Post-needling pain & soreness (Mild)
47.	⁷⁵ Effects of dry needling in the sternocleidomastoid muscle on cervical motor control in patients with neck pain: a randomised clinical trial.	RCT	To determine the changes produced by trigger point dry needling of sternocleidomastoid in patients with neck pain, and to observe how it might modify cervical motor control.	Adverse effect	Contralateral side pain Headache Dizziness Earache Haematoma Insufficient details reported on severity
48.	⁷⁶ Trigger point acupuncture (Dry Needling) and associated fecal incontinence in multiple sclerosis: A case report.	Case report	Reports a case of fecal incontinence in a patient with Multiple Sclerosis seeking dry needling (or trigger point acupuncture) treatment	Adverse reaction	Dysautonomia (Severe)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
49.	²⁷ Radial nerve injury following dry needling.	Case report	Present a case of radial nerve injury following DN	Complication	Nerve injury (Severe)
50.	⁷⁷ Short- Term changes in neck pain, widespread pressure pain sensitivity, and cervical range of motion after the application of trigger point dry needling in patients with acute mechanical neck pain: A randomized clinical trial.	RCT	To determine the effects of trigger point dry needling on neck pain, widespread pressure pain sensitivity, and cervical range of motion in patients with acute mechanical neck pain and active trigger points in the upper trapezius muscle.	Adverse event	Post-needling pain & soreness (Mild)
51.	⁷⁸ Post-needling soreness and trigger point dry needling for hemiplegic shoulder pain following stroke.	RCT	To determine the presence of post-needling induced pain in subjects who had suffered a stroke and received trigger point dry needling, and to investigate the effects of including trigger point dry needling into a rehabilitation program for shoulder pain in this population.	No term reported	Post-needling pain & soreness (Mild)
52.	⁷⁹ The effect of combining physiotherapy with dry needling in patients with cervical spondylosis:...	RCT	The contribution of DN applied to concomitant active TPs in the upper trapezius muscle on the treatment outcomes of physiotherapy in CS.	Adverse event	No clinical data reported
53.	⁸⁰ Pneumothorax After Dry Needling of Intrascapular Muscles Using a Rib Bracketing Technique: ...	Case report	To describe the clinical presentation, progression, and outcome of a patient who developed a pneumothorax following DN.	Adverse event	Pneumothorax (Severe)
54.	⁸¹ Dry needling in the management of patients meeting clinical diagnostic criteria for subacromial pain syndrome: a case series.	Case series	To describe the use of dry needling, in conjunction with exercise, as a management strategy for patients meeting clinical diagnostic criteria of subacromial pain syndrome and to observe the short- and intermediate-term effects of dry needling with therapeutic exercise in this population.	Adverse event	Pain during treatment (Mild) Bleeding or bruising (Mild)
55.	⁸² The Effect of Adding Dry Needling to Physical Therapy in the Treatment of Cervicogenic Headache: A Randomized Controlled Trial.	RCT	To compare the long-term effect of adding real or sham dry needling with conventional physiotherapy in cervicogenic headache	Adverse event	Post-needling pain & soreness (Mild)
56.	⁸³ Dry needling as an adjunct treatment to multimodal rehabilitation protocol following rotator cuff repair surgery: ...	RCT	to determine the effects of MTrP-DN compared to S-DN in a MRh on postoperative shoulder pain for patients following RCR.	Adverse event	Bleeding or bruising (Mild) Pain during treatment (Mild) Post needling pain and/or soreness (Mild)
57.	⁸⁴ Effect of dry needling injection and kinesiotaping on pain and quality of life in patients with mechanical neck pain.	RCT	To evaluate the effect of KT on posterior cervical spine and DN into a posterior paracervical muscle of patients with MNP	Minor reversible adverse event	Post-needling pain & soreness (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
58.	⁸⁵ <i>Dry needling has lasting analgesic effect in shoulder pain: a double-blind, sham-controlled trial</i>	RCT	We evaluated the pattern of analgesic efficacy and local sensory changes of a single session of dry needling for Myofascial pain syndrome in patients with chronic shoulder pain.	Major adverse event Minor side effect	Post-needling pain & soreness (Mild)
59.	²² <i>Dry needling-induced pneumothorax.</i>	Case report	Describe a case in which a pneumothorax developed after dry needling of the infraspinatus, supraspinatus, rhomboid, and paraspinal muscles.	Adverse effect	Pneumothorax (self-limiting) (Moderate)
60.	⁸⁶ <i>Comparison of ozone and lidocaine injection efficacy vs dry needling in myofascial pain syndrome patients.</i>	RCT	To evaluate efficacy of ozone injection in myofascial pain patients, compared with two currently used methods including lidocaine injection and dry needling.	Minor adverse event	Post-needling pain & soreness (local) (Mild)
61.	⁸⁷ <i>Comparing the efficacy of dry needling and extracorporeal shock wave therapy in treatment of plantar fasciitis.</i>	RCT	To compare the improvement of pain and function in patients with <i>plantar fasciitis</i> treated with extracorporeal shockwave and dry-needling therapy.	Side effect	Post-needling pain & soreness (Mild)
62.	⁸⁸ <i>Dry needling in chronic abdominal wall pain of uncertain origin.</i>	Case series	To report the effect of dry needling treatment for patients who suffer from chronic abdominal wall pain of uncertain etiology and in whom specific myofascial trigger points were identified	Side effect	Post-needling pain & soreness (Mild)
63.	⁸⁹ <i>Comparison of the effectiveness of botulinum toxin, dry needling, pharmacological treatment, and manual therapy for bruxism-induced myalgia: a prospective randomized study</i>	RCT	To evaluate and compare the effectiveness of BoNT-A, DN, PT and MT	Side effect	Pruritis (Itching) (Mild)
64.	⁹⁰ <i>Trigger point dry needling and proprioceptive exercises for the management of chronic ankle instability: A randomized clinical trial.</i>	RCT	To compare the effects of combined trigger point dry needling and proprioceptive and strengthening exercises to proprioceptive and strengthening exercises on ankle pain and function.	Adverse event	Post-needling pain & soreness (Mild)
65.	⁹¹ <i>Effects of Low-Load Exercise on Postneedling-Induced Pain After Dry Needling of Active Trigger Point in Individuals With Subacromial Pain Syndrome.</i>	RCT	To determine the effectiveness of low-load exercise on reducing post needling-induced pain after dry needling of active trigger points in the infraspinatus muscle.	Adverse event	Post-needling pain & soreness (Mild)
66.	⁹² <i>Is a Combination of Exercise and Dry Needling Effective for Knee OA?</i>	RCT	To assess the effectiveness of adding dry needling to an exercise program on pain intensity and disability in patients with knee osteoarthritis.	Adverse event and common side effect	Post-needling pain & soreness (Mild) Bleeding or bruising (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
67.	⁹³ <i>The influence of verbal suggestion on post-needling soreness and pain processing after dry needling treatment: An experimental study.</i>	RCT	To examine the effect of verbal suggestion on post-needling soreness in healthy subjects after dry needling over trapezius muscle.	No term reported	Post-needling pain & soreness (Mild)
68.	⁹⁴ <i>Treatment of supraspinatus tendinopathy with ultrasound guided dry needling.</i>	Case report	To describe the treatment of a patient with tendinopathy using sonographically guided dry needling.	No term reported	Post-needling pain & soreness (Mild)
69.	⁹⁵ <i>Effect of Dry-Needling Induced Muscle Soreness (DIMS) on the Severity of Pain Post Deep Trigger Point Needling.</i>	RCT	To evaluate the correlation between the deep dry-needling induced muscle soreness and severity of shoulder pain in patients with myofascial pain.	Common adverse event	Post-needling pain & soreness (Mild)
70.	⁹⁶ <i>Comparison of efficacy of ultrasound-guided platelet rich plasma injection versus dry needling in lateral epicondylitis—a randomised controlled trial</i>	RCT	To compare the efficacy of USG-guided PRP injection versus USG-guided dry needling in treatment of LE.	Adverse event	Post-needling pain & soreness (Mild)
71.	⁹⁷ <i>Intramuscular stimulation vs sham needling for the treatment of chronic midportion Achilles tendinopathy: A randomized controlled clinical trial.</i>	RCT	Is intramuscular stimulation more effective than sham intramuscular stimulation/dry needling for the treatment of Achilles tendinopathy?	Adverse event Needling side effect	Post-needling pain & soreness (Mild) Pain during treatment (deep ache) (Mild) Bleeding or bruising (Mild)
72.	⁹⁸ <i>Dry-needling and exercise for chronic whiplash-Associated disorders: A randomized single-blind placebo-controlled trial.</i>	RCT	To investigate the effectiveness of dry-needling and exercise compared with sham dry-needling and exercise for people with chronic whiplash-associated disorders.	Serious adverse event Adverse effect	Post-needling pain & soreness (Mild)
73.	⁹⁹ <i>Dry needling combined with guideline- based physical therapy provides no added benefit in the management of chronic neck pain: A randomized controlled trial.</i>	RCT	To determine the added benefit of combining dry needling with a guideline-based physical therapy treatment program consisting of exercise and manual therapy on pain and disability in people with chronic neck pain.	Serious or significant adverse event Mild adverse effect	Post-needling pain & soreness (Mild) Headache (Mild)
74.	¹⁰⁰ <i>Ultrasound-guided dry needling decreases pain in patients with piriformis syndrome.</i>	RCT	To investigate the effect of dry needling on buttock pain intensity in patients with Piriformis syndrome.	Major adverse effect	Bleeding or bruising (Mild) Pain during treatment (Mild)
75.	¹⁰¹ <i>Comparison of two different dry-needling techniques in the treatment of myofascial pain syndrome.</i>	RCT	To compare the efficacy of two different dry needling techniques in myofascial pain syndrome.	Adverse event profile	Post-needling pain & soreness (Mild) Nausea (Mild) Vertigo (Mild) Pain during treatment (burning sensation) (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
76.	¹⁰² Elite athletes' experiences of musculoskeletal pain management using neuroanatomical dry needling: A qualitative study in Swedish track and field.	Qualitative study	To investigate how elite track and field athletes with a history of musculoskeletal pain describe their perceptions of clinical treatments based on dry needling guided by a neurological map.	Severe treatment reaction	Post-needling pain & soreness (Mild) Muscle stiffness likened to cramping (Mild) Fatigue (Mild) Altered motor control (Mild)
77.	¹⁰³ Effectiveness of dry needling in the treatment of neck pain and disability associated with myofascial trigger points.	Retrospective cohort study	To evaluate the effectiveness of dry needling with fast-in and fast-out technique for myofascial trigger points in the upper trapezius muscle associated with neck pain.	Complication	Post-needling pain & soreness (Mild)
78.	¹⁰⁴ Dry needling in lateral epicondylitis: a prospective controlled study.	RCT	To compared the outcomes of first-line treatment and dry needling	Complication	Bleeding or bruising (Mild) Pain during treatment (Mild)
79.	²⁴ A case with iatrogenic pneumothorax due to deep dry needling.	Case report	Case presentation of iatrogenic pneumothorax due to deep dry needling over the thorax.	Complication	Pneumothorax (self-limiting) (Mild)
80.	¹⁰⁵ Effects of pain neuroscience education and dry needling for the management of patients with chronic myofascial neck pain: a randomized clinical trial.	RCT	To observe the medium-term effects on pain, disability, and psychological factors of a combination of myofascial trigger point dry needling with pain neuroscience education versus dry needling alone versus control care as usual in patients with chronic neck pain.	Adverse effect	Post-needling pain & soreness (Mild)
81.	³³ Current State of Dry Needling Practices: A Comprehensive Analysis on Use, Training, and Safety	Survey	To provide an overview of the current practice of DN...	Adverse event	No clinical data reported
82.	¹⁰⁶ Efficacy of quadriceps vastus medialis dry needling in a rehabilitation protocol after surgical reconstruction of complete anterior cruciate ligament rupture.	RCT	To determine the pain intensity, range of motion, stability, and functionality improvements by adding quadriceps vastus medialis TrP-DN to the rehabilitation protocol provided to subacute ACL reconstructed patients.	Adverse effect	Bleeding or bruising (Mild) (One participant discontinued the study with no further information reported)
83.	¹⁰⁷ Short-term effects of two deep dry needling techniques on pressure pain thresholds and electromyographic amplitude of the lumbosacral multifidus in patients with low back pain – a randomized clinical trial.	RCT	To compare the effects of deep dry needling with and without needle manipulation on pressure pain thresholds and electromyographic amplitude of the lumbosacral multifidus.	Common adverse symptoms Minor adverse effect	Vertigo (Mild) Bleeding or bruising (Mild) Post-needling pain & soreness (Mild)

	Source	Design	Stated aim/purpose/question	Descriptive term(s) utilised	Effects reported and Categorisation(s)
84.	¹⁰⁸ <i>A pilot study examining the feasibility and effects of dry needling on pain during strength testing for individuals with bilateral patellofemoral pain and high kinesiophobia</i>	Cohort study	To examine the feasibility and fidelity of examining the effects of dry needling in those with bilateral PFP and high kinesiophobia...	Adverse event	Pain during treatment (Mild) Bleeding or bruising (Mild) Post-needling stiffness/tightness (Mild)
85.	¹⁰⁹ <i>Reflex anoxic seizures (Ras) during dry needling.</i>	Case report	Case description of tonic-clonic seizure ensuing after multiple needle insertions	Adverse event	Faintness or syncope (lasting 30 sec.) (Mild)
86.	¹¹⁰ <i>A comparison of dry needling and kinesiotaping therapies in myofascial pain syndrome: a randomized clinical study.</i>	RCT	To compare the effectiveness of dry needling and kinesiotaping therapies on pain, quality of life, depression, and physical function in the treatment of myofascial pain syndrome.	No term reported	Faintness or syncope (Mild)
87.	¹¹¹ <i>Ultrasound-guided miniscalpel-needle release versus dry needling for chronic neck pain: A randomized controlled trial.</i>	RCT	To compare ultrasound-guided miniscalpel-needle release versus ultrasound-guided dry needling for chronic neck pain	Adverse events	Pain during treatment (Mild) Somatic reaction (diaphoresis) (Mild)

RCT: Randomised controlled trial

Establishing research priorities in animal chiropractic: a mixed-methods study informed by interested parties

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Background: *Animal chiropractic is a relatively small subspecialty at the intersection of two well-established professions, chiropractic and veterinary medicine, and is commonly used to manage musculoskeletal conditions in animals. Despite increasing utilization, research guiding its clinical application remains limited.*

Objective: *To identify and prioritize research gaps in the animal chiropractic profession to establish interested party-informed research priorities.*

Établissement des priorités de recherche en chiropratique animale : *étude à méthodes mixtes tenant compte du point de vue des parties intéressées*

Contexte : *La chiropratique animale est une sous-spécialité relativement restreinte, à la croisée de deux professions bien établies, soit la chiropratique et la médecine vétérinaire. Elle est couramment utilisée dans la prise en charge des affections musculosquelettiques chez les animaux. Malgré son utilisation croissante, les recherches susceptibles d'orienter son application clinique demeurent limitées.*

Objectif : *Repérer et hiérarchiser les lacunes de la recherche dans le domaine de la chiropratique animale afin d'établir des priorités de recherche tenant compte du point de vue des parties intéressées.*

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Conflicts of Interest:

The authors have no disclaimers or competing interests to report in the preparation of this manuscript. Canadian Memorial Chiropractic College (CMCC) has received financial donations from the American Veterinary Chiropractic Association (AVCA) to support technology and research development; these funds did not influence the design nor the results of this study. The AVCA covered travel expenses for CMCC-affiliated investigators to attend its Annual Conference for keynote lectures and delivering workshops. The AVCA had no role in the design, conduct, or analysis of this study, aside from permitting its execution during the conference.

Methods: *A sequential mixed-methods design was used, comprising an online topic identification survey, in-person Nominal Group Technique sessions, and a final prioritization survey.*

Results: *Thirteen major research topics and 71 subtopics were identified and prioritized by Veterinarians and Chiropractors from Canada and the United States. The top five priorities were objective outcomes, safety and adverse events, condition-specific treatment effects, mechanisms of manual therapies, and treatment comparisons.*

Conclusion: *This study identified research priorities informed by interested parties to inform the future studies and strengthen grant applications by clearly demonstrating the demand for research in specifically identified areas.*

(JCCA. 2026;70(2):184-202)

KEY WORDS: veterinary chiropractic; animal chiropractic; musculoskeletal disorders; research prioritization; complementary and alternative veterinary medicine; chiropractic education; evidence-informed practice

Introduction

Musculoskeletal (MSK) conditions, such as low back pain, are the leading cause of disability worldwide¹, resulting in substantial burdens to individuals, society, and health care systems^{1,2}. In human health care, chiropractors have been regarded as specialists in spine and MSK care³, and in Canada, the majority of people with neck and low back pain consult either a chiropractor, a medical doctor, or a combination of both². Chiropractic care using manual therapy techniques, such as spinal manipulative therapy (SMT), has been shown to be an effective treatment for MSK conditions⁴, reducing pain, disability and improving range of motion for neck pain⁵, low back pain⁶, and other MSK conditions⁷.

In veterinary medicine, MSK conditions are also highly prevalent, with veterinarians ranking them among the

Méthodes: *Un devis séquentiel à méthodes mixtes a été utilisé. Celui-ci comprenait un sondage en ligne visant à recenser les sujets de recherche, des séances en personne fondées sur la technique du groupe nominal et un sondage final de priorisation.*

Résultats: *Treize grands sujets de recherche et 71 sous-thèmes ont été recensés et classés par ordre de priorité par des vétérinaires et des chiropraticiens du Canada et des États-Unis. Les cinq principales priorités étaient les mesures objectives des résultats, l'innocuité et les événements indésirables, les effets du traitement selon l'affection, les mécanismes d'action des thérapies manuelles et les comparaisons entre traitements.*

Conclusion: *Cette étude a permis de dégager des priorités de recherche tenant compte du point de vue des parties intéressées afin d'orienter les études futures et de renforcer les demandes de subvention en démontrant clairement la nécessité de mener des recherches dans les domaines précisément cernés.*

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MOTS CLÉS: chiropratique vétérinaire, chiropratique animale, troubles musculosquelettiques, priorisation de la recherche, médecine vétérinaire complémentaire et parallèle, enseignement de la chiropratique, pratique éclairée par les données probantes

third⁸ or fourth⁹ most common conditions^{9,10} seen in practice. MSK conditions affect a wide range of species, including 49.4% of British eventing horses¹¹, 56% of small animals⁸, and up to 55% of dairy cattle¹², resulting in significant impacts on an animal's ability to perform daily activities or maintain mobility^{8,9,10}. Diagnosing and treating MSK conditions in animals presents unique challenges due to their inability to verbally communicate in the way humans do. As a result, veterinary practitioners rely on palpation¹⁰ and subjective measures, such as Clinical Metrology Instruments (CMIs), that use behavioural and functional observations (e.g., changes in posture, gait, demeanor, ability to perform daily activities)¹⁰ to identify signs of pain, discomfort, or an underlying pathology^{8,9}.

Veterinary medicine traditionally emphasizes treatment of diseases through pharmaceutical or surgical approach-

es.^{10,13} However, a branch of veterinary medicine – Complementary and Alternative Veterinary Medicine (CAVM) – has emerged as a growing field that encompasses various approaches to preventing, diagnosing, and treating animal health issues. These approaches, which are typically not emphasized in veterinary school curricula, are instead taught through continuing education courses or additional extracurricular certifications.^{14,15} One such professional certification program trains both licensed chiropractors and veterinarians through an extensive program to obtain a certification in animal (veterinary) chiropractic, with a focus on animal MSK care. Currently, more than 1500 veterinarians and chiropractors worldwide hold an active certification in animal chiropractic.^{16,17}

With MSK conditions being a leading cause of pain and impairment in both canine and equine populations^{8,9}, the demand for alternative treatments among animal owners is steadily increasing^{14,15}. As a result, CAVM approaches, such as rehabilitation therapy and animal chiropractic care, are commonly used to manage various MSK conditions in companion, sport, and working animals.^{14,18,19} Animal chiropractic care primarily uses manual therapies, including mobilizations, manipulations, massage, stretching, among others.^{14,18,19,20} From a theoretical standpoint, these interventions aim to enhance neuromusculoskeletal function by increasing range of motion, alleviating pain perception, and/or improving neuromuscular control.^{18,19} Practitioners certified in animal chiropractic contribute to animal care by supporting rehabilitation, both as a first line approach and in post-surgical recovery, and by maintaining optimal physical condition.^{14,20} This approach is particularly beneficial for animals involved in sports and agility competitions, helping to reduce risks of injuries²⁰, enhance performance, and address behavioural issues²¹, while also minimizing veterinarian treatment costs, surgical interventions, and recovery time for injured competitive animals²⁰.

While numerous alternative therapies exist, there is no universal guideline for their protocols, treatments, or dosages.^{18,22} Consequently, even though interest in animal chiropractic is growing among animal owners, skepticism persists within the veterinary community regarding its efficacy, safety, and scientific basis.^{13,14, 22} Specifically, existing research on animal chiropractic often presents important limitations such as small sample sizes, lack of control groups^{14,18}, variability in treatment

protocols¹⁵ and lack of valid and reliable outcome measures^{9,15}. As a result, not only is the quality of evidence suboptimal, but reported treatment effects also vary considerably^{14,18}, making the current evidence insufficient to draw definitive conclusions. These limitations in the current evidence highlight the responsibility of the practitioners to prioritise animal welfare without replacing necessary conventional veterinary treatments²² or making unsupported claims, while communicating clearly with veterinarians and animal owners to manage expectations and obtain informed consent²², even in the presence of inconclusive evidence.

To move the field forward, it is essential to establish a clear and focused agenda that guides research efforts toward the most relevant and impactful areas. Within animal chiropractic, limited resources and research capacity make it especially important to ensure that future studies address pressing clinical needs and contribute meaningfully to the profession. However, existing research gaps and priorities within animal chiropractic have not yet been systematically defined. By identifying and prioritizing potential research topics in collaboration with interested parties in the animal chiropractic community, this study lays the foundation for future targeted research efforts that can optimise the use of available resources and support the development of evidence-informed care. Therefore, the objective of this study was to identify and prioritize research gaps in the animal chiropractic profession to establish interested party-informed research priorities.

Methods

This study employed a sequential mixed-methods approach and involved 1) an online topic identification survey, 2) in-person nominal group technique (NGT) sessions, and 3) a prioritization survey of the research priorities identified in the first two parts. This project received research ethics approval from the Research Ethics Board at the Canadian Memorial Chiropractic College (REB Approval number: 2409B01).

Online topic identification survey

An online survey was conducted to identify preliminary topics on research gaps within the animal chiropractic field.

Participants and recruitment

Individuals from 15 animal chiropractic organizations (such as chiropractic and veterinary chiropractic professional associations, regulatory bodies, educational institutions, etc.) in Canada and United States of America were identified as interested parties to the animal chiropractic profession through their involvement with, association to, or interest in animal chiropractic (e.g., researchers, educators, animal owners, practitioners, etc.). These individuals were identified by the primary investigator (NMS) as leaders within their respective organizations based on organizational structure. They were asked to disseminate the survey to up to five individuals within their organization, including themselves. This resulted in a potential pool of 75 invited participants, all of whom were required to be at least 18 years of age and to have involvement, association, or interest in the field of animal chiropractic.

Survey

An email including a link to the online survey (SurveyMonkey®, SurveyMonkey Canada Inc., Ottawa, Canada) was distributed in October 2024 and open for three weeks. All participants provided their informed consent prior to participating. The survey collected information regarding:

- Demographic characteristics (age and sex),
 - Relationship and years of involvement with animal chiropractic,
 - Utilization of animal chiropractic care,
 - Academic credentials,
 - Clinical questions specific to practitioners certified in animal chiropractic or veterinary spinal manipulative therapy (vSMT):
 - Post-graduate animal chiropractic training program, additional degrees, certifications, and training, etc.,
 - Practice location (zip/postal code),
 - Type of animals treated,
 - Manual therapy techniques used,
 - Modalities used,
 - Familiarity with research regarding manual therapy to treat animals.
 - Belief that research is necessary in the field of animal chiropractic, and
- Identification of topics that need to be researched in the field of animal chiropractic.

The results from the open-ended question, “what topics are needed to be researched in the field of animal chiropractic. Please list as many as you can and be as specific as possible” was compiled (details below) and used during the in-person NGT sessions.

In-person Nominal Group Technique Participants and recruitment

Participants were recruited through posters, announcements, and word of mouth at the American Veterinary Chiropractic Association (AVCA) Annual Conference in November 2024. Participation was open to all conference attendees over the age of 18 who were interested parties to the animal chiropractic field.

Seven in-person NGT sessions were held in a designated meeting room during the 2024 AVCA Annual Conference in Richardson, Texas (November 15th-17th 2024). Each session was limited to a maximum of 10 participants, lasted for 90 minutes, and focused on identifying and refining research gaps and setting priorities of research topics within animal chiropractic. Specifically, each session was conducted with the following structure:

Introduction and preparation phase

The group leaders (MF, SW) provided participants with an explanation of the meeting’s purpose, a description of how the session would proceed, the roles and expectations of participants, and an explanation of how the session results would be utilized. Informed consent and participant information (listed above) were collected at the beginning of each session. A live working document was projected onto the main screen for all participants to see and was iteratively updated by an investigator (NMS, SW) within and throughout the sessions.

The group leader introduced the NGT question to the participants: “What are the topics or areas within animal chiropractic that you think need to be researched?” and presented the collated research topics identified in the online survey and previous sessions.

Silent idea generation

Participants were instructed to independently and silently focus on brainstorming research gaps within ani-

mal chiropractic and write down as many topics as they could think of within a 10-minute timeframe. Participants were instructed to either expand from the research gaps identified in the survey and previous sessions or come up with new research topics. They were also instructed to not focus on the feasibility and logistics of conducting the study, but rather just focus on the areas where research was needed.

Round robin recording of ideas

The group leaders facilitated a round-robin process of approximately twenty minutes where each participant around the table shared one topic they identified. An investigator recorded each topic verbatim on the master document. The group leaders would ask questions for clarification, but no discussion was allowed during this phase.

Participants were permitted to contribute topics that were not initially written down but were inspired by others' contributions. The leader continued around the table until all topics had been recorded. When a participant ran out of topics, they could pass their turn. This continued until all participants finished sharing all their topics.

Clarification and discussion of ideas

The group leaders then facilitated a discussion of approximately twenty minutes where participants could discuss each topic with each other and could request clarification on any topic that was generated before it was finalised for voting. This included modifying the wording of the original topic, but only with the agreement of the topic originator. Topics were altered from the list if there was a unanimous agreement among participants, identification of duplicates, or if the group wished to combine similar topics together.

Ranking and results

In the final phase, participants ranked the list of topics and subtopics according to what they, as a group, considered the most important research gaps to determine research priorities, starting with the most important topic or subtopic and proceeding in decreasing levels of importance. The results from the ranking phase were presented to the participants at the end of their own session and used as the starting list for the following NGT session.

Prioritization survey

Participants

Participants who responded to the initial online topic identification survey and/or participated in one of the NGT sessions were invited to respond to the final prioritization survey.

Survey

The final list of research topics from the last NGT session was compiled into the final online ranking survey on SurveyMonkey®, which was then distributed via email. Participants were asked to rank the major research topics in terms of priority with what they think the 'most important topic' is at the top and proceed in decreasing levels of importance.

The subsequent questions asked participants to rank the subtopics within each major research topic with what they considered the 'most important topic' at the top, and continuing in decreasing order of importance. In the instructions, participants were instructed not to consider study feasibility, design, or methodology, and instead to focus on the research topics and their relative importance.

Data analysis

All demographic data collected from the online survey and the NGT sessions were analysed using descriptive statistics, including means and standard deviations for numerical data, and count and percentages for categorical data. Descriptive statistics were used to report frequency distributions (count and percentages) for the online survey and NGT session outcomes. These included animals treated in animal chiropractic practice, manual therapy techniques and modalities used, and familiarity with research in animal chiropractic and manual therapy.

The results from the open-text question "What topics are needed to be researched in the field of animal chiropractic? Please list as many as you can and be as specific as possible" from the initial online survey were analyzed using an inductive thematic analysis. Specifically, each response was independently coded by two persons: an investigator (NMS) and a research assistant (KW) who then met to review coding, refine thematic categories and reach coding and theme consensus. A third investigator (SW) participated in coding discussions for contextualization, review coding and theme decisions, and helped resolve disagreements.

For the final prioritization survey data, similar analysis to Keter *et al.*²³ was conducted. Specifically, the composite score results of overall perceived importance from the final online survey ranking were used to establish the strength of each ranked topic.

Each rank was assigned a weight, with the most important rank weighted the highest, the second most important rank weighted slightly less, and so on, with decreasing weights for lower importance ranks. The composite score was calculated by multiplying each number of respondents who ranked the topic as the X most important priority by its corresponding weight and summing these products using the formula:

Composite Score (CS) = (n1 × 13) + (n2 × 12) + (n3 × 11) + (n4 × 10) + ... + (n13 × 1).

Each topic was reorganized based on the strength of its composite score. Topics with higher composite scores indicated greater perceived importance, whereas topics with lower composite scores reflected lower levels of im-

portance. This process was repeated to calculate a composite score for both major topics and their corresponding subtopics.

Results

Participants

Forty-two animal chiropractic interested parties of a potential 75 participants responded to the online survey for a 56% response rate. Most (69.0%) respondents were female with an average age of 53.17 years (standard deviation [SD]: 12.2) (Table 1). The majority of the online survey respondents were either a Doctor of Veterinary Medicine (DVM/VMD) (52.4%) or a Doctor of Chiropractic (DC) (45.2%). Of note, only five respondents did not complete an animal chiropractic program, while 33.3% reported certification in providing acupuncture to animals. The respondents' relationship to animal chiropractic was further broken down with 16 (38.1%) animal owners, 15 (35.7%)

Table 1.
Demographics and involvement with animal chiropractic

		Online Topic Identification Survey (n=42)	NGT (n=29)
Sex	Male	13 (31.0%)	17 (58.6%)
	Female	29 (69.0%)	12 (41.4%)
Age	(mean ±SD)	53.17 ±12.2	55.5 ±11.7
Relationship to Animal Chiropractic	Doctor of Veterinary Medicine	22 (52.4%)	12 (41.4%)
	Doctor of Chiropractic	19 (45.2%)	17 (58.6%)
	Animal Owners	16 (38.1%)	15 (51.7%)
	Education	15 (35.7%)	1 (3.4%)
	Association	11 (26.2%)	6 (20.7%)
	Research	5 (11.9%)	1 (3.4%)
	Other (student, insurance, shelter/rescue, regulation)	5 (11.9%)	2 (6.9%)
Academic Credentials and Certifications (self-reported)	Bachelor's Degree	22 (52.4%)	11 (37.9%)
	Master's Degree or Master's Candidate	13 (30.9%)	4 (13.8%)
	Doctor of Chiropractic	19 (45.2%)	17 (58.6%)
	Doctor of Veterinary Medicine / Veterinariae Medicinae Doctoris)	22 (52.4%)	12 (41.4%)
	Animal Chiropractic Certification	37 (88.1%)	21 (72.4%)
	Acupuncture Certified	14 (33.3%)	8 (27.6%)
	Fellowship	3 (7.14%)	0 (0%)
	Diplomate	4 (9.5 %)	1 (3.4%)
	Other Academic Credentials	8 (19.0%)	0 (0%)
	Other Certifications	20 (47.6%)	15 (51.7%)

		Online Topic Identification Survey (n=42)	NGT (n=29)
Animal Chiropractic Program Attended	Options for Animals	12 (28.6%)	12 (41.4%)
	Parker University	11 (12.2%)	11 (37.9%)
	Animal Chiropractic Education Source	7 (16.7%)	2 (6.9%)
	Veterinary Chiropractic Learning Centre	3 (7.1%)	2 (6.9%)
	Healing Oasis Wellness Centre	3 (7.1%)	0 (0%)
	Other (International Academy of Animal Chiropractic/ AVCA/Health Pioneers Institute)	2 (4.8%)	1 (3.4%)
	Not Applicable	4 (9.5%)	0 (0%)
	Did not respond	0 (0%)	1 (3.5%)
Years of Involvement with Animal Chiropractic Field	0-5 years	7 (16.7%)	5 (17.2%)
	6-10 years	4 (9.5%)	5 (17.2%)
	11-15 years	6 (14.3%)	1 (3.4%)
	16-20 years	6 (14.3%)	7 (24.1%)
	21-25 years	6 (14.3%)	3 (10.3%)
	26-30 years	6 (14.3%)	5 (17.2%)
	30+ years	7 (16.7%)	3 (10.3%)
Frequency of Personal Animal Chiropractic Care Use	I do not own an animal	3 (7.1%)	0 (0.0%)
	0 times	3 (7.1%)	2 (6.9%)
	1-3 times	2 (4.8%)	1 (3.4%)
	4-6 times	2 (4.8%)	2 (6.9%)
	7-9 times	1 (2.4%)	1 (3.5%)
	10+ times	31 (73.8%)	22 (75.8%)
	Did not respond	0 (0%)	1 (3.4%)

NGT = Nominal group technique; SD = standard deviation; AVCA = American Veterinary Chiropractic Association
Animal Chiropractic Certifications: CVSM, cAVCA, cVCA, CAC, CAC candidate, CVC, VOM, Advanced Animal Chiropractic.
Other Certifications: CVMRT, CCRT, CCAT, CERP, CCRP, spine trauma management, whiplash and trauma, AC, CCSP, DNM, cVMA, CVS, Graston, Magn Wave, Fear free elite, Activator Advances, AIMLA Veterinary Laser, EMR, CBFP, MPAC, fascial work, Masterson Method, Kinesiotaping. Acupuncture Certified: CVA, AVCA, neurofunctional acupuncturist for small animals, CVBMA. Fellowship: FCoAC, FACFN, Diplomate: DACVSMR, ACVSMR, DACVS-LA, DACT. Other Academic Credentials: Veterinary Assistant, Registered Massage Therapist, DC or DVM student, Doctorate of Humanities

involved through education, 11 (26.2%) through an association, 5 (11.9%) through research and 1 (2.38%) each through insurers, shelter/rescue, and regulation.

In total, there were 29 participants in the NGT sessions, with slightly over half of the participants (58.6%) being male, with an average age of 55.5 years (SD: 11.7) (Table 1). They consisted of 12 (41.4%) DVMs and 17 (58.6%) DCs with further relationships to animal chiropractic through 15 (51.7%) animal owners, six (20.7%) involved with an association, and one (3.4%) each involved with education, research, shelter/rescue and regulation.

The most commonly treated animals by participants

were dogs, cats, and horses with 62.5% to 96.6% of practitioners reporting working with these species. Ranch and livestock animals were also reported to be treated, though less frequently, by up to 37.5% of practitioners, while exotic, wildlife and other animals (i.e., reptiles, pocket pets, raccoons, etc.) were rarely treated (2.5% to 20.7%). A wide variety of manual therapies and modalities were reportedly used to treat animals, with the top four techniques being vSMT (55.2% to 97.2%), soft tissue therapy (51.7% to 66.7%), light therapies (58.3% to 62.15%), and some form of acupuncture or acupressure (27.6% to 50%) (Table 2).

Table 2.
Manual therapy and modality techniques used (self-reported)

Manual Therapy or Modality Technique	Online Topic Identification Survey (n=36)	NGT (n=29)
vSMT	35 (97.2%)	16 (55.2%)
Soft tissue therapy	24 (66.7%)	15 (51.7%)
Light therapy	21 (58.3%)	18 (62.1%)
Acupuncture	18 (50.0%)	8 (27.6%)
Pulsed Electro Magnetic Fields (PEMF)/MagnaWave	8 (22.2%)	5 (17.2%)
IATSM/ Graston	5 (13.9%)	4 (13.8%)
Mobilizations	5 (13.9%)	2 (6.9%)
Trigger Point	5 (13.9%)	2 (6.9%)
Homeopathy (essential oils, herbal supplements, Bach Flowers)	4 (11.1%)	4 (13.8%)
Manual therapy	4 (11.1%)	2 (6.9%)
Activator	3 (8.3%)	3 (10.3%)
Exercise	3 (8.3%)	1 (3.4%)
Kinesiology taping	3 (8.3%)	1 (3.4%)
Ultrasound	3 (8.3%)	1 (3.4%)
Extracorporeal Shock Wave Therapy (ESWT)	2 (5.6%)	3 (10.3%)
Electrical Stimulation	2 (5.6%)	2 (6.9%)
Hydrotherapy	2 (5.6%)	1 (3.4%)
Other (Ancient Chinese massage therapy/ NST/ muscle testing/ glandular therapy, Gua Sha, traction, own technique, physio, myocardial release, rehabilitation modalities, vibration)	11 (30.6%)	5 (17.2%)
Interventions within Veterinary Scope of Practice	1 (2.8%)	4 (13.8%)

Online topic identification survey results

The online topic identification survey participants mainly familiarized themselves with research regarding manual therapy for animals by sporadically reading specific papers (65.8%) and through discussions with peers (52.6%). Only 15.8% reported subscribing to an academic journal, and 2.6% indicated obtaining research updates through the AVCA or by watching educational webinars that review current research. There were eight (19.0%) participants who were actively involved in leading or participating in research, and one participant who had published peer-reviewed articles, while 13.2% were not familiar with research on manual therapy for animals. Of note, 100% of online survey respondents believed that research on manual therapy for animals is needed.

Topics identified on the qualitative analysis of the re-

sponses to “what topics are needed to be researched in the field of animal chiropractic” included safety and adverse events, mechanisms of manual therapies, animal-specific investigations, outcome-based investigations, treatment and changes in outcomes, objective outcomes, subjective outcomes, treatment effects on specific conditions, cost-benefit, effectiveness, efficacy, force-time characteristics, indications and contraindications, diagnostic reliability, comparison with other care, and risks and benefits.

Nominal Group Technique results

Twenty-nine participants attended one of seven NGT sessions. Participants in these sessions were not asked about their research familiarity or their perceptions of research need, as the in-person format assumed a need for research

and was designed to provide an opportunity to brainstorm potential research topics.

At the end of all NGT sessions, the final list had identified and ranked 13 major topics and 71 subtopics (Table 3). Notably, ten of the thirteen topics had ranked sub-

topics, as multiple subtopics were identified within those categories. Additionally, five ideas were identified that did not fit within a specific research topic, as they more closely identified as main goals for the animal chiropractic research as a whole.

Table 3.

NGT identified and ranked research topics and subtopics with final subtopic composite score prioritization rankings

Major Research Topics <i>Listed in ranked order identified by NGT sessions</i>	Subtopics <i>Listed in ranked order identified by NGT sessions</i>	Subtopic Composite Score <i>Ranked in Final Prioritization Survey</i>	
		Composite Score	Average Composite Score
1. Safety & Adverse Events	1. Safety to animal – Safety/ Adverse Events/Harms /tissue damage & force parameters (force guideline, education/training) – variation of practitioner strategy	233	6.66
	2. Risk of injury of treatment/Safety – Intervertebral disc disease (IVDD) population – Older (e.g., disc desiccation) – Puppies & kittens & Foals, immature skeleton population	207	5.91
	3. Extremity adjustments	122	3.49
	4. Reporting of adverse events	121	3.46
	5. When is ‘enough’ – avoiding over-adjusting	110	3.14
	6. Risk-Benefit analysis	115	3.29
	7. Safety for practitioner	72	2.06
2. Objective Outcomes (numbers)	1. Video gait and posture & biomechanical analysis (normal vs abnormal) Quadruped compensation static (e.g., head carriage position, mane flip)	420	12
	2. Activity levels pre-post adjustment, duration of changes, weight change	371	10.6
	3. Force plate analysis (Gait – weight distribution/compensation), temporospatial analysis	360	10.29
	4. Performance (e.g. time, dock dive distance, agility, any course sport)	339	9.69
	5. Physiological parameters (measurable: cortisol, oxytocin, hormones, thyroid, immune markers , inflammatory markers)	294	8.4
	6. Audible cavitation effects	120	3.43
	7. Lameness locator/ mobility / thermoimaging	268	7.66
	8. Remote effects/Somatovisceral	235	6.71
	9. Reproductive benefits (semen, eggs, % rate of conception, dystocia)	179	5.11
	10. Milk production (related to comfort levels, cow noise)	143	4.09
	11. Pain pressure threshold (PPT), PPT paired with thermo-imaging	161	4.6
	12. Objective functional evaluation (e.g., step climb)	139	3.97
	13. Chiro care decrease amount of joint injections	156	4.46

Major Research Topics <i>Listed in ranked order identified by NGT sessions</i>	Subtopics <i>Listed in ranked order identified by NGT sessions</i>	Subtopic Composite Score <i>Ranked in Final Prioritization Survey</i>	
		Composite Score	Average Composite Score
3. Subjective Outcomes	1. Quality of life / function (like ODI, Ohio state QoL)	265	7.57
	2. Pain (vocal & acknowledgement)	218	6.23
	3. Show/Performance (e.g. video analysis of Westminster winners) Porcine conformation position	192	5.49
	4. Animal mood and behaviour change (Anxiety/Personality)	198	5.66
	5. Rider satisfaction	141	4.03
	6. Saddle fit (rider has scoliosis, rider has previous injuries)	124	3.54
	7. Audible cavitation effects	65	1.86
	8. Taste/quality of meat	57	1.63
4. Specific Conditions & Treatment Effects	1. Degenerative joint or Disc lesions (IVDD) & atrophy	612	17.49
	2. Age-related effects – pain & mobility, QoL Arthritis small animals and horses (old vs young)	580	16.57
	3. Acute versus chronic	479	13.69
	4. Post-op surgery (e.g., no tx versus chiro), arthritic seniors	498	14.23
	5. Extension/ continuity of life / untreatable conditions	437	12.49
	6. Comorbidities: how they effect treatment success	384	10.97
	7. Degenerative myelopathy	370	10.57
	8. Hip dysplasia	402	11.49
	9. CCL tear, insufficiency – chiropractic manipulation	370	10.57
	10. Urinary incontinence	336	9.6
	11. Paralyzed dog (Down dog – IVDD, Fibrocartilaginous Embolus)	375	10.71
	12. Histological difference in IVDD gene-positive or clear – dogs	198	5.66
	13. Pelvic disorders (elderly restoration), effects	209	5.97
	14. K9 vestibular syndrome	235	6.71
	15. K9 cognitive dysfunction	140	4
	16. Effects of tail docking on posture & biomech of lumbar spine and sacroiliac joints– cats and dogs	133	3.8
	17. Excessive nail length – biomechanical effects	143	4.09
	18. Cold/limber/swimmer tails	84	2.4

Major Research Topics <i>Listed in ranked order identified by NGT sessions</i>	Subtopics <i>Listed in ranked order identified by NGT sessions</i>	Subtopic Composite Score <i>Ranked in Final Prioritization Survey</i>	
		Composite Score	Average Composite Score
5. Treatment Comparisons	1. Multimodal treatment compared to single therapy	328	9.37
	2. Treatment protocols (per population) Order of assessment and treatment Equine – Teeth, feet, spine order	280	8
	3. Instrument (Activator, Arthrostim, neuro impulse gun) versus manual therapy, instrument vs instrument	229	6.54
	4. PT vs PT + chiro (post-surgery)	239	6.83
	5. Chiro versus Medication (e.g., NSAIDs)	292	8.34
	6. Chiro care vs surgery population – IVDD	261	7.46
	7. Longitudinal study (e.g., same litter, treatment versus no treatment)- Hip dysplasia DM	163	4.66
	8. Upper cervical for IVDD/dural torque, cranial sacral, Logan, tonal technique	169	4.83
	9. Extremity adjustments	131	3.74
	10. Cost/Risk-benefit	112	3.2
	11. TMJ adjustments – activity levels, physicalities (e.g., ability, posture, coordination, digestive changes, sacral levels)	106	3.03
6. Animal-specific Investigations	1. Small versus large animals	88	2.51
	2. Various animal species, purpose/use (e.g., pet, agility, working)	80	2.29
	3. Pretension with tool adjustments – ideal setting/tool for each animal	42	1.2
7. Research database (use of historical data)	1. Insurance data (e.g., risk analysis of chiro care)	38	1.09
	2. Historical Data	67	1.91
8. How/Why Treatment Works (i.e., Mechanisms of Manual Therapies)	1. How adjustments work (physiological changes)	60	1.71
	2. Neuro/biochemical changes affect outcomes (e.g. speed)	45	1.29
9. Best Practices (are we doing what we say we're doing)	1. Duration and frequency of treatment (Acute, chronic, maintenance phases)	161	4.6
	2. Number of segments adjusted/threshold	98	2.8
	3. Maintenance care	92	2.63
	4. Clinical guidelines (standardized health screen checklist – flow decision tree)	87	2.49
	5. Time frame for treating paralysis (early versus late) – prognosis	87	2.49
10. Diagnostic Tests	1. Inter-examiner reliability (e.g., function & pain scales)	62	1.77
	2. X-rays	43	1.23

Major Research Topics <i>Listed in ranked order identified by NGT sessions</i>	Subtopics <i>Listed in ranked order identified by NGT sessions</i>	Subtopic Composite Score <i>Ranked in Final Prioritization Survey</i>	
		Composite Score	Average Composite Score
11. Survey of non-chiro veterinarians on perceptions of chiropractic care	–	–	–
12. Survey of treatment used by practitioners	–	–	–
13. Contextual Factors (practitioner state of mind, intent, etc.)	–	–	–

Items in bold: Denote items that were consistently emphasized as important or frequently mentioned by participants throughout the sessions.

NGT = Nominal group technique; IVDD = Intervertebral Disc Disease; PPT = Pain pressure threshold; ODI = Oswestry Disability Index; QoL = Quality of Life; Tx = Treatment; DM = Degenerative Myelopathy; CCL = Canine Cruciate Ligament; K9 = Canine; PT = Physical Therapy; Chiro = Chiropractic; NSAIDs = non-steroidal anti-inflammatory drugs; TMJ = Temporomandibular joint

The goals for the animal chiropractic research were identified as improving public education and perception, enhancing education of veterinarians on chiropractic care during professional training, fostering conversations and collaborations with regulatory boards, establishing best practices and consistent standards of care and competency, and generating high-quality scientific evidence.

Final prioritization survey

Of the 71 total participants across the first two stages, eight participated in both. Therefore, 63 unique participants from the online survey and the NGT sessions were emailed the link to the final prioritization survey (Figure 1). Thirty-five participants responded to the final survey, yielding a response rate of 55.6%.

After the composite score analysis was conducted, the major topics were reordered based on strength. The top five ranked topics were objective outcomes, safety & adverse events, specific conditions and treatment effects, mechanisms of manual therapies, and both subjective outcomes and treatment comparisons equally ranked for fifth place (Table 4). All composite scores for the subtopics are presented in Table 3.

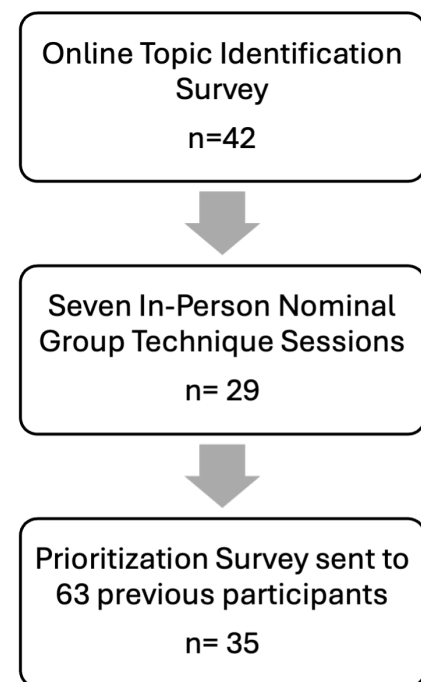


Figure 1.
Flow of participants across study phases

Table 4.
Ranked prioritization of major topics

Major Topics in Ranked Order	Composite Score	Average Composite Score
Objective Outcomes	406	11.6
Safety & Adverse Events	375	10.71
Specific Conditions & Treatment Effects	366	10.46
How/Why Treatment Works (Mechanisms of Manual Therapies)	298	8.51
Subjective Outcomes	296	8.46
Treatment Comparisons	296	8.46
Animal-specific Investigations	279	7.97
Best Practices (are we doing what we say we're doing) – Dose	231	6.6
Research database (use of historical data)	212	6.06
Diagnostic Tests	155	4.43
Survey of non-vSMT trained veterinarians on Perceptions of Chiropractic Care	118	3.37
Survey of Treatment Used by Practitioners	101	2.89
Contextual Factors	52	1.49

Within the top ranked research priority of objective outcomes, the strongest five research subtopic priorities were biomechanical analysis (CS=420, average CS=12), pre/post analysis of activity levels (CS=371, average CS=10.6), force plate analysis (CS=360, average CS=10.29), performance measures (CS=339, average CS=9.69), and physiological parameters (CS=294, average CS=8.4).

Within the second ranked safety and adverse events research priority, the strongest research subtopic priorities were safety to animals (CS=233, average CS= 6.66), the risk of injury with treatment (CS=207, average CS=5.91), extremity adjusting (CS=122, average CS=3.49), reporting of adverse event (CS=121, average CS=3.46), and risk-benefit analysis (CS=115, average CS=3.29).

Research into intervertebral disc disease (IVDD) (CS=612, average CS=17.49), aging (CS=580, average CS=16.57), post operative care (CS=498, average CS=14.23), acute versus chronic (CS=479, average CS=13.69), and continuity of life care (CS=437, average

CS=12.49) were the strongest priorities within the third ranked specific conditions and treatment effects topic.

Within the fourth-ranked mechanisms of manual therapy topic, the physiological changes of the adjustment (CS=60, average CS=1.71) were ranked higher than how neurological and/or biochemical changes affect outcomes (CS=45, average CS=1.29).

Within co-fifth ranked subjective outcomes, the strongest priorities were quality of life (CS=265, average CS=7.57), pain (CS=218, average CS=6.23), mood/behavioural changes (CS=198, average CS=5.66), performance (CS=192, average CS=5.49), and rider satisfaction (CS=141, average CS=4.03).

Multimodal treatments compared to single therapy (CS=328, average CS=9.37), chiropractic care compared to medications (CS=292, average CS=8.34), population-specific treatment protocols (CS=280, average CS=8), chiropractic care compared to surgical care of IVDD (CS=261, average CS=7.46), and post-surgical physical therapy alone versus physical therapy and chiro-

practic care (CS=239, average CS=6.83) were the strongest priorities within the co-fifth ranked treatment comparisons topic.

Discussion

Animal chiropractic research remains limited, with existing studies examining various aspects of the field, including utilization²⁴, reviews of manual therapy techniques^{18,19}, retrospective analysis of CAVM services, and scoping reviews on physiological responses to manual therapy in animal models²³. These studies provide valuable insights into practice trends and theoretical understanding. However, there remains limited high-quality studies within animal chiropractic, including randomized control trials, systematic reviews or quantitative investigations that could contribute to a stronger evidence base.

The structured, interested party-driven research priorities identified in this study provide directions for future investigations and support the development of an evidence-informed animal chiropractic profession by outlining and ranking where research is most needed. The top-ranked priorities: objective outcomes, safety and adverse events, specific conditions and treatment effects, mechanisms of manual therapies, subjective outcomes, and treatment comparisons, reflect a collective commitment amongst animal chiropractic practitioners and interested parties to enhance the credibility of the profession, improve clinical decision making, and foster the integration of animal chiropractic within veterinary healthcare.

Objective outcomes emerged as the highest priority, highlighting the need for standardized and measurable indicators to assess patient changes. Measures such as biomechanical outcomes, activity levels, performance measures, and physiological parameters can provide practitioners with data to monitor progress, guide treatment decisions, and communicate findings more effectively with animal owners. These outcome measures can also contribute to building consistency in clinical practice and enhancing the profession's scientific credibility. Clark and Comerford's existing work on mobility assessment in dogs with MSK disease highlights the advantages and limitations of both subjective and objective measures, including force plate and kinematic gait analysis, in diagnosing and monitoring MSK disorders⁸, as well as Adie's use of a pressure-sensitive walkway to assess gait symmetry following animal chiropractic manipulations in

dogs²⁵. The 2022 American Animal Hospital Association (AAHA) Pain Management Guidelines for Dogs and Cats highlight the validity of force plate and pressure-sensitive walkways for clinical research and their use in dedicated assessment centres for screening, diagnosing, and monitoring canine limb pain. However, the guidelines consider the force plates expensive, challenging and labor intensive¹⁰ to implement in most clinical practices.

The emphasis on safety and adverse events reflects the profession's responsibility to ensure animal welfare and minimize risk. Priority areas identified include safety to animals, such as adverse events, tissue damage, and force parameters (e.g., typical force-time characteristics and practitioner education/training). Additional concerns include the risk of injury associated with treatment, particularly in vulnerable populations such as animals with IVDD, older animals, and skeletally immature animals such as puppies and foals. Extremity adjustments and the systematic reporting of adverse events were also highlighted as key areas requiring attention. These considerations may be essential for supporting meaningful risk-benefit analyses, enabling informed consent, and guiding the development of professional guidelines. While research specifically focused on adverse events in animal chiropractic remains limited²⁶, Benedetti *et al.*²⁷ observed in their pilot study that chiropractic treatment in healthy horses elicited some transient discomfort behaviours compared with a grooming control session but did not trigger physiological signs of acute stress and was well tolerated when performed by a qualified animal chiropractor. In broader studies, adverse event outcomes may be reported as secondary outcomes. For example, Adie included a subjective exit interview questionnaire specifically asked, "What adverse outcome(s) if any did you observe in your pet?" and reported that no animal owners noted adverse events or unwanted outcomes occurred during treatment.²⁵ However, this observation was not the central focus of the study. These findings highlight the need for more targeted research to better understand the safety of animal chiropractic interventions.

The prioritization of specific conditions and treatment effects highlights the need to determine which clinical presentations respond most effectively to chiropractic care. Research priorities in this area include conditions such as intervertebral disc disease, age-related issues, postoperative care, acute versus chronic presentations,

and continuity of life care. While some studies address related topics, significant gaps remain. For example, Cramer, Solano, and Constable explored the epidemiology of lameness in cattle, examining prevalence, incidence, and risk factors, but did not address treatment interventions.¹² Similarly, the 2015 AAHA / AAFP (American Association of Feline Practitioners) Pain Management Guidelines reviewed a range of pain management strategies, including non-steroidal anti-inflammatory drugs (NSAIDs), opioids, anesthetics, acupuncture, diet, exercise, and lifestyle modifications, and briefly mentioned animal chiropractic care.¹³ However, the veterinary guidelines concluded that evidence for chiropractic care in veterinary pain management is insufficient, unreliable, and contradictory, in contrast to the robust evidence base supporting chiropractic care in human medicine.¹³ Promising research has begun to provide novel evidence that animal chiropractic treatment may help reduce the likelihood of early-onset spondylosis in young Boxers. Although animal chiropractic care is not currently a routine intervention for this condition due to limited supporting evidence, findings from recent randomized studies suggest its potential as a preventative or delayed-onset measure for spondylosis.²⁸ Obtaining more knowledge pertaining to specific conditions and treatment effects has the potential to guide treatment planning and support evidence-informed claims in animal chiropractic practice.

The prioritization of research into the mechanisms of manual therapy highlights the importance of understanding the physiological, neurological, and biochemical changes that occur during chiropractic adjustments and how these changes influence clinical outcomes. A long-standing history of using animal models in MSK studies²⁹ has contributed to their findings extrapolated to human applications and advancements in human medicine, chiropractic, and broader health research. For example, Han *et al.*³⁰ demonstrated the analgesic effects of SMT and mobilizations in a rat model of acute lumbar radiculopathy, suggesting a potential link to anti-inflammatory processes, though the exact mechanisms remain unclear. Other studies have explored biomechanical aspects of SMT using porcine spines, revealing that both the force magnitude and the site of SMT application significantly influence the distribution of forces into the spine structures.³¹ Feline models have been used to investigate changes in intradiscal pressure and the influence

of viscoelastic properties of spinal tissues in response to SMT.³² These findings may inform the adaptation of chiropractic techniques and research findings to animal care³³ and may be increasingly applicable within animal chiropractic contexts, offering valuable insights to support the development of evidence-informed practices in animal chiropractic.²⁹ Nevertheless, these findings should be interpreted with caution as the studies were originally designed focused on their application to humans.

The prioritization of subjective outcomes emphasizes the importance of evaluating quality of life, perceived pain, behaviour, performance, and owner or rider satisfaction as part of animal chiropractic care research. Of note, performance was also highlighted within objective outcomes, however, it can span both objective and subjective categories. Performance can be quantified objectively using tools such as kinematic gait analysis to provide measurable data while performance can also be assessed subjectively based on owner or practitioner observations of gait patterns. Subjective measures, such as CMIs, provide valuable insights into animal well-being and owner perceptions, often complementing objective data.^{10,25} The 2022 AAHA Pain Management Guidelines for Dogs and Cats reviewed 18 CMIs and categorized their validity based on an overview of published studies assessing psychometric properties. However, while the guideline summarizes CMIs as fully validated, moderately validated, having limited validation, or not validated, the specific criteria used to determine these classifications are not described. Overall, 14 CMIs were rated as moderately to fully validated and four CMIs were rated as unvalidated or having only limited validation¹⁰. Current research has evaluated pain and functional status using owner-reported questionnaires and practitioner-assessed functional tasks, finding significant improvements across all subjective measures, including decreased pain scores and enhanced mobility and function following chiropractic manipulation²⁵. Wells *et al.*⁹ reviewed current approaches to assessing mobility and function in veterinary medicine, such as the Canine Geriatric Functional Score (CGFS), and emphasized the need for further validation of standardized assessment methods. They also suggested adapting validated human subjective assessment tools for veterinary use.⁹ Regardless of their validation status – and despite 70.8% of dog owners expressing a willingness to use health questionnaires, and these tools being freely available to veterinarians – utilization remains low. One study reported only

4.4% of practitioners used subjective outcome questionnaires.⁹ Research is needed to identify barriers to implementation and strategies to improve uptake.

The prioritization of treatment comparisons reflects the need to evaluate the relative effectiveness of animal chiropractic care within different therapeutic contexts, including multimodal approaches versus single therapies, animal chiropractic care compared to medications, and its role alongside surgical or rehabilitative interventions. Comparative research in this area has the potential to inform evidence-informed treatment protocols tailored to specific populations and conditions. To support this, high-quality randomized control trials are essential for evaluating the effectiveness of different treatment methods and identifying appropriate providers for implementing interventions to target populations³⁴. For example, Haussler *et al.*³⁵ conducted a randomized control trial on 61 competitive performance horses with back pain attributed to spinal MSK disorders, examining the effects of low-level laser therapy (LLLT) and chiropractic care. They observed reduced back pain, muscle hypertonicity and stiffness in the group receiving LLLT, and improved trunk and pelvic flexion reflexes in the group receiving chiropractic care.³⁵ The combination of both therapies produced improvements across all measured outcomes, suggesting potential synergistic benefits.³⁵ Similarly, Sullivan, Hill and Haussler investigated instrument-assisted chiropractic treatment, therapeutic massage, and phenylbutazone in horses without clinical signs of MSK pain by measuring spinal mechanical nociceptive thresholds.³⁶ By day seven, both chiropractic and massage produced significant increases in these thresholds, whereas the phenylbutazone resulted in decreased thresholds on days 1–3 followed by only a small increase at day seven. These findings demonstrate an antinociceptive effect of chiropractic and massage, even in an MSK condition-free equine population.³⁶

In addition to identifying specific research priorities, this study also revealed broader goals essential for advancing the animal chiropractic profession. These goals include improving public education and perception of animal chiropractic, integrating chiropractic content into veterinary training, fostering conversations and collaborations with regulatory bodies, and establishing best practices to ensure consistency and standard competency across practitioners. The generation of high-quality scientific

evidence remains a central goal, underscoring ongoing efforts to integrate animal chiropractic into mainstream veterinary care. These goals reflect a comprehensive vision for the field that not only addresses clinical and scientific gaps but also supports professional development, public trust, and regulatory alignment.

Strengths and limitations

This study's key strength is its robust methodology for identifying and ranking research priorities within the animal chiropractic field. The mixed-methods approach of combining the online topic identification survey with the NGT sessions ensures input is shaped by participants and was refined iteratively across multiple stages to enhance the relevance and robust nature of the findings to reflect real-world needs and support evidence-informed practice.

Rather than using a formal Delphi process, the NGT was selected because it is well suited to early-stage priority setting, allowing for the efficient generation, clarification, and ranking of a broad range of topics within a short time frame, especially for a relatively small and geographically dispersed profession. With the NGT, participants were not limited to a narrowly predefined expert panel but rather the initial online survey recruitment intentionally sought broad input from interested professional and organisational parties and the in-person NGT was conducted at a professional conference as it is one of the few practical opportunities to assemble the animal chiropractic community. Delphi methods aim to iteratively refine and narrow opinions toward a predefined consensus threshold across multiple rounds, however, the purpose of the present study was to capture the breadth of perceived research needs and assign relative strength to each topic rather than exclude items that did not reach consensus. A future Delphi study using these priorities as a starting framework would be well suited to reassess, refine, and update the research agenda as new evidence emerges and the field continues to evolve.

This study has several limitations. Most participants were certified animal chiropractic practitioners, primarily affiliated with the AVCA and based in the United States and Canada. This limits the generalizability of the findings to international contexts and may exclude perspectives from other key interested parties such as non-vSMT trained veterinarians, animal owners, and veterinary regulatory bodies. However, those certified in animal chiro-

practic are uniquely positioned to speak to the challenges and experiences faced by their profession, including interactions with the public, other health care professionals, and regulatory bodies. Of note, the results are reported using the original wording provided by participants to preserve the authenticity of their contributions and may not necessarily follow methodological standards. Nonetheless, their insights provide valuable context for shaping a meaningful and relevant research agenda. Finally, recruitment through professional associations may introduce a selection bias to potentially favour more engaged and aligned viewpoints.

Implementation and next steps

Animal chiropractic is a relatively small but growing subspecialty at the intersection of two well-established professions. Given the limited capacity and resources available to fund and conduct high quality research, it is essential to strategically prioritise and focus on the research topics and subtopics outlined in the priorities established here. Doing so will ensure involved parties are actively involved in efforts that are both meaningful and aligned with the most pressing gaps identified in the field. This targeted approach can help maximize the impact of future research and foster interdisciplinary collaboration.

In parallel with these prioritization efforts, initiatives to consolidate and improve access to existing animal chiropractic literature are beginning to emerge. For example, the Canadian Memorial Chiropractic College has recently published an online Animal Chiropractic Library Guide that serves as a centralized repository of published research in this area. This resource provides a single access point for clinicians, educators, and researchers seeking to review the current literature, while also allowing users to submit citations for newly published work as it becomes available. Increasing the visibility and use of such tools can strengthen the foundation on which future research priorities are implemented and help ensure that new investigations build on existing knowledge.

These research priorities can inform the sequencing of future studies and strengthen grant applications by clearly demonstrating the demand for research in specifically identified areas. To advance the field meaningfully, efforts should focus on building research capacity, such as developing collaborative teams, mentorship structures, and institutional support, to lead and sustain high-quality investigations. Establishing funding mechanisms and strategic partnerships will also be essential to ensure continuity, promote innovation, and support long-term growth in animal chiropractic research.

Conclusion

This study provides a structured, interested party-driven research agenda that identifies key research priority areas for advancing the evidence base in animal chiropractic care. By emphasizing objective outcomes, safety, condition-specific effectiveness, underlying mechanisms, subjective measures, and treatment comparison, these research priorities offer a roadmap of topics to guide clinically relevant evidence. Addressing these priorities may not only strengthen the scientific foundation of the profession but also enhance its integration within animal healthcare, and acceptance among animal owners and veterinary professionals. Ultimately, these efforts aim to improve patient outcomes, promote informed decision-making, and support the responsible growth of animal chiropractic as an evidence-informed discipline.

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Abbreviations

Term	Meaning
AC	Animal Chiropractic
AVCA	American Veterinary Chiropractic Association
CAC	Certified Animal Chiropractor
cAVCA	American Veterinary Chiropractic Association certified
CBFP	Unable to Identify Acronym
CCAT	Certified Companion Animal Therapist
CCRP	Certified Canine Rehabilitation Practitioner
CCRT	Certified Canine Rehabilitation Therapist
CCSP	Certified Canine Sports Practitioner
CERP	Certified Equine Rehabilitation Practitioner
cIVCA	International Veterinary Chiropractic Association certified
CoAC	College of Animal Chiropractors
CVA	Certified Veterinary Acupuncturist
CVBMA	Certified Veterinary Balance Method Acupuncturist
CVC	Certified Veterinary Chiropractor
CVMRT	Certified Veterinary Massage and Rehabilitation Therapist
cVMA	Certified in Veterinary Medical Acupuncture
cVSMT	Certified in Veterinary Spinal Manipulative Therapy
DACT	Diplomate of American College of Theriogenology
DACVS-LA	Diplomate of American College of Veterinary Surgeons- Large Animal
DACVSMR	Diplomate of the American College of Veterinary Sports Medicine and Rehabilitation
DC	Doctor of Chiropractic
DNS	Dynamic Neuromuscular Stabilization
DVetHom	Doctorate in Veterinary Homeopathy
DVM	Doctor of Veterinary Medicine
EMRS	Electro-Magnetic Radiation Specialist
FACFN	Fellow of the American College of Functional Neurology
FCoAC	Fellow of the College of Animal Chiropractors
IVCA	International Veterinary Chiropractic Association
MPAC	Unable to Identify Acronym
VMD	Veterinary Medical Doctorate
VOM	Veterinary Orthopedic Manipulation

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Effectiveness of chiropractic care for low back pain: protocol for an updated systematic review and meta-analysis of randomized trials

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A 2016 review of randomized trials found that chiropractic care was as effective as physiotherapy for low back pain and was unable to establish the effectiveness of chiropractic care vs. exercise therapy or medical care; however, this review had several

Efficacit   des soins chiropratiques dans le traitement de la lombalgie: protocole d'une revue syst  matique actualis  e et d'une m  ta-analyse d'essais randomis  s
Une revue d'essais randomis  s publi  e en 2016 a conclu que les soins chiropratiques   taient aussi

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Conflicts of Interest:

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methodological limitations. We will conduct an updated systematic review to address these limitations and determine the effectiveness of chiropractic care compared to other usual care approaches for adults with non-specific low back pain. We will search for eligible trials indexed in MEDLINE, AMED, Embase, CINAHL, the Index to Chiropractic Literature, and the Cochrane Library from January 1, 2016 through August 31, 2026. Pairs of independent reviewers will conduct study selection, data abstraction, and risk-of-bias assessment. We will conduct meta-analyses using random-effects models and assess the certainty of evidence of all outcomes with the GRADE approach. Our results will be disseminated in a peer-reviewed publication and conference presentations.

(JCCA. 2026;70(2):203-213)

KEY WORDS: chiropractic care; low back pain; systematic review; effectiveness

Introduction

Low back pain (LBP) is a common condition and a leading cause of disability associated with considerable societal and socioeconomic burden.¹ In 2021, the global point prevalence of activity-limiting LBP was 9.4%, meaning that over 740 million people were affected at any one time.¹ In 2018, the Lancet Low Back Pain Series Working Group identified that provision of low value care for LBP was common.²⁻⁴ Several international clinical guidelines published since 2016 have recommended prioritizing non-pharmacological treatment options for patients with LBP.⁵⁻¹⁰ Regardless, primary care management of LBP often focuses on prescription medications (e.g., non-steroidal anti-inflammatory drugs, skeletal muscle relaxants, opioids), radiological/advanced imaging techniques, and invasive therapies (e.g., interventional procedures, surgery).³

efficaces que la physiothérapie pour traiter la lombalgie, mais n'avait pas permis d'établir leur efficacité comparativement à la thérapie par l'exercice ou aux soins médicaux. Cette revue présentait toutefois plusieurs limites méthodologiques. Nous réaliserons une revue systématique actualisée afin de remédier à ces limites et de déterminer l'efficacité des soins chiropratiques comparativement à d'autres approches de soins usuelles chez les adultes atteints de lombalgie non spécifique. Nous rechercherons les essais admissibles répertoriés dans MEDLINE, AMED, Embase, CINAHL, l'Index to Chiropractic Literature et la Cochrane Library entre le 1^{er} janvier 2016 et le 31 août 2026. Des binômes d'évaluateurs indépendants procéderont à la sélection des études, à l'extraction des données et à l'évaluation du risque de biais. Nous effectuerons des méta-analyses au moyen de modèles à effets aléatoires et évaluerons, selon la méthode GRADE, le degré de certitude des données probantes pour tous les critères de jugement. Nos résultats seront diffusés dans une publication évaluée par les pairs et lors de présentations à des congrès.

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MOTS CLÉS: soins chiropratiques, lombalgie, revue systématique, efficacité

Chiropractors deliver many of the non-pharmacological treatments recommended by current guidelines⁵⁻¹², including the 2023 World Health Organization guideline for primary low back pain¹⁰. These treatments include spinal manipulative therapy, patient education, and exercise. However, the effectiveness of overall chiropractic care (i.e., combined chiropractic interventions) for LBP remains uncertain.¹³⁻¹⁸ The most recent systematic review of pragmatic studies¹³ found similar effects of chiropractic care compared to physiotherapy for LBP; however, the comparative analyses were limited to only one or two studies per outcome.¹³ The review was also unable to establish the effectiveness of chiropractic care compared to exercise therapy or medical care because of limited available evidence.¹³ Moreover, the review's findings were based on six trials of variable quality and several new trials compar-

ing chiropractic care to usual care interventions, such as medical care or physiotherapy, have since been published (e.g., Gedin *et al.*¹⁸, Goertz *et al.*¹⁹, Vining *et al.*²⁰). Further, the previous review¹³ pooled study results using standardized mean differences that are difficult to interpret,²¹ used an aggregate score for risk-of-bias assessment that may be misleading,^{22,23} and explored sources of heterogeneity and assessed the certainty of evidence using methods that were suboptimal¹³. Our objective is to conduct a systematic review that addresses these limitations to determine the effectiveness of chiropractic care compared to other usual care approaches for the management of LBP. We plan to update the economic evaluation component of the previous review¹³ in a separate study.

Methods

Standardized reporting and protocol registration

We reported our protocol in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) checklist²⁴ and registered our protocol with the Open Science Framework (<https://osf.io/gd7wz>)²⁵.

Information sources and searches

An experienced medical librarian (RJC) will search MEDLINE (Ovid), AMED (Ovid), Embase (Ovid), CINAHL (EBSCO), Index to Chiropractic Literature (chiroindex.org), and the Cochrane Library (Wiley). We will run our searches from January 1, 2016 – i.e., six months prior to the last search date of the previous systematic review¹³ – through August 31, 2026. Our database-specific search strategies will be developed and reviewed by a second librarian using the Peer Review of Electronic Search Strategies (PRESS) checklist.²⁶ Also, we will search clinical trial registries (e.g., ClinicalTrials.gov, International Clinical Trials Registry Platform) to identify ongoing trials and contact authors for publication/data availability, explore the reference lists of eligible articles and related systematic reviews (including the prior review¹³), and contact content experts to identify additional eligible studies.

Eligibility criteria

Our eligibility criteria are summarized below using the PICOS (i.e., Population, Intervention, Comparison intervention, Outcome measures, Study designs) framework.²⁷

Participants/population

Inclusion criteria

We will include studies that enrolled adults (18 years or older) with non-specific LBP (i.e., pain located between the costal margin and inferior gluteal folds, not associated with a specific pathology or condition) of any duration, with or without leg pain.

Exclusion criteria

We will exclude studies that enrolled patients with specific pathologies accounting for their LBP, such as infection, neoplasm, metastasis, osteoporosis, fracture, or inflammatory arthritis.

Intervention

In line with the prior review,¹³ our intervention of interest will be receipt of chiropractic care²⁸. This is defined as care provided by a chiropractor, including, but not limited to spinal manipulation, soft-tissue therapy, education, reassurance, and self-care advice (e.g., icing, stretching, and strengthening exercises).²⁸

Comparator/control

The comparison will be non-receipt of chiropractic care (e.g., usual medical care, physiotherapy, exercise therapist care, wait-list control [with ongoing usual care]).

Outcomes

We will extract data on all patient-important outcomes that are reported, as guided by the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) recommendations,²⁹ including the following: (1) pain intensity, (2) physical functioning, (3) emotional functioning, (4) role functioning, (5) social functioning, (6) sleep quality, (7) patient satisfaction, (8) opioid use, and (9) adverse events^{30,31}. We will consider outcomes for physical functioning, emotional functioning, role functioning, social functioning, and sleep quality that are reported over a minimum four-week follow-up period (from baseline).

Study designs

Inclusion

We will include English- or French-language pragmatic randomized controlled trials that compared chiropractic

care to usual care for LBP delivered by other health care providers.

Exclusion

We will exclude studies that investigated chiropractic care combined with other forms of care in which the effects of chiropractic care cannot be isolated (e.g., chiropractic care plus physiotherapy vs. medical care), and studies that assessed the effect of spinal manipulative therapy as a stand-alone intervention (i.e., fastidious trials). We will contact study authors when necessary for clarification regarding eligibility and to confirm that comparison interventions were considered as usual care. We will also exclude non-randomized (quasi-experimental) controlled trials, protocols, observational studies, books and book chapters, dissertations, and other gray literature (e.g., abstracts, conference proceedings, presentations).

Study selection

Prior to initiating the screening process, and after duplicate records have been removed (see Figure 1), pairs of reviewers will conduct training and calibration exercises using standardized screening forms. After calibration, reviewers will screen, independently and in duplicate, the titles and abstracts of all identified citations and the retrieved full-text of all citations judged as potentially eligible by at least one reviewer using online systematic review software (DistillerSR, Evidence Partners, Ottawa, Canada; <https://www.distillersr.com/>). Reviewers will discuss and resolve disagreements with the help of a third, senior reviewer when required. Figure 1 includes a PRISMA flow diagram of our study selection process.

Data abstraction

We will conduct calibration exercises with a standardized data extraction form to improve inter-reviewer reliability. Next, pairs of reviewers will extract the following data independently and in duplicate from all included studies:

- (1) study characteristics (i.e., first author's last name, trial design, trial registration, study status [e.g., completed, ongoing], year of publication, country where the study was conducted, number of sites, funding source, length of follow-up),
- (2) population details (i.e., mean age, proportion of patients ≥ 65 years, proportion of patients with

male sex, proportion with LBP $\geq$ three months, population type [e.g., general population, military service members]),

- (3) chiropractic care and control group information (i.e., number of patients randomized to chiropractic or usual care; type of usual care provided, such as medical care, physiotherapy, exercise therapist care, wait-list control; number of patients analyzed per treatment arm at follow-up; reason[s] for loss to follow-up in each treatment arm), and
- (4) all patient-important outcomes including pain intensity; physical, emotional, role and social functioning; sleep quality; patient satisfaction; opioid use; and adverse events (see Table 1).

If multiple instruments were used in a study to measure the same outcome domain, we will collect data from the most commonly reported instrument among eligible trials. When trials report the same outcome at multiple timepoints, we will use data from the longest follow-up in our analyses unless there is $\geq 20\%$ missing data, in which case we will use the next longest follow-up that has $< 20\%$ missing data. We will also only include data from studies with the largest sample size in instances where two or more articles' study populations overlap by $\geq 50\%$. Disagreements will be resolved through discussion and involvement of a third senior reviewer if consensus is not achieved.

Risk of bias assessment

Pairs of reviewers will independently assess the risk of bias among eligible studies using the Risk of Bias instrument for Use in SysTematic reviews-for Randomized Controlled Trials (ROBUST-RCT),³² according to the following six core domains: random sequence generation, allocation concealment, blinding of participants, blinding of health care providers, blinding of outcome assessors, and infrequent missing outcome data for each treatment arm. For this last item, we will consider $< 10\%$ missing data as definitely low risk of bias, 10% to $< 15\%$ missing data as probably low risk of bias, 15% to $< 20\%$ missing data as probably high risk of bias^a, and $\geq 20\%$ missing

^a Reviewers will have the option of rating as 'probably low' risk of bias if the reason for missing data is unlikely to be related to the outcome, with no imbalance in numbers or reasons for missing data between intervention and control groups.

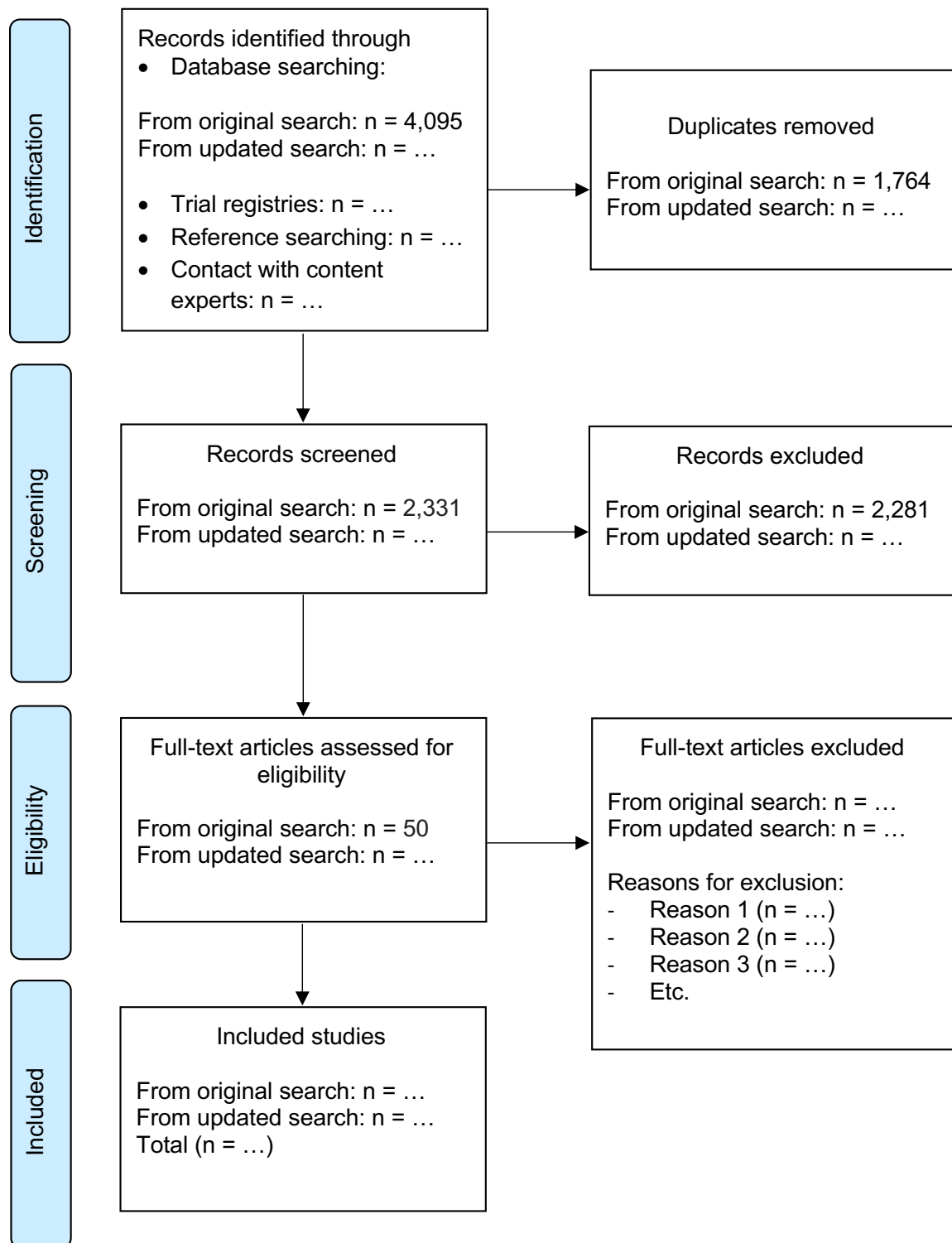


Figure 1.
PRISMA flow diagram.

Table 1.

GRADE evidence profile of chiropractic care vs. usual care in adult patients with non-specific low back pain

Study characteristics	Quality assessment					Summary of findings	Overall certainty in the evidence
No. of trials (patients)	Risk of bias	Inconsistency _a	Indirectness _b	Imprecision _c	Publication bias	Treatment association (95% CI)	
Pain intensity (e.g., 10 cm VAS for pain)							
X (...)	X	X	X	X	X	X	X
Physical functioning (e.g., 0-100 points SF-36 physical functioning scale)							
X (...)	X	X	X	X	X	X	X
Emotional functioning (e.g., 0-100 points SF-36 mental component summary scale)							
X (...)	X	X	X	X	X	X	X
Role functioning (e.g., 0-100 points SF-36 physical role functioning scale)							
X (...)	X	X	X	X	X	X	X
Social functioning (e.g., 0-100 points SF-36 social functioning scale)							
X (...)	X	X	X	X	X	X	X
Sleep disturbance (e.g., 10 cm VAS for sleep quality)							
X (...)	X	X	X	X	X	X	X
Patient satisfaction (e.g., 0-10 points satisfaction scale)							
X (...)	X	X	X	X	X	X	X
Prescription opioid receipt (yes vs. no)							
X (...)	X	X	X	X	X	X	X
Adverse events (yes vs. no) ^d							
X (...)	X	X	X	X	X	X	X

CI = confidence interval; *GRADE* = Grading of Recommendations Assessment, Development, and Evaluation; *SF-36* = short form 36 health survey questionnaire; VAS = visual analogue scale.

^a Inconsistency refers to unexplained heterogeneity of results. An I^2 of 75%-100% indicates that heterogeneity may be considerable.

^b Indirectness results if the patients, intervention, comparison/control, or outcomes of interest are different from the research question under investigation.

^c In this review, serious imprecision refers to situations in which the 95% CI includes both benefit and harm.

^d Examples of manual therapy and/or patient-important analgesic-induced adverse events include the following: muscle soreness, joint pain, stiffness, headache, dizziness, nausea, vomiting, constipation, radiating symptoms, paresthesia, or fatigue.^{30,31}

data as definitely high risk of bias. For all but the last item, response options will be categorized as ‘definitely or probably yes’ and ‘definitely or probably no.’ Reviewers will then judge the risk of bias related to each of the six items as ‘definitely or probably low’ (assigned as low risk of bias) and ‘definitely or probably high’ (assigned as high risk of bias).³² Disagreements between reviewers will be resolved as previously described.

Synthesis and presentation of findings

For treatment effects that are reported as binary outcomes (e.g., opioid use, adverse events), we will calculate the odds ratio (OR) and its corresponding 95% confidence interval (CI). We will then transform the OR to a relative risk (RR) using the formula: $RR = OR / (1 - \text{baseline risk} * (1 - OR))$ and then calculate the risk difference (RD) using the formula: $RD = \text{baseline risk} * (RR - 1)$.³³ The

baseline risk (i.e., proportion of patients in the non-chiropractic care control group who had the events) for each outcome will be calculated as the median control group risk across included trials.

With continuous outcomes, pooling effect estimates from different instruments that report on a common domain is often done by converting each instrument to standard deviation (SD) units and combining effects across studies as the standardized mean difference (SMD). This approach has important limitations including difficulties in interpretation and vulnerability to baseline heterogeneity of trial participants.^{21,34} Therefore, we will use linear transformation – assuming instruments reporting on shared domains have similar measurement properties – to convert all measures on a common domain to the most frequently reported scale among eligible trials.^{34–36} For example, we will convert all instruments measuring pain intensity to a 10-cm visual analogue scale (VAS), higher scores are worse; physical functioning to the 100-point 36-item Short Form Survey (SF-36) physical functioning scale, higher scores are better; emotional functioning to the 100-point SF-36 mental component summary scale, higher scores are better; role functioning to the 100-point SF-36 scale of role limitations due to physical problems, higher scores are better; social functioning to the 100-point SF-36 social functioning scale, higher scores are better; sleep disturbance to a 10-cm VAS, higher scores are worse; and patient satisfaction to a 10-point satisfaction scale, higher scores are better.³⁵

After converting all continuous outcome measures in common domains to a single tool, we will pool treatment effects as the weighted mean difference (WMD) and associated 95% CI and co-present the corresponding minimally important difference (MID) (i.e., the smallest amount of improvement in a treatment outcome that patients recognize as important).^{34,36} We will use anchor-based MIDs of 1.5 cm on the 10-cm VAS for pain intensity,³⁷ 10 points on the 100-point SF-36 subscales for physical, emotional, role, and social functioning,³⁸ 1 cm on the 10-cm VAS for sleep quality,³⁹ and 1 point on the 10-point scale for patient satisfaction⁴⁰. We will then calculate the probability of achieving greater than or equal to the MID with chiropractic care and with the control intervention.^{21,34} We will use the mean and SD of the control and chiropractic care group responses from each included trial, with the established MID for the outcome in question to estimate the

probability of achieving greater than or equal to the MID in the control and chiropractic care groups, respectively. We will then use the probabilities from both groups to acquire the RD for achieving greater than or equal to the MID with chiropractic care in each trial. The estimated RDs will then be pooled across trials using the inverse variance method.^{21,34}

Modelling assumptions for estimating the RD of achieving the MID assume that SDs of outcome measurements are the same in both the treatment and control groups, and that change scores in both groups are normally distributed. To verify modelling assumptions, we will compare SDs between treatment and control groups, and calculate the mean effect score $\pm$ 2 SDs in each treatment group for all trials that contribute to our analyses to identify any cases in which the distributions are substantially skewed.^{34,41}

Heterogeneity will be examined by visual inspection of forest plots (e.g., similarity of point estimates, extent of overlap of CIs), and assessment using the I^2 statistic. We will use the DerSimonian–Laird method and random-effects models for the meta-analysis of all outcomes reported in two studies or more. Random-effects models are more conservative in that they consider both within- and between-study variability.^{41,42} We will summarize results descriptively when meta-analysis is not possible (e.g., one study per outcome). For all outcomes reported in 10 studies or more, we will investigate small-study effects using contour-enhanced funnel plots and will perform Egger’s test for continuous outcomes and Harbord’s test for binary outcomes.^{43,44} All data analyses will be performed in Stata (StataCorp, Release 18.0, College Station, TX, USA), and comparisons will be 2-tailed using a statistical significance threshold (α) of 5%.

Subgroup analyses

We will explore sources of heterogeneity in our pooled analyses according to the following subgroups:

- (1) different comparators (e.g., usual medical care, physiotherapy, exercise therapist care, wait-list control),
- (2) different study populations (e.g., general community, military service members),
- (3) patient age (e.g., < 65 years vs. $\geq$ 65 years),
- (4) duration of LBP at baseline (acute vs. chronic),

- (5) trials with shorter (< 3 months) vs. longer ($\geq$ 3 months) follow-up, and
- (6) risk of bias (on an item-by-item basis).

We hypothesize that trials of younger patients, patients with acute pain, of shorter follow-up, and at higher risk of bias will show larger beneficial effects with chiropractic care.¹³⁻¹⁵

We will conduct subgroup analyses when at least two studies are available in each subgroup and we will perform test of interaction ($p < 0.05$) for subgroup effects.⁴⁵ We will assess the credibility of significant subgroup effects using the Instrument for Assessing the Credibility of Effect Modification Analyses (ICEMAN) criteria.⁴⁶

Certainty in the evidence

We will assess certainty of the evidence for all outcomes using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach.^{47,48} This approach considers risk of bias, inconsistency, indirectness, imprecision, and publication bias. We will use the 'Making GRADE the Irresistible Choice' (MAGIC) platform (<https://app.magicapp.org>) to develop summary of finding tables and rate the overall certainty of evidence as high, moderate, low, or very low depending on the grading of the individual domains (Tables 1 and 2).^{47,48} We will not rate down certainty in the evidence for risk of bias if the subgroup analysis shows no association of treatment effects between trials at low and high risk of bias (on a component-by-component basis).⁴⁹ If a significant subgroup effect is found, we will present the pooled effect

for studies at low risk of bias (for affected domains) and not rate down the certainty of evidence for risk of bias. If we cannot conduct subgroup analysis (e.g., all trials are at risk of bias), then we will report the pooled effect estimate but rate down our certainty of evidence for risk of bias.

Ethics

We do not require research ethics approval to conduct this systematic review as we will not be requiring access to, or use of, individual patient data.

Discussion

Low back pain is the leading cause of years lived with disability worldwide.¹ In Canada, annual direct health care costs associated with LBP have been estimated at between \$6 and \$12 billion.⁵⁰ Spinal manipulative therapy, often provided by chiropractors as part of a multimodal care approach,²⁸ has been shown in some reviews^{14,15,17} (but not all¹⁶) to be effective for both acute and chronic LBP in terms of pain reduction and improvement in functional status. However, several of these reviews¹⁴⁻¹⁶ included studies that investigated spinal manipulative therapy delivered by non-chiropractic practitioners or as a stand-alone intervention. Findings from prior reviews^{13,17,51,52} also suggest that the clinical and cost effectiveness of overall chiropractic care (i.e., combined chiropractic interventions) for LBP remain uncertain. Moreover, several new trials have been published.^{18-20,53} Our systematic review will aim to identify studies addressing the clinical effectiveness of chiropractic care compared to usual care approaches offered by other provider groups (e.g.,

Table 2.
Quality of evidence levels for GRADE^{47,48}

Quality level	Definition
High	We are very confident that the true effect lies close to that of the estimate of the effect
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect
Very low	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

GRADE = Grading of Recommendations Assessment, Development, and Evaluation.

medical care, physiotherapy) among adult patients with non-specific LBP. The results of our study may inform policy-makers, health care practitioners, and patients on whether to incorporate chiropractic care when managing non-specific LBP. We plan to conduct a systematic review of economic evaluations of chiropractic care for LBP in a future study.

Strengths and limitations

Strengths of our review will include a comprehensive search for eligible randomized controlled trials, appraisal of the risk of bias among individual studies, and use of the GRADE approach to rate the certainty of evidence. We will convert all significant pooled mean effects to RDs to facilitate interpretation, and evaluate the assumptions underlying our outcome transformation and MID-based RD estimates. We will also use pre-defined subgroup analyses to explore sources of heterogeneity and assess the credibility of all potential subgroup effects. A limitation of our review is that MID-based estimates can underestimate treatment effects if most patients (e.g., > 95%) in both groups experience effects greater than the MID.³⁴ Another limitation is we will exclude non-English and -French publications, which may lead to selection bias.

Knowledge translation

We will publish our work in a peer-reviewed journal, and present our results at relevant conferences, to disseminate our findings.

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Management of U.S. Veterans presenting with axial spondyloarthritis to a chiropractic clinic: a case series

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Background: *Axial spondyloarthritis (axSpA) is an immune-mediated condition characterized by signs and symptoms of inflammatory back pain (IBP) affecting the spine and sacroiliac (SI) joints, peripheral arthralgia, enthesitis, and systemic extra-articular complications. While chiropractic treatment is effective for chronic mechanical low back pain, evidence is limited for management of patients with axSpA. This report describes the chiropractic management of three U.S. Veterans with chronic spine pain and axSpA.*

Prise en charge de vétérans américains consultant une clinique chiropratique pour une spondylarthrite axiale: série de cas

Contexte: *La spondylarthrite axiale (axSpA) est une affection à médiation immunitaire caractérisée par des signes et des symptômes de douleur rachidienne inflammatoire touchant la colonne vertébrale et les articulations sacro-iliaques, ainsi que par des arthralgies périphériques, une enthésite et des complications systémiques extra-articulaires. Bien que les traitements chiropratiques soient efficaces contre la lombalgie mécanique chronique, les données relatives à la prise en charge des patients atteints d'axSpA demeurent limitées. Le présent rapport décrit la prise en charge chiropratique de trois vétérans américains atteints d'axSpA et présentant des douleurs rachidiennes chroniques.*

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Conflicts of Interest:

The authors have no disclaimers, competing interests, or sources of support or funding to report in the preparation of this manuscript. Data related to these cases are stored in the patient electronic medical records and is available upon reasonable request from the corresponding author.

The patients presented to the VA Puget Sound Health Care System, and the facility Privacy Officer approved the report. Each of the patients provided consent for publication.

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Case presentation: All patients were co-managed with rheumatology, and each presented at different points of disease progression. All three cases improved in terms of pain, function, or quality of life. No adverse events were reported.

Summary: Patients with axSpA pursue chiropractic services, but the role of chiropractors in the management of patients with axSpA is unclear. This report outlines the experiences of three patients treated in a VA chiropractic clinic. Further research is needed to evaluate the effectiveness and safety of chiropractic treatment of individuals with axSpA.

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KEY WORDS: chiropractic, spinal manipulation, therapeutic exercise, axial spondyloarthritis, non-radiographic axial spondyloarthritis, interdisciplinary care, case report

Background

Seronegative spondyloarthropathies are a group of chronic, immune-mediated inflammatory diseases that affect between 0.5-1.9% of individuals worldwide, and which are responsible for considerable pain, disability, social burden, and decreased quality of life.¹ Axial spondyloarthritis (axSpA) is the most common seronegative spondyloarthropathy subtype and is widely underdiagnosed. An estimated 300,000 Canadians live with axSpA and nearly two-thirds of them experience significant symptoms.²

Classically, axSpA has a familial predilection, is highly associated with the human leukocyte antigen B27 (HLA-B27) allele, and is also most commonly diagnosed in males younger than 45 years old.³ Clinical symptoms include chronic inflammatory back pain (IBP) and stiffness, peripheral arthralgia, enthesitis, and extra-articular complications such as psoriasis, as well as symptoms of the ocular, gastrointestinal, and pulmonary systems.⁴

While this condition was formerly described exclu-

Présentation de cas: Tous les patients ont été pris en charge conjointement avec le service de rhumatologie et ont consulté à différents stades de l'évolution de la maladie. Chez les trois patients, une amélioration de la douleur, de la capacité fonctionnelle ou de la qualité de vie a été constatée. Aucun événement indésirable n'a été signalé.

Résumé: Les patients atteints d'axSpA ont recours à des services chiropratiques, mais le rôle des chiropraticiens dans leur prise en charge demeure incertain. Le présent rapport expose l'expérience de trois patients traités dans une clinique chiropratique du département des Anciens Combattants des États-Unis. Des recherches supplémentaires sont nécessaires pour évaluer l'efficacité et l'innocuité des traitements chiropratiques chez les personnes atteintes d'axSpA.

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MOTS CLÉS: chiropratique, manipulation vertébrale, exercice thérapeutique, spondylarthrite axiale, spondylarthrite axiale non radiographique, soins interdisciplinaires, rapport de cas

sively as ankylosing spondylitis, differentiation between subtypes of this condition was prompted by the increased availability of magnetic resonance imaging (MRI) which paved the way for earlier detection of sacroiliitis and axSpA recognition before other visible radiographic changes (e.g., ankylosis). The enhanced sensitivity in detection evolved the understanding of the disease course and prompted a 2022 update in the *Assessment of Spondyloarthritis International Society (ASAS)* classification and nomenclature to create a distinction between the most common subtypes of this condition, radiographic axial spondyloarthritis (r-axSpA) and non-radiographic axial spondyloarthritis (nr-axSpA).⁵⁻⁷

Management recommendations for patients with axSpA include a personalized approach with a multidisciplinary team coordinated by a rheumatologist. In addition to medication management with non-steroidal anti-inflammatory drugs (NSAIDs) and biologic medications, non-pharmacological approaches like therapeutic exercise, patient education, and lifestyle change are common-

ly recommended.^{7,8} Chiropractic services (e.g., advice, education, spinal manipulation, manual therapies, exercise prescription) are well documented for their benefits to patients with chronic mechanical low back pain and are recommended by clinical practice guidelines for the management of back pain.^{9,10} Patients with axSpA do present to chiropractors seeking treatment,¹¹ however, literature pertaining to chiropractic management of axSpA remains limited^{12–15}.

In the US and Canada, chiropractic is a doctoral-level profession that holistically approaches the evaluation and management of musculoskeletal conditions with non-surgical and non-pharmacological approaches.¹⁶ The purpose of this case series is to describe the chiropractic management of three patients at different progressions of axSpA disease diagnosis and management within an integrated hospital-based system.

Case presentations

We followed the CARE Checklist guidelines for reporting for case reports.¹⁷

Case 1

A 22-year-old Hispanic male U.S. Army veteran presented to the chiropractic clinic with a history of chronic lower back and left posterolateral hip pain. Two years earlier, he was diagnosed with nr-axSpA and was medically discharged from military service. A chart review of a rheumatology consultation one year before the chiropractic consultation revealed chronic uveitis, laboratory testing demonstrating the presence of HLA-B27 allele and elevated inflammatory markers, and advanced imaging with MRI confirmed bilateral sacroiliitis. Ankylosis was not visible on plain-film lumbar radiographs. (Figure 1) He did not have known family history of autoimmune disease, toxic exposure, or additional pertinent past medical history. Relevant treatment history included minimal benefit with oral NSAIDs and steroid injections to the SI joints, and significant relief of pain and stiffness after initiating rheumatologist-prescribed the Tumor Necrosis Factor inhibitor (TNFi) medication adalimumab.

Upon presentation to the chiropractic clinic, he described symptoms of diffuse joint stiffness upon waking and following heavy lifting as well as pain and stiffness which went through cycles of relapsing and remitting. Pain intensity was rated 2 out of 10, while interference

with enjoyment of life and general activity were rated 2 and 1 out of 10, respectively using the pain, enjoyment of life, and general activity (PEG) scale.¹⁸ He reported daily morning stiffness, lasting for up to three hours, that was relieved by walking and stretching. His referral was prompted by a six-month relapse of lower back and left hip pain that hindered his ability to lift weights, run, and play soccer.

Upon examination, pathological reflexes were absent and muscle stretch reflexes, lower extremity myotomes, and skin sensation were all within normal limits. Lumbar extension was moderately reduced and provocative for pain at the bilateral posterior superior iliac spine while lumbar flexion was palliative. Prone SI joint extension bilaterally provoked ipsilateral lower back pain. Thigh thrust and lumbar facet loading were unremarkable. Pain and tenderness were elicited upon palpation of the left quadratus lumborum, left hip external rotators, and the bilateral SI joints. The patient was diagnosed in the chiropractic clinic with mechanical nonspecific lumbosacral pain, complicated by nr-axSpA. As no red flags were observed, the veteran was actively following rheumatology, and a recent pelvic MRI and laboratory testing were on file, no additional workup was deemed appropriate at the time of consultation.

Given the absence of ankylosis, a trial of care was initiated with thoracolumbar, lumbopelvic, and bilateral femoroacetabular high-velocity low-amplitude (HVLA) manipulation, flexion-distraction manipulation to the lumbar spine, myofascial release to the lumbar and hip musculature, and a targeted home exercise program promoting lumbopelvic stability for eight visits over six months. The patient was educated regarding the relapsing-remitting nature of systemic inflammatory conditions. He was encouraged to stay active, including a graded approach to returning to weightlifting, running, and playing soccer, and he was reassured that increasing his activity level to tolerance was safe without undue risk of setting back his overall improvement. He was also advised to continue with treatment as recommended by the rheumatologist to minimize symptoms and disease progression. As expected, his symptoms did relapse and remit throughout the course of care. During these relapses, the veteran reported difficulty connecting with his prescribing provider to refill his biologic medication. The treating chiropractor



Figure 1.

AP and lateral lumbar radiographs without any signs of sacroiliitis or ankylosis (Case 1).

contacted the patient's rheumatologist to facilitate refill of the prescription.

Following a therapeutic withdrawal from care, a re-evaluation was performed at visit 8. At this time, the veteran presented with minimal lower back pain, with intensity rated 1 out of 10 (50% improvement), and pain impact on enjoyment of life and general activity were rated 0 (100% improvement) and 1 (no change) out of 10, respectively. Although pain flares in the absence of medication continued, he resumed weightlifting three to four times weekly with improved tolerance, regularly playing soccer, and began practicing yoga. He denied experiencing any soreness or adverse events related to his chiropractic treatments. At this time, he was transitioned

to care on an as-needed basis for flare management, and it was recommended that he continue his home exercise program.

Case 2

A 55-year-old white male U.S. Navy veteran with previously diagnosed r-axSpA presented to the chiropractic clinic with chronic non-progressive neck, mid back, and lower back pain with intermittent radiating pain to the right groin and posterior knee. He reported his symptoms began after contracting *salmonellosis* thirty-five years earlier, which led to frequent attacks of diffuse axial and peripheral joint pain since the infection. Nine years later, he tested positive for HLA-B27, was diagnosed with

chronic irritable bowel disease, and lumbar radiographic imaging revealed bilateral symmetric erosive sacroiliitis and fusion of the SI joints. (Figure 2) No ankylosis was evident within the lumbar spine. Other pertinent radiographic imaging revealed mild multilevel degeneration of the cervical spine, mild anterior wedging of T8, T9, and T11 within the thoracic spine, and femoral neck osteopenia with a dual-energy X-ray absorptiometry (DEXA) scan performed two years earlier. He did not have any known history of toxic exposure or other pertinent past medical history. His recent treatment regimen included rheumatologist-prescribed TNFi (infliximab) infusions every five weeks for the last seven years. He described infusions as crucial to reducing his frequency and intensity of symptomatic exacerbations and additionally perceived that his chiropractic treatments played an important role in his ability to perform activities of daily living and re-

duced his need for oxycodone medication which was prescribed to be used on an as needed basis.

Due to patient reported benefit with chiropractic treatment, for the past twelve years he was managed with a supportive care plan consisting of patient education, manual therapy, exercise, and lifestyle advice for chronic pain.

At his most recent trial of care, pain intensity, enjoyment of life, and general activity were all rated 5 out of 10 using the PEG scale, and Neck Disability Index¹⁹ was scored 6 out of 40 (two questions were skipped by the patient). He denied any temporal association with pain in all regions of complaint and reported thoracic pain that was provoked with deep inspiration and coughing. Upon examination, pathological reflexes were absent, and muscle stretch reflexes, upper extremity myotomes, and skin sensation were all within normal limits. Cervical,

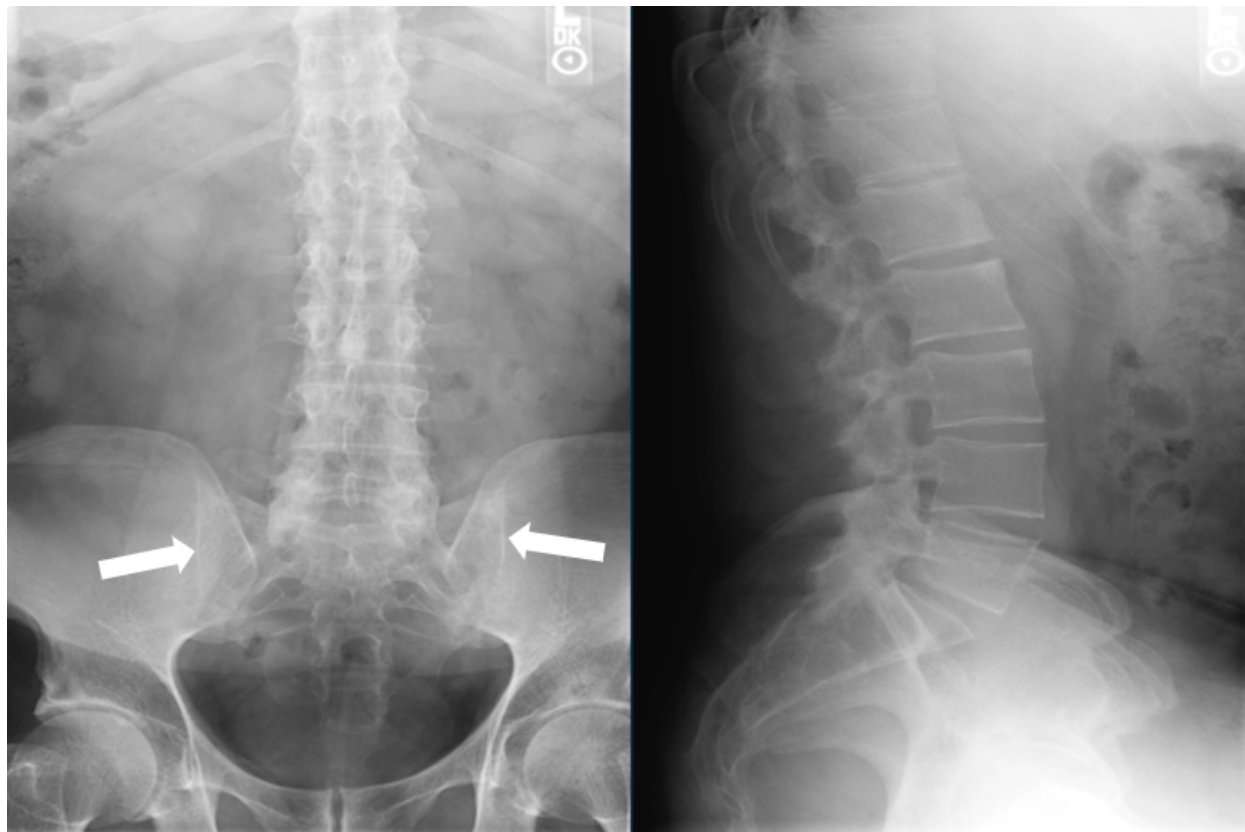


Figure 2.

AP and lateral lumbar radiograph displaying bilateral symmetric erosive sacroiliitis and sacroiliac joint fusion (Case 2).

thoracic, and lumbar ranges of motion were all moderately reduced, except for left thoracic rotation, which was markedly decreased, and all ranges of motion increased his pain and stiffness. Facet loading and prone SI extension testing both increased lumbosacral pain bilaterally. Repeated end-range loading with cervical retraction and lumbar extension were palliative for local pain. The veteran's goals for treatment were to obtain manual therapies and self-management strategies for continued pain relief and to minimize the need for pain medication.

He was diagnosed with mechanical nonspecific cervical, thoracic, and lumbosacral pain, complicated by multiple thoracic compression deformities, r-axSpA, and reactive arthritis. As the veteran was actively following rheumatology and his symptoms were stable at time of presentation, obtaining updated imaging and labs to evaluate inflammatory activity were deemed unnecessary. Treatment consisted of cervical, cervicothoracic, thoracic, and lumbar HVLA spinal manipulation as well as myofascial release to each region of complaint. In addition to his medication management prescribed by rheumatology, he was prescribed and encouraged to pursue a consistent home exercise program of postural-based strengthening and stretching, and to begin walking for exercise on a consistent basis.

Throughout this most recent trial of care, significant improvement in thoracic and lumbosacral mobility was observed without adverse event reported. At re-evaluation pain was rated 7 out of 10 (40% worsening), enjoyment of life was rated 5 out of 10 (no change), and general activity was rated 6 out of 10 (20% worsening), using the PEG scale, reflective of the veteran experiencing a flare-up of lumbopelvic pain. As recommended during treatment, he initiated a consistent home exercise program, reporting he had lost 10 pounds over 5 months. At his request, we agreed to a supportive chronic pain treatment plan at a frequency of one visit every one to two months.

Case 3

A 36-year-old white male U.S. Army veteran was referred to the chiropractic clinic for chronic neck and lower back pain, and he additionally reported poor sleep quality and depression. Prior to the chiropractic presentation, rheumatology was consulted due to suspicion of axSpA. Chart review revealed that the patient was positive for the HLA-B27 allele and suffered from chronic uveitis

and peripheral arthralgias. The patient denied a family history of autoimmune disease, symptoms of inflammatory bowel disease, or psoriatic skin lesions. An MRI performed six years earlier was unremarkable for evidence of SI joint inflammation or ankylosis. Considering the absence of MRI findings, the rheumatologist assessed that there was a low suspicion of seronegative spondyloarthropathy and diagnosed him with fibromyalgia. Two years later, following worsening chronic uveitis with unclear etiology, the patient returned to rheumatology. He was prescribed a short dose of the biologic medication adalimumab, and he experienced significant relief of his ocular symptoms and musculoskeletal pain but was lost to follow-up.

He presented to the chiropractic clinic one year later, reporting atraumatic diffuse neck pain and worsening, insidious, lower back pain accompanied by morning stiffness lasting for three to four hours on average. His pain alternated in laterality at the lumbosacral junction and bilateral posterolateral hips. He also reported pain radiating to the right posterior thigh, without paresthesia or weakness. Pain intensity was rated 7 out of 10, while impact on enjoyment of life was rated 6 out of 10, and generalized activity was rated 8 out of 10. Neck Disability Index was scored 32 out of 50, reflecting severe disability. He reported using a single-point cane when walking long distances due to lower back pain and stiffness. Prior treatment with lumbar radiofrequency ablation provided him with relief, but symptoms were now regressed back to pre-treatment status.

Upon examination, pathological reflexes were absent, and muscle stretch reflexes, upper and lower extremity myotomes, and skin sensation were all within normal limits. Cervical, thoracic, and lumbar ranges of motion were all moderately reduced and provocative for pain. Passive supine cervical rotation was provocative for neck pain bilaterally, while no other cervical orthopedic testing elicited symptoms. Lumbar facet loading increased ipsilateral lumbosacral pain. Posterior pelvic pain provocation increased SI joint pain ipsilaterally to the side that was tested. He was diagnosed with mechanical nonspecific cervical, thoracic, and lumbar pain with concern for axSpA. Updated lumbar and pelvic MRIs were ordered, and coordination efforts were initiated to reconnect the veteran with rheumatology to inquire about re-establishing treatment with adalimumab. MRI revealed a mild

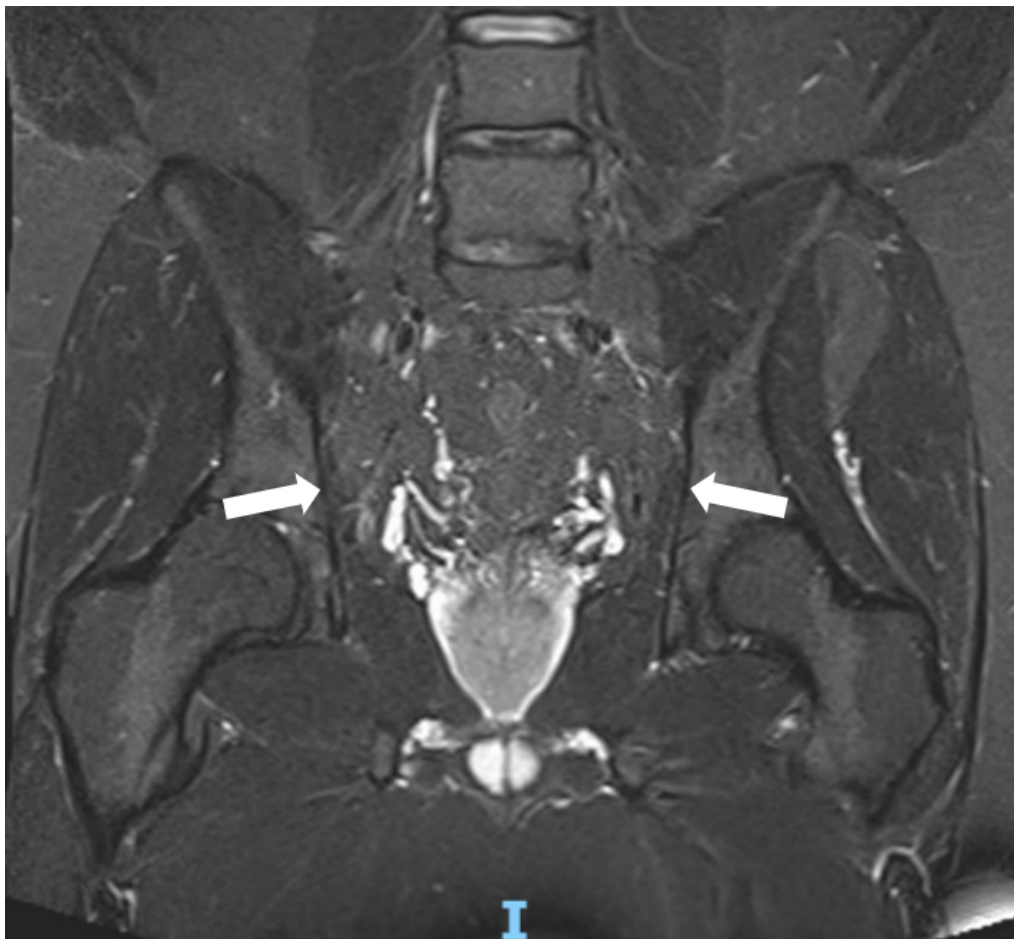


Figure 3.

T2 weighted lumbar MRI demonstrating the absence of sacroiliitis or fusion with well defined sacroiliac joint margins (Case 3).

symmetric L5-S1 disc bulge without nerve root contact, and signs of sacroiliitis remained absent. (Figure 3)

The chiropractic treatment plan consisted of cervical, cervicothoracic, thoracic, and lumbosacral HVLA spinal manipulation, myofascial release, and a home exercise program with an emphasis on cervical and thoracic mobilization, as well as pelvic stabilization exercises. He was followed in the clinic once per month for 18 months. Throughout this care, the veteran presented with fluctuating pain intensity, which became more stable after re-establishing care with a new rheumatologist. That provider diagnosed the veteran with recurrent uveitis with concern for inflammatory peripheral arthritis and/or nr-axSpA and re-initiated adalimumab medication. At final re-evalua-

tion, the patient noted reduced stiffness in all regions of complaint following re-initiation of the biologic medication and a decrease in pain intensity and improved ability to perform generalized activity, which were rated 5 (29.5% improvement) and 7 (13% improvement) out of 10 respectively on the PEG questionnaire. At this point, he was transitioned to an as-needed treatment plan for flare-up management. He denied experiencing any soreness or adverse events related to his chiropractic management.

Discussion

This case series presents the first description of chiropractic management for US military veterans with known

or suspected axSpA spanning various stages of disease progression. Case 1 represented the management of an early progression of nr-axSpA in a younger veteran who received multidisciplinary care including prescription medication from rheumatology, and manual therapy, exercise, and education from the chiropractor. Case 2 described supportive care for chronic pain in an older veteran with longstanding r-axSpA who received consistent chiropractic care for chronic pain, complementing his primary rheumatologic treatment. Case 3 involved diagnostic testing and coordination of care for a patient with suspected axSpA.

In the absence of other disease states, recognition of well-established clinical features greatly increases the likelihood of identifying axSpA.²⁰ (Table 1) Chronic IBP is a key clinical feature in differentiating axSpA from other conditions. Hallmarks of IBP include relapsing and remitting back pain of insidious onset that begins before age forty, is worse at night and upon first waking, improves with movement, and does not improve with rest (Figures 4 and 5).^{21,22} Although the specificity of IBP for an axSpA diagnosis is limited, if these hallmark symptoms are present, then further investigation is indicated and referral to a rheumatologist is warranted.²³ All three cases

Table 1.
Likelihood ratios of clinical features for the diagnosis of axial spondyloarthritis.

Axial Spondyloarthritis Features	Likelihood ratios (LR) for diagnosis ²¹	Case 1	Case 2	Case 3
Sacroiliitis by MRI	9.0	☑	☑	☒
HLA-B27 expression	9.0	☑	☑	☑
Anterior Uveitis	7.3	☑	☒	☑
Family history of seronegative spondyloarthropathy, inflammatory bowel disease, psoriasis, or uveitis	6.4	☒	?	☒
Good response to NSAIDs	5.1	☒	☒	☒
Dactylitis	4.5	☒	☒	☒
Peripheral arthritis	4.0	☑	☑	☑
Inflammatory bowel disease	4.0	☑	☑	☒
Heel pain (enthesitis)	3.4	?	☑	☑
Inflammatory back pain	3.1	☑	☑	☑
Elevated ESR/CRP	2.5	☑	☑	☑
Psoriasis	2.5	☒	☒	☒

☑ Feature present ☒ = Feature absent ? = Unclear/unknown

Acronyms: CRP, c-reactive protein; ESR, erythrocyte sedimentation rate; MRI, magnetic resonance imaging; NSAIDs, non-steroidal anti-inflammatory drugs.

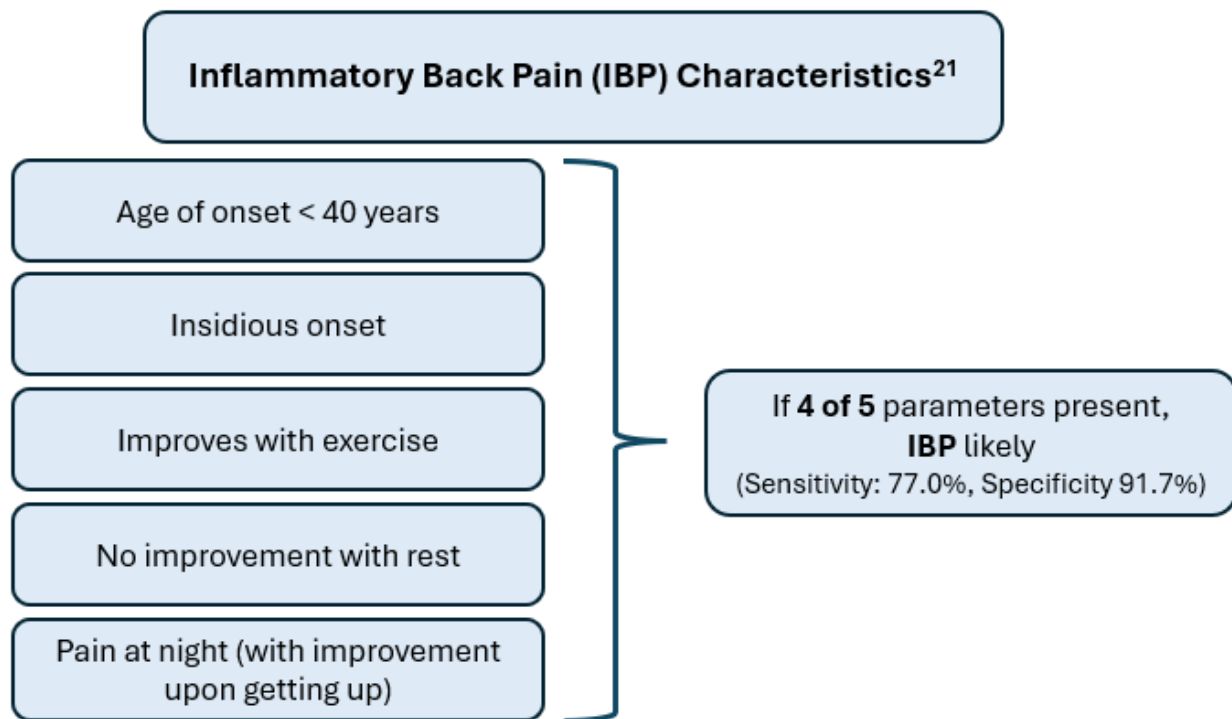


Figure 4.

Assessment of Spondyloarthritis International Society (ASAS) inflammatory back pain diagnostic criteria.²¹

exhibited IBP symptoms, tested positive for HLA-B27, and presented extraspinal features, but disease manifestation visible on imaging varied.

Despite radiographic features being absent in patients with nr-axSpA, evidence of inflammatory lesions such as bone marrow edema and fat metaplasia within the SI joints may be present and viewed with MRI. Rather than two distinct diseases, the non-radiographic distinction in nomenclature functions to capture the broad spectrum of axSpA and allow for acknowledgment of disease progression.²⁴ A considerable number of cases with nr-axSpA may never develop radiographic sacroiliitis or ankylosis.²⁵ When transition from nr-axSpA to r-axSpA does occur, it tends to progress slowly, occurring in only 5.8% of patients over 10 years, with even lower rates in those managed with TNFis.²⁵ The ASAS recommends rheumatologist opinion for axSpA diagnosis, and their classification criteria combine clinical, laboratory, and imaging features.

The differential diagnoses for axSpA share many similar features and can be difficult to distinguish between.

Alternative diagnostic considerations include mechanical non-specific low back pain, spondylosis, fibromyalgia, diffuse idiopathic skeletal hyperostosis (DISH), Scheuermann disease, osteitis condensans ilii, and infectious sacroiliitis.²¹ Diagnostic imaging evidence of inflammatory sacroiliitis on MRI is a suggestive of axSpA, but other conditions can mimic this appearance. Conditions presenting similarly on imaging include osteoarthritis, stress fractures, infective sacroiliitis, and osteitis condensans ilii.²⁶ Radiographic diagnosis can be further complicated as sacroiliitis is not specific for axSpA as it has been observed in patients with mechanical low back pain and must be correlated with other clinical findings alongside expert opinion by rheumatologist to confirm diagnosis.²⁷ The HLA-B27 allele is highly associated with axSpA, but has also been found to be prevalent in those with standalone anterior uveitis and inflammatory bowel disease, juvenile idiopathic arthritis, reactive arthritis, psoriatic arthritis, and undifferentiated spondyloarthritis.²⁸ Many of these diagnoses may be present concurrently and they are not mutually exclusive.

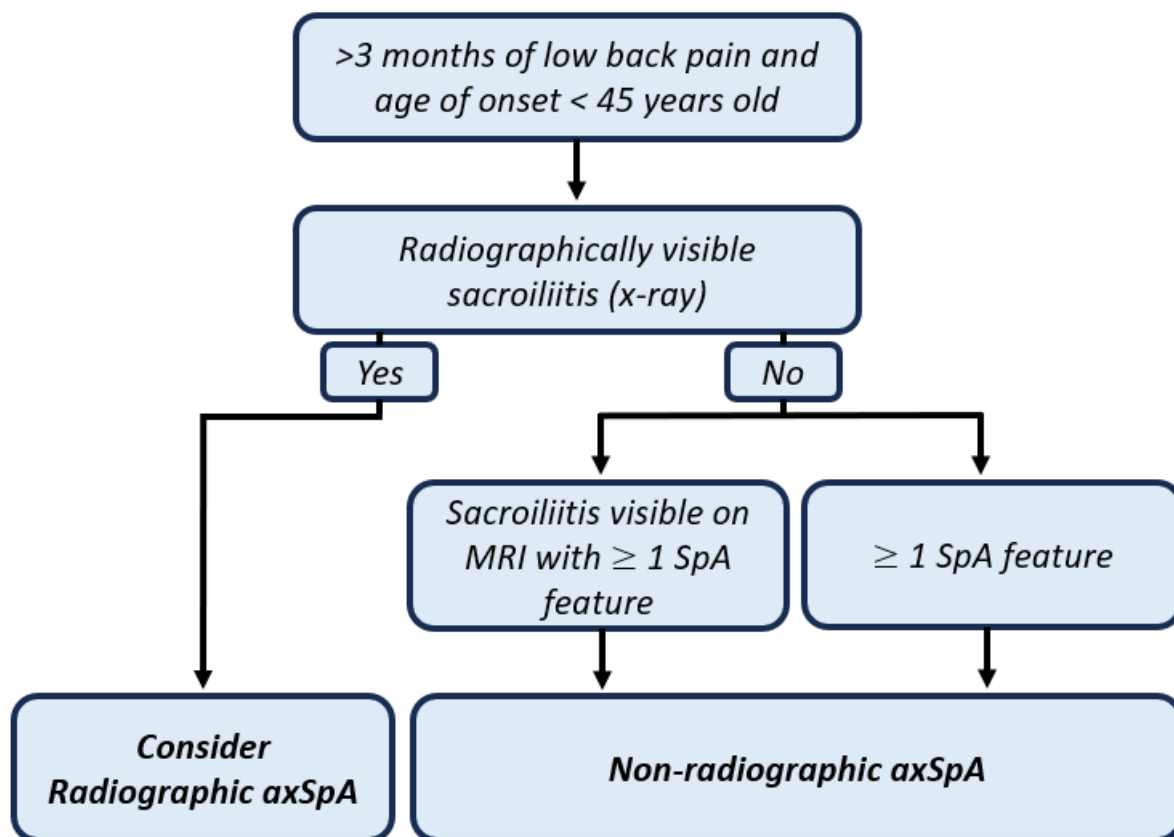


Figure 5.

Classification Criteria for axial spondyloarthritis (axSpA) when evaluating low back pain (LBP) and spondyloarthritis (SpA) features (modified from ASAS criteria).^{4,5}

Case 3 was initially diagnosed with fibromyalgia, only to receive medication treatment relief two years later as nr-axSpA was considered.²⁹ In the absence of definitive axSpA imaging findings or lab markers such as HLA-B27, c-reactive protein, and erythrocyte sedimentation rate, differentiating between the two pathologies can be difficult. The prevalence of fibromyalgia has been reported to co-occur with axSpA in between 4-25% of cases.³⁰ Case 2 presented with a past medical history of reactive arthritis, a disease in the same family of seronegative spondyloarthropathies as axSpA. Inflammatory sacroiliitis is predictive for reactive arthritis disease progression, with 22-26% of cases evolving to r-axSpA.^{31,32} Disc degeneration is also common in patients with axSpA and may provoke concurrent mechanical spine pain.³³ Case presentations may have similar clinical characteristics on clinical

examination, laboratory findings, or diagnostic imaging, but they often do not fit the comprehensive clinical profile of axSpA. According to the ASAS guideline, the entirety of the clinical picture must be accounted for alongside expert opinion by rheumatologist to confirm diagnosis.⁷

The development of ankylosis of the spine is the leading source of functional limitation in patients with established axSpA.³⁴ Despite the wide variation of severity of inflammatory symptoms and degree of ankylosis, the disease burden and management are similar for both nr-axSpA and r-axSpA.³⁵ The goals of treatment are generally to alleviate symptoms, improve functioning, maintain the ability to work, decrease disease complications, and forestall skeletal damage as much as possible. Clinical guidelines recommend treatment with medications such as NSAIDs, TNFis, supervised and unsupervised exercise,

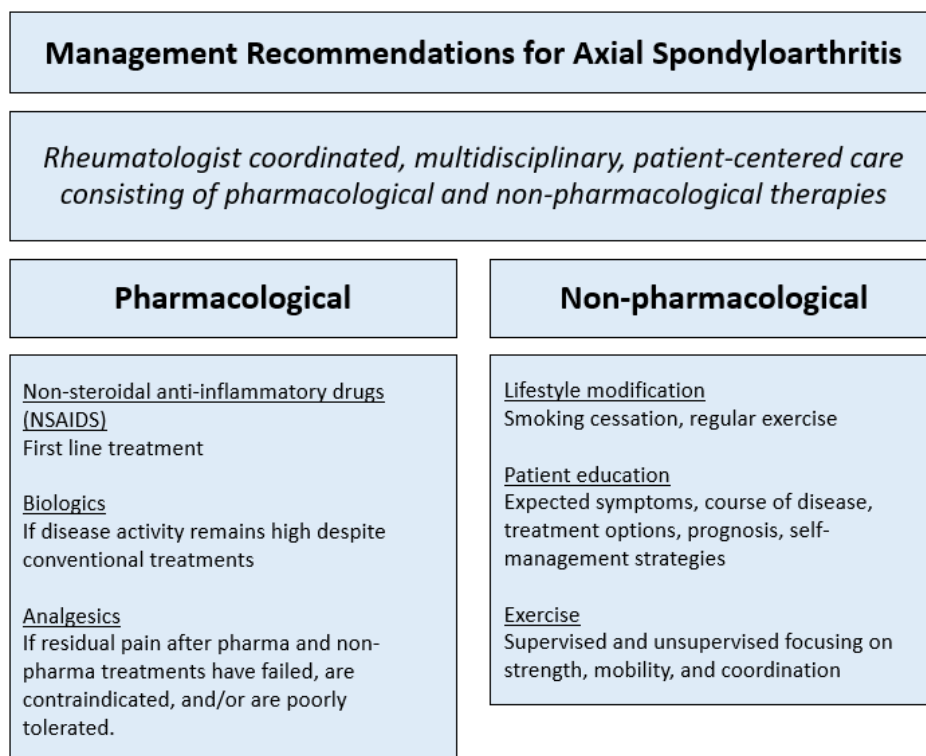


Figure 6.
Management recommendations for axial spondyloarthritis.^{7,8}

and formal education on self-management and the nature of the disease.^{7,8} (Figure 6)

Chiropractors employ various methods to address axial pain, including joint manipulation and mobilization, soft-tissue therapies, patient education, lifestyle recommendations, therapeutic exercise, and physical modalities (e.g., electrical stimulation, heat). Although disease presentations varied and the diagnosis of one case was uncertain, chiropractic management of each case remained similar, was guideline-concordant, and, as an adjunct to medication management, may have contributed to reduced pain symptoms, improved function, attainment of functional goals, and increased enjoyment of life.

Chiropractic services do not address the underlying inflammatory etiology of axSpA, but they are consistent with management guidelines and may play a role in pain management, improving mobility, and improving function. A recently published observational study suggests that more education of chiropractors is needed to increase appropriate screening for inflammatory back pain in their

offices.¹¹ In cases where IBP is suspected, chiropractors can play a role in referral coordination to a rheumatologist, as was done in cases one and three. The ability of chiropractors to function in the larger healthcare system as licensed independent practitioners can support patients' pain and quality of life through recognition of axSpA and providing guidance towards appropriate management indirectly or directly alongside a rheumatologist.

Chiropractic providers must be cautious of potential safety concerns when treating patients with axSpA, particularly when applying spinal manipulation.^{36,37} Chronic inflammation, limited spinal mobility, and increased physical inactivity with axSpA can lead to both new bone formation in the spine as well as increased bone loss. This bone loss represents a point of caution when providing HVLA spinal manipulation, as it is well established that patients with axSpA have a high prevalence of osteoporosis and fracture alongside potential ankylosis.³⁸⁻⁴¹ The American College of Rheumatology (ACR) recommends against spinal manipulation for patients with r-axSpA in

the presence of spinal fusion or advanced spinal osteoporosis.⁸ No recommendations were made by ACR in the context of spinal manipulation and nr-axSpA. In contrast, the World Health Organization guidelines on safety in chiropractic do not consider ankylosing spondylitis to be contraindicated in the absence of ligamentous instability, anatomic subluxation, or ankylosis.¹⁰ Our case 2 with r-axSpA did have known osteopenia via a recent DEXA scan. However, the severity of osteopenia was mild, and he had a long history of benefit with spinal manipulation. Therefore, treatment using HVLA spinal manipulation was initiated, and no adverse events occurred. Fracture risk should be considered by the treating chiropractor and clinical decisions regarding spinal manipulation are best considered on a case-by-case approach.

Limitations

Our report has several limitations inherent to its design as a case series. Case series do not have a control group which precludes the ability to establish causality between treatment administered and the observed outcomes described. As these patients were treated in an outpatient setting, several uncontrolled factors exist that may have influenced their response to treatment. Treatments did not occur in isolation, and it is not possible to identify which treatment(s) resulted in patient improvements. Further, low back pain episodes are commonly self-limiting and axSpA is relapsing and remitting in nature, thus natural history may have played a role in the outcomes reported.^{42,43}

We suspect that appropriate medication management of IBP symptoms led to the largest effect on patient outcomes. The role of the chiropractors may be most well suited to identifying IBP, coordination with rheumatology, and providing adjunctive non-pharmacologic treatment options. This study was also limited to a small sample size that may not be generalizable to other patients with axSpA.

Summary

This case series suggests that chiropractic services may be effective as an adjunct to standard medical care in patients with spine pain due to axSpA. While it is important for providers to be cautious of potential contraindications to HVLA spinal manipulation, such as osteoporosis and spinal fusion from ankylosis, none were present in these

patients and chiropractic care was well-tolerated without adverse events. Further research is needed to investigate the role of chiropractors in the management of individuals with chronic spine pain related to axSpA.

Abbreviations

ASAS	Assessment of Spondyloarthritis International Society
axSpA	axial spondyloarthritis
DEXA	dual energy X-ray absorptiometry
DISH	diffuse idiopathic skeletal hyperostosis
HLA-B27	human leukocyte antigen B27
HVLA	high-velocity, low-amplitude
IBP	inflammatory back pain
MRI	magnetic resonance imaging
nr-axSpA	non-radiographic axial spondyloarthritis
NSAID	non-steroidal anti-inflammatory drug
PEG	pain, enjoyment of life, and general activity
r-axSpA	radiographic axial spondyloarthritis
SI	sacroiliac joints
SpA	spondyloarthritis
TNFi	tumor necrosis factor inhibitor

Authors' contributions

ZS, KM, and CD drafted the manuscript which was critically revised and approved by all authors and provided patient care described within this study.

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The chiropractor's role in addressing social determinants of health: a case report of a U.S. Veteran with acute housing instability

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Objective: Housing is a well-established social determinant of health (SDOH) where housing instability can negatively affect physical health and access to health care. We present a case where housing instability was reported while under chiropractic management of neck pain and headaches.

Clinical features: A 54-year-old male under care at a Veterans Affairs chiropractic clinic for mechanical neck pain and cervicogenic headaches, presented at follow-up visit four with new-onset nausea, change in headache, and recent residential furnace failure.

Rôle du chiropraticien dans la prise en compte des déterminants sociaux de la santé: rapport de cas concernant un vétérán américain en situation d'instabilité résidentielle aiguë

Objectif: Le logement constitue un déterminant social de la santé (DSS) bien établi, et l'instabilité résidentielle peut nuire à la santé physique et à l'accès aux soins de santé. Nous présentons un cas dans lequel une situation d'instabilité résidentielle a été signalée pendant la prise en charge chiropratique de douleurs cervicales et de céphalées.

Caractéristiques cliniques: Un homme de 54 ans suivi dans une clinique chiropratique du département des Anciens Combattants pour des douleurs cervicales mécaniques et des céphalées cervicogènes a signalé, lors de sa quatrième visite de suivi, l'apparition récente de nausées, une modification de ses céphalées et une panne récente du système de chauffage de son logement.

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Conflicts of Interest:

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The involved patient provided signed consent for case publication. The Butler VA Health Care System Privacy Officer approved this submission.

Intervention and outcome: Care coordination was initiated by the chiropractor with the social work team due to concerns of housing instability. Following furnace repairs and return to stable housing, the veteran reported significant symptom improvement and was lost to follow up.

Summary: We demonstrate real-world recognition of an SDOH impacting a presenting complaint to a chiropractic clinic. Timely action was taken by the chiropractor to coordinate appropriate care to address acute housing instability.

(JCCA. 2026;70(2):228-235)

KEY WORDS: case report, chiropractic, housing instability, social determinant of health, biopsychosocial

Intervention et résultat: En raison des préoccupations liées à l'instabilité résidentielle, le chiropraticien a entrepris une coordination des soins avec l'équipe de travail social. Après la réparation du système de chauffage et le rétablissement de conditions de logement stables, le vétérinaire a signalé une amélioration considérable de ses symptômes, puis a été perdu de vue.

Résumé: Ce cas illustre le repérage, en contexte réel, d'un déterminant social de la santé ayant une incidence sur le motif de consultation dans une clinique chiropratique. Le chiropraticien est intervenu rapidement pour coordonner les soins nécessaires afin de remédier à la situation d'instabilité résidentielle aiguë.

(JACC. 2026;70(2):228-235)

MOTS CLÉS: rapport de cas, chiropratique, instabilité résidentielle, déterminant social de la santé, biopsychosocial

Introduction

A foundational framework for healthcare delivery is the biopsychosocial (BPS) model of care.¹ The broader *social* constructs weave within and alongside the *bio-* and *psycho-*components of the BPS model and are referred to as social determinants of health (SDOH).² The World Health Organization defines SDOH as non-medical factors that affect a person's health outcomes such as where a person is born, and where a person grows, works, lives, worships, and ages which are influenced by broader systems such as social structures, policy, or governmental systems.³ Healthy People 2030 categorizes SDOH by domain: economic stability, education access and quality, health care access and quality, neighborhood and built environment, and social and community context (Table 1).^{3,4}

Spine pain is a major societal concern in the United States, annually costing hundreds of billions of dollars in medical care, lost productivity, and lost wages.^{5,6} There is a broad range of care options for those suffering from spine pain with an emphasis in recent years on non-pharmacological care including complementary and integrative health options.⁷ This is evident particularly with the Veterans Health Administration (VA), the largest inte-

Table 1.
Social determinants of health (SDOH) subdomains according to Healthy People 2030.⁴

Economic Stability
Employment
Food Insecurity
Housing Instability
Poverty
Education Access and Quality
Early Childhood Development and Education
Enrollment in Higher Education
High School Graduation
Language and Literacy
Health Care Access and Quality
Access to Health Services
Access to Primary Care
Health Literacy
Neighborhood and Built Environment
Access to Foods That Support Healthy Dietary Patterns
Crime and Violence
Environmental Conditions
Quality of Housing
Social and Community Context
Civic Participation
Discrimination
Incarceration
Social Cohesion

grated healthcare system in the United States, taking a leading role in delivering complementary and integrative health services as part of the care package.⁸ Integrated healthcare delivery is an asset in the holistic evaluation and management of patients. In this setting, clinicians may recognize negatively impacting SDOH and coordinate with the appropriate resources that extend beyond the patient's presenting primary complaint. Regarding spine pain, patients often experience coexisting burdens within SDOH domains that complicate spinal pain recovery including housing instability, mental health comorbidities, illiteracy, and job loss as barriers to routine healthcare.⁹⁻¹¹

The chiropractic profession is an integral part of the array of care pathways offered for spine pain.^{8,12} As licensed independent clinicians, chiropractors evaluate, diagnose, manage, and coordinate care specific to a patient's condition, most often neuromusculoskeletal complaints.¹³ Beyond the chief complaint, chiropractors consider past medical history, treatments, co-morbid conditions, and patient preferences among other aspects of the intake. Chiropractors have the resources to evaluate and act on identifying key SDOH contributing to patient presentation irrelevant of practice setting.^{14,15}

Numerous examples of chiropractors' consideration of SDOH in the clinical environment are described in the literature such as tobacco cessation¹⁶, substance use¹⁷, self-directed violence¹⁸, and intimate partner violence¹⁹. Some suggest a demonstrable lack of attention to the *psycho-* and *social-* constructs of the BPS model in chiropractic practice while others indicate more broad fragmentation and limited implementation of the BPS model of health care.^{2,20,21} Further, there is a evident knowledge gap and limited curriculum integration of SDOH in doctor of chiropractic programs, creating a potential barrier to identifying and addressing social needs in clinical settings.^{22,23}

Chiropractors working in integrated care settings, such as VA, may have the opportunity to optimize and model best practice considerations to identify and triage care for social needs (e.g., SDOH). At VA, chiropractors are positioned with resource accessibility to streamline referrals and co-manage for the benefit of the patient which includes a shared electronic health record, interdisciplinary co-localization, patient aligned care teams, pre-defined response teams for medical, behavioral, and social emergencies, and housing and substance use support teams.

Chiropractors' modeling of real-world identification and subsequent appropriate action for concerns of a SDOH impacting a patient is lacking in the literature.

Thus, we present a clinical case where a chiropractor triaged and activated social work services related to an acute, housing instability circumstance for a veteran seeking care for a neuromusculoskeletal complaint. The patient provided consent for the publication of this case report.

Case report

Patient information

A 54-year-old male Army veteran was referred to the Butler VA Health Care System chiropractic clinic with a chief complaint of mechanical neck pain and associated headaches to consider acupuncture as an adjunct to rehabilitative exercises. Neck disability index (NDI) at the initial visit scored 10 out of 50 (20%), with a score of 5/5 on question 5, which is specific for headache. The Pain Intensity, Enjoyment of Life, General Activity (PEG-3) scored a composite of 10 and an average of 3 out of 10.

His medical history was remarkable for chronic migraines, hyperlipidemia, and insomnia. His psychiatric history included generalized anxiety disorder, depression, post-traumatic stress disorder, and a remote history of suicidal ideation. For social history, he denied use of tobacco or recreational drugs and had been sober from alcohol for 24 years. He was an automotive salesman at a car dealership, and he lived in an apartment with his teenage daughter.

He had experienced stable, near-daily intermittent left-sided neck pain with radiating pain to the left side of his head for the past five years. His cervical spine pain was localized to the left suboccipital region, and the pain radiated in a "question mark" pattern over his left ear ending at the temporal region of his head. He denied radiating pain or paresthesia to either left or right upper extremity or face.

Prior to the evaluation in the chiropractic clinic, he had attended two sessions with the VA physical therapy clinic for the same concern of neck pain and headaches. He was responsive to repeated end range loading strategies and continued performing cervical retractions several times per day for home exercise, which improved his suboccipital and temporal pain frequency from 4-5 times to 2-3

times per week. Otherwise, he had no prior history of conservative, interventional, or surgical procedures for this presenting concern.

For pertinent findings from the review of systems, he reported chronic, stable migraines that were separate and distinct from his five-year history of neck and head pain. He experienced migraines once per month, with associated blurry vision, “dots” in his visual field, and photophobia. Migraines were well-managed with daily propranolol for prophylaxis and zolmitriptan as an abortive therapy. At the initial chiropractic clinic visit, his last migraine had occurred approximately three weeks prior.

Physical exam

Heel, toe, and tandem walks were performed without difficulty and Romberg was unremarkable. Neurological exam was largely unremarkable with cranial nerves within normal limits, and upper extremity strength, deep tendon reflexes, and sensation were intact throughout C5-T1 dermatomes bilaterally. There was no evidence of dysmetria, tremor, or pronator drift. As this was a regional complaint, no lower extremity examination was performed.

Observed active cervical range of motion was full and unrestricted, with perceived tightness at end range in all planes of motion. Shoulder depression was provocative for concordant neck and head pain with right lateral flexion while all other cervical orthopedic loading maneuvers were unremarkable for symptomatic provocation. End range loading procedures, slouch-over-correct, and seated cervical retraction decreased neck pain.

Palpatory findings

Palpation found the left suboccipitals were tender and provocative for concordant neck and head pain, and the left splenius capitis and left levator scapulae were hypertonic. Segmental dysfunction was identified at left C0-C1, C1-C2, and C2-C3 with concordant pain provocation on segmental joint loading assessment.

Imaging

Plain films of the cervical spine on file from three years prior demonstrated multilevel degenerative changes and neural foraminal narrowing of the lower cervical spine. A prior brain magnetic resonance imaging study demonstrated a few isolated subcortical white matter foci of T2/

FLAIR hyperintensity which correlated with sequelae of migraine headache.

Clinical impression of primary complaint

The working diagnosis was mechanical neck and associated cervicogenic headache due to cervical derangement and secondary myofascial involvement. A trial course of acupuncture was recommended for a series of six visits at a frequency of one time per week to supplement his cervical retraction end range loading home exercise program provided by his VA physical therapist.

Acute housing instability

At his fourth visit to the chiropractic clinic for acupuncture, he reported new-onset nausea over the prior few days. In this same time period, his cervicogenic headache pattern progressed from intermittent to constant, and cervical retraction end range loading was no longer an effective self-management strategy for neck pain and headache. During the day, his headache severity improved while at work only to increase in severity upon returning home to his apartment. He denied new onset diplopia, dysarthria, dysphagia, nausea, loss of consciousness, weakness, or vomiting.

He disclosed that the heat in his apartment building had not worked for several days, and outdoor minimum nighttime temperatures ranged from 23-37 degrees Fahrenheit in the prior four nights.²⁵ His landlord was aware of the furnace failure, and on inspection of the building, heating ventilation and air conditioning (HVAC) systems were all shut off. The patient understood this meant there was a risk of carbon monoxide in the apartment. He and his 16-year-old daughter stayed at his residence the night prior to this scheduled chiropractic clinic visit and used extra layers of blankets for warmth. His daughter had also complained of daily headaches since the time the heat had stopped working.

Due to a concern for housing instability (Table 2) at the visit, the chiropractor immediately contacted the patient's primary care social worker to discuss care coordination options. The chiropractor then contacted the medical center's Health Care for Homeless Vets (HCHV) team coordinator.²⁶ A same-day visit was arranged with the on-site U.S. Department of Housing and Urban Development-Veteran Affairs Supportive Housing (HUD-VASH) team social worker who met the patient after he completed his

Table 2.
Housing instability definitions according to Watson and Carter.²⁶

Term	Definition
Housing insecurity	A significant lapse for a given household of one or more elements of secure housing
Secure housing	Stable occupancy of a decent, safe, and affordable housing unit
Affordable	Shelter costs are manageable over the long term without severely burdening or compromising other consumption that normally is essential for health and well-being
Stable Occupancy	Household does not face substantial risk of involuntary displacement for economic or non-economic reasons
Decent and Safe	The housing unit has physical attributes* that satisfy functional needs for well-being related to health, security, and support for activities of daily living.

*Attributes include appropriate facilities for excluding: external threats, providing climate control, storing and preparing food, maintaining physical and mental hygiene, and developing human potential.

appointment at the chiropractic clinic. It was determined that the patient did meet criteria of acute housing instability, and he was provided with county resources. The chiropractor coordinated care and communicated with the patient's primary care team, HCHV team coordinator, and HUD-VASH team through available telecommunication modalities, allowing for regular updates and closing the loop on next steps for his case management.

Following the review of the case and discussion of available resources with HUD-VASH, the patient elected to remain at the apartment with his daughter without functioning HVAC. The treating chiropractor and social work team concurred the possibility of carbon monoxide exposure, and the patient elected to open a window for ventilation as a precautionary measure rather than seek temporary housing elsewhere. He expressed appreciation for the rapid response by the care team and was pleased with the community resources presented to him by the HUD-VASH team social worker.

At the patient's fifth planned visit the following week, he shared that the climate control had been restored to his apartment building, and HVAC repairs were underway. The complaint of daily headaches at the prior visit had resolved. His response to care at visit five was positive for symptom reduction, with numeric pain rating of 1 out of 10, and stating, "My neck is ten times better. It's looser and not as tight." Coincidentally, in the same time frame, he had a routine interval follow-up visit with neurology regarding his chronic migraines who modified his medi-

cations, with an increased propranolol dosage and rotated to a disintegrating zolmitriptan with prochlorperazine and naproxen.

Unfortunately, the patient was lost to follow-up after the fifth visit at the chiropractic clinic and did not return for additional care. As the trial of care was intended for six visits, outcome assessment measures were not collected for pre-post evaluation due to the loss to follow-up.

Discussion

We present a case of an Army veteran with an acute housing instability circumstance during the course of a care plan for mechanical neck pain and associated cervicogenic headache at a VA chiropractic clinic. The loss of heat during cold winter months in the patient's apartment, leading to a rapid deterioration in his housing status and acute change in his headache presentation was confounded by suspicion, though not confirmed, of acute carbon monoxide exposure due to faulty HVAC. This case models a real-world example of identification and triage based on changes in SDOH at a follow-up visit to the chiropractic clinic. While his rapid symptomatic progression and resolution cannot be directly attributed to treatment in the chiropractic clinic, the veteran's acute housing instability warranted care coordination with the VA Medical Center's social work services and highlights the importance of understanding how SDOH such as environmental exposure and housing status may result in changes in neuromusculoskeletal concerns and, more im-

portantly, the nuances of care available within integrated care systems.

SDOH accounts for 30-80% of health outcomes, highlighting the importance of their prudent consideration during all patient encounters.^{3,27,28} Housing instability is just one example of an SDOH that afflicted over 35,000 veterans and over 650,000 Americans total in 2023, according to the Annual Homelessness Assessment Report.²⁹ It is associated with increased risk of acute and chronic medical conditions, increased pain severity and functional limitations, and reduced accessibility and impairs continuity of care.^{11,30,31} Housing instability and insecurity may present in a variety of forms including affordability, stable occupancy, or decent and safe housing. (Table 2).^{12,13,32} In our case, the specific concern for housing instability is deviation from decent and safe housing due to inadequate climate control and carbon monoxide exposure.

Particular to lumbar spine pain and SDOH's impact on care delivery, social isolation increases the likelihood of imaging, specialty care, and physical therapy visits; housing instability increases the likelihood of emergency department visits, hospitalizations, and imaging; food insecurity increases the likelihood of emergency department visits, hospitalizations and specialty visits; and financial strain increases the likelihood of physical therapy visits while it reduces the likelihood of emergency department visits and hospitalization.³³ In our case, outpatient chiropractic services had the opportunity to engage the patient immediately on identification and seek out the appropriate resources.

Chiropractors can play a key role in the evaluation, management, and care coordination for SDOH as they relate to care, especially considering the increased rates of chiropractic services in integrated healthcare settings and underserved communities.^{12,13,32,34} Although there appears to be no widely accepted and standardized screening process for housing instability, such as the number or depth of questions, as well as at what phase of care these screenings occur³⁵, screening questions may still open routes to additional care coordination should they be needed. In the VA, as an example, any clinician may utilize screening tools such as the Homelessness Screening Clinical Reminder to identify at-risk veterans.³⁶ This tool and associated referral pathways to social work or other housing services are programmed into the electronic health record system. For the majority of chiropractors in private prac-

tice or those outside of unique integrated settings, unified and coordinated systems may not be available within the electronic health record, making identification and appropriate referrals more nuanced to the local region, county, or province. Chiropractors can strive to overcome these barriers by understanding housing instability risk within their patient population and familiarizing themselves with services offered internal to their healthcare organization and local support services including state or province and county programs.

Limitations

The limitations of this study are consistent with case reports as it describes one example of acute housing instability for one patient in one chiropractic clinic. This example cannot be generalized to all cases of acute housing instability. This case does not highlight the complexities and challenges of chronic housing instability or homelessness, nor does it address the nuances of identifying and coordinating care when in private practice. The treating chiropractor sought HUD-VASH referral to address acute housing instability and did not pursue additional diagnostic lab work to confirm carbon monoxide poisoning thus the diagnosis is empirical and related to patient reporting and changes to his housing situation only.

Summary

We describe an Army veteran who attended care at a VA chiropractic clinic for neck pain and cervicogenic headache who underwent acute housing status change. By nature of the integrated setting, a chiropractor identified concerns for housing and could seek to address this SDOH through care coordination. This case exemplifies the benefits of an integrated health care delivery for care coordination and the opportunity to consider housing as an SDOH in the delivery of a patient's care who had a primary neuromusculoskeletal complaint at a chiropractor's office.

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Clinical management of a Veteran with chronic scan-negative cauda equina syndrome: a case report

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Objective: *To describe the clinical presentation, diagnostic considerations, and safety-first course of chiropractic care for an adult male with chronic scan-negative cauda equina syndrome.*

Clinical features: *A 41-year-old male U.S. Veteran sought chiropractic care for progressively intensifying chronic low back pain and bilateral lower extremity pain along with progressive bladder dysfunction, groin hypoesthesia, and sexual dysfunction. The history and examination findings raised concern for cauda equina syndrome, but a same-day MRI and neurosurgery consult failed to yield surgical indications.*

Prise en charge clinique d'un vétérân atteint d'un syndrome chronique de la queue de cheval sans anomalie à l'imagerie: rapport de cas

Objectif: *Décrire la présentation clinique, les considérations diagnostiques et le déroulement d'une prise en charge chiropratique axée avant tout sur la sécurité chez un homme adulte atteint d'un syndrome chronique de la queue de cheval sans anomalie à l'imagerie.*

Caractéristiques cliniques: *Un vétérân américain de 41 ans a consulté en chiropratique pour une lombalgie chronique d'intensité croissante et des douleurs bilatérales des membres inférieurs, accompagnées d'une dysfonction vésicale progressive, d'une hypoesthésie de l'aine et d'une dysfonction sexuelle. L'anamnèse et les constatations faites à l'examen ont soulevé la possibilité d'un syndrome de la queue de cheval, mais une IRM réalisée le jour même et une consultation*

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Conflicts of Interest:

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The involved patient provided consent for case publication.

Intervention and outcomes: *Chiropractic care involved 8 visits over 10 weeks. Care focused on neurological monitoring and patient education along with soft-tissue therapy, flexion-distraction, and spinal manipulation. The patient reported improvements in pain, function, and neurological features following this course of care, and no adverse events occurred.*

Summary: *This case emphasizes timely recognition of features associated with cauda equina syndrome and illustrates a cautious, multimodal approach to chiropractic co-management for an individual with scan-negative cauda equina syndrome.*

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KEY WORDS: pain, low back; cauda equina syndrome; chiropractic; manual therapies; Veterans health; veterans health services

en neurochirurgie n'ont révélé aucune indication chirurgicale.

Intervention et résultats: *La prise en charge chiropratique a comporté huit consultations réparties sur dix semaines. Elle était axée sur la surveillance neurologique et l'éducation du patient, et comprenait également un traitement des tissus mous, des techniques de flexion-distraction et des manipulations vertébrales. Au terme de cette prise en charge, le patient a signalé une amélioration de la douleur, de la capacité fonctionnelle et des manifestations neurologiques. Aucun événement indésirable n'est survenu.*

Résumé: *Ce cas souligne l'importance de reconnaître rapidement les manifestations associées au syndrome de la queue de cheval et illustre une approche multimodale prudente de la prise en charge chiropratique conjointe d'une personne atteinte d'un syndrome de la queue de cheval sans anomalie à l'imagerie.*

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MOTS CLÉS: lombalgie, syndrome de la queue de cheval, chiropratique, thérapies manuelles, santé des vétérans, services de santé aux vétérans

Introduction

Cauda equina syndrome (CES) is a serious neurologic condition characterized by dysfunction of the lumbosacral nerve roots within the spinal canal.^{1,2} It typically manifests as a constellation of neuromuscular and urogenital features, including severe low back pain (LBP), lower extremity radicular pain or paresthesia, lower extremity weakness, gait disturbance, reduced perineal or genital sensation (i.e., saddle anesthesia), diminished reflexes, and bowel, bladder, or sexual dysfunction.³ Although back pain, radicular leg pain, and lower extremity neurological deficits are frequently present, they are not required for diagnosis.³

While large disc herniations are the most common cause of CES (Figure 1), clinicians must also consider other compressive causes (e.g., neoplasms, hematomas) along with non-compressive etiologies (e.g., ischemia, infection).¹ The estimated incidence of CES in the gen-

eral population ranges from 0.3 to 1 per 100,000 individuals.⁴ Among patients with a history of lumbar disc surgery, CES occurs more frequently, accounting for approximately 2–6% of cases.⁵ In primary care settings, CES is reported in approximately 0.08% of patients presenting with LBP, with a comparable prevalence suspected among adults seeking chiropractic care.^{4,6} Magnetic resonance imaging (MRI) is the diagnostic gold standard for CES, as it provides definitive evidence of mechanical compression of the cauda equina nerves or other etiologic pathology.

The classification of CES typically depends on acuity: *acute* CES involves a rapid onset of symptoms, whereas *chronic* CES involves an insidious or gradually progressive clinical course.⁷ Chronic CES is less understood and may arise from degenerative changes that progressively narrow the spinal canal, compromising nerves of the cauda equina.^{8,9} While gradual compression may allow for

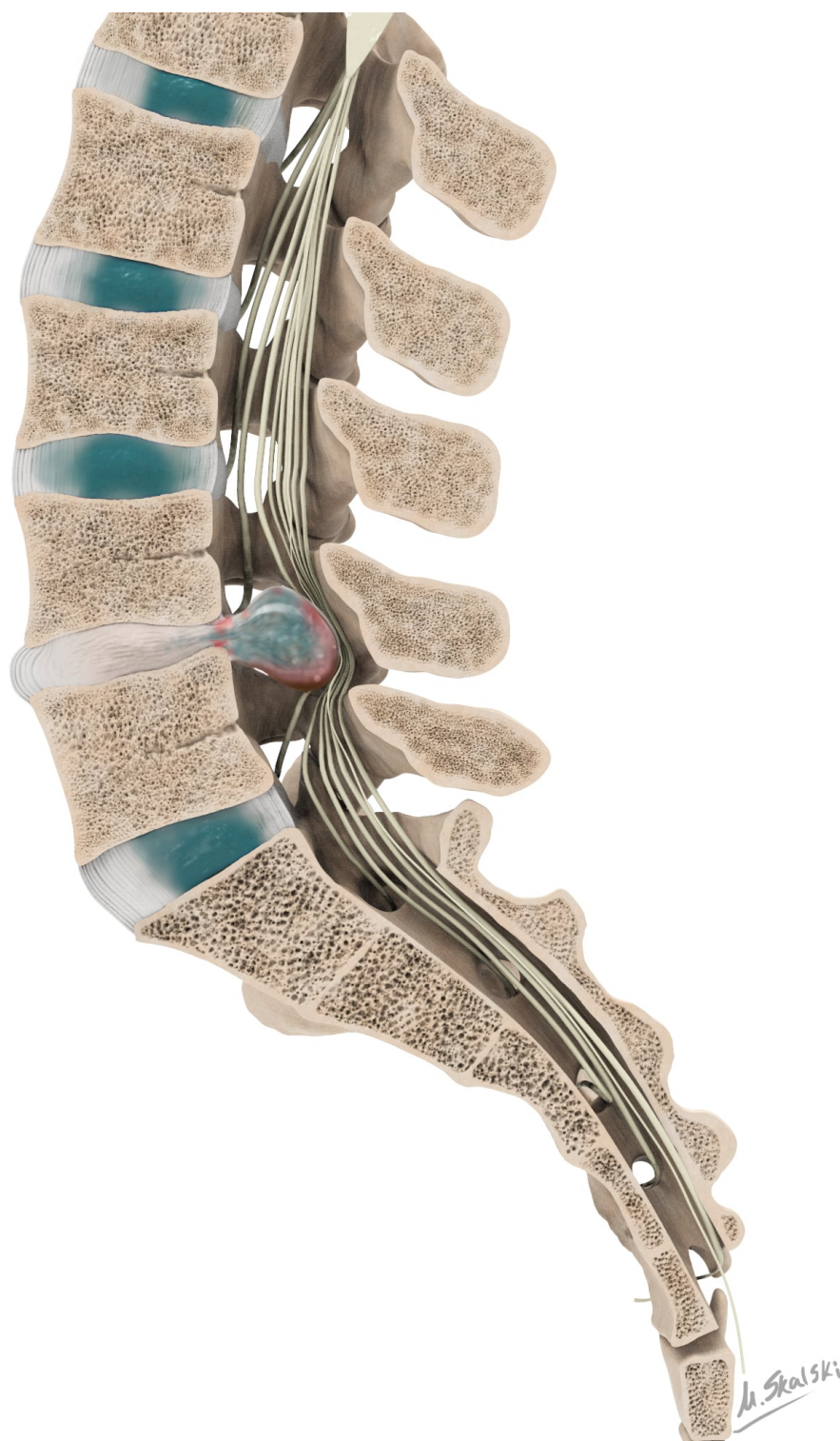


Figure 1.
Sagittal lumbar spine demonstrating a large L4 central disc herniation compressing the cauda equina.

early physiologic adaptation, persistent or progressive compression of the cauda equina eventually gives rise to the development of CES features.¹⁰

More recently, CES has been further classified based on imaging findings into *scan-positive* and *scan-negative* CES subtypes.¹¹ Scan-positive CES refers to cases in which radiologic evidence demonstrates compression of the cauda equina nerve roots consistent with clinical findings, whereas scan-negative CES describes patients with classic CES features in the absence of demonstrable cauda equina compression or causative etiology on MRI.^{7,8} Scan-positive CES is typically considered a surgical emergency, with decompression within 24–48 hours associated with improved prognosis.^{11,12} Since scan-negative CES lacks a structural target for neurosurgical decompression, surgery is not indicated. Consequently, scan-negative CES represents a distinct clinical entity that poses significant challenges regarding both diagnosis and management.

The purpose of this report is to highlight the red flag features that necessitated emergent referral and to illustrate a safety-first course of chiropractic care, characterized by continuous symptom monitoring and serial neurological assessments, with prioritization of red flag screening and graded application of patient-tolerated interventions for an adult male with chronic scan-negative CES.

Case presentation

A 41-year-old Caucasian male U.S. Veteran sought chiropractic care for LBP at a Veterans Affairs (VA) outpatient chiropractic clinic. His LBP was primarily located at his axial lumbosacral junction. It began insidiously about 15 years prior but had been gradually intensifying over the previous two years, to what he then described as an “excruciating” and “unbearable burning” sensation extending from his lumbar spine to his bilateral posterior thighs. His pain was worse with thoracolumbar extension and prolonged walking, while it was temporarily relieved with seated lumbar flexion-based stretching. He denied any history of invasive spine procedures or recent injuries, infections, or fevers. Baseline measures indicated high levels of distress and disability, with an 8/10 pain intensity and a Back Bournemouth Questionnaire score of 49/70.

Over the previous year, he described having experienced a gradual onset of intermittent periods of reduced

sensation in his legs and groin (i.e., saddle anesthesia), and erectile dysfunction resulting from diminished sensation. Additionally, he explained how this coincided with the gradual onset of unpredictable episodes of urinary retention or urinary incontinence. He explained how his bladder dysfunction initially occurred about one to two times per week but described how this had gradually progressed to a nearly daily occurrence that had been ongoing for the 3–4 months prior to his chiropractic intake.

This Veteran also expressed growing concern for how his condition was negatively impacting his daily activities. He explained how his worsening symptoms, in combination with housing instability and his mental health conditions (i.e., PTSD, depression, and adjustment disorder), had resulted in a breakdown of his interpersonal relationships and social roles. He also noted how his pain and bladder dysfunction had caused substantial distress, which he felt had contributed to his desperation and prior attempts at suicide. These issues prompted his admission to an inpatient VA mental health rehabilitation program, which is where he was residing prior to his seeking chiropractic care for his LBP.

A physical exam was performed after history taking. The exam did not reveal any spinal deformities, and his gait was normal. There were no overt limitations in active thoracolumbar range of motion although thoracolumbar extension reproduced his characteristic lower back and thigh pain. The thoracolumbar paraspinal regions were mildly tender to palpation with moderately guarded musculature, while spinal percussion did not elicit sharp pain. Lower extremity dermatomal testing revealed asymmetrical sensory findings with diminished sensation over the left lateral leg and foot (i.e., L5-S1 dermatomes), while myotome testing and deep tendon reflexes were normal and symmetrical. Upper motor neuron lesion screening was performed via ankle clonus, Hoffman sign, and Trömner sign, which were all normal. The Slump test was negative for reproduction of lower extremity radicular pain, while the Slump test and the Kemp test did reproduce his characteristic lower back pain.

The combination of clinical features reported by the Veteran supported a preliminary diagnosis of suspected chronic CES likely secondary to underlying degenerative and stenotic changes. Differential diagnoses in-

cluded myelopathy secondary to canal stenosis or lumbar radiculopathy with associated groin hypoesthesia requiring further diagnostic clarification. Although the physical exam did not reveal overtly concerning findings, the progressive and debilitating symptom pattern consistent with CES, combined with the high-risk nature of this condition, warranted immediate referral to the emergency department (ED) for further diagnostic evaluation. Chiropractic treatment was withheld during this initial visit. The Veteran was thoroughly counseled regarding the potential for CES and its serious neurological sequela if not identified and treated in a timely fashion. A same-day lumbar spine MRI was performed at a non-VA ED, which showed severe left and moderate right neuroforaminal stenosis at L5-S1 vertebral segments with mild canal stenosis throughout the lower lumbar spine (Figures 2-3 and Table 1). The ED also placed a neurosurgery consult, which was ultimately declined on the basis that his lumbar spine MRI findings were considered non-surgical. While the neuroforaminal stenosis shown on MRI may have accounted for the pa-

Table 1.
*Lumbar spine MRI findings on the date of the
chiropractic intake**

Impression	
1.)	The conus medullaris and cauda equina are unremarkable.
2.)	Multilevel degenerative changes of the lumbar spine, most pronounced at L5-S1.
3.)	L5-S1: Severe left and moderate right neural foraminal stenosis.
4.)	L4-L5: Mild bilateral neural foraminal stenosis.
5.)	L3-S1: Mild central canal stenosis.

*Full MRI report available in *Appendix 1*

tient's L5-S1 thigh pain and reduced leg sensation, the mild central canal stenosis did not provide a clear structural explanation for the bladder dysfunction or groin hypoesthesia; this combination of features is consistent with scan-negative CES.

Following the determination by neurosurgery that this Veteran was a non-surgical candidate, he returned to the chiropractic clinic with a strong desire to initiate treatment. At this second visit, he explained how his LBP, groin hypoesthesia, and daily urinary dysfunction had continued, unchanged. These collective clinical features, along with the MRI results, justified an updated diagnosis of scan-negative CES with concurrent radiculopathy, complicated by various psychosocial factors.

The informed consent process heavily emphasized the risks for progressive neurological deficits and included instructions that any worsening of bladder function, groin hypoesthesia, or lower extremity weakness necessitated an immediate return to the ED. Informed consent also emphasized how treatment would be adapted to involve limited force to minimize risk. He verbalized an understanding of these risks and expressed a strong desire to proceed with treatment. A modified approach to treatment was initiated during this second visit, emphasizing a cautious safety-first approach to care. A multimodal treatment approach was used, which included patient education on his condition and features that should prompt emergency follow-up, soft-tissue therapy, application of moist heat, and patient tolerated flexion-distraction applied to the lumbo-pelvic region. More forceful treatments involving the lumbar spine were intentionally deferred to observe the patient's response to less forceful approaches.

One week later, the patient returned for his third visit. He denied any adverse events or worsening neurologic features. He reported similar symptoms as the previous visit but noted a mild-to-moderate reduction of his lower back and leg pain for two to three days after his prior visit, and he attributed this improvement to the flexion-distraction treatment. This multimodal treatment approach was continued at visit three without modification.

The fourth visit occurred two weeks later, as the patient had missed his appointment that was scheduled for the prior week. He reported a marginal lasting reduction in his LBP to a 7/10 intensity, accompanied by a decreased frequency of radiating leg pain and fewer episodes of bladder dysfunction. Groin hypoesthesia and sexual dysfunction continued, unchanged. A repeat lower extremity neurological exam was unchanged from his initial visit. Considering the patient's symptomatic improvement, high-velocity, low-amplitude (HVLA)



A: T1-weighted lumbar spine MRI

B: T2-weighted lumbar spine MRI

Figure 2.

Sagittal lumbar spine MRI images on the date of chiropractic intake.

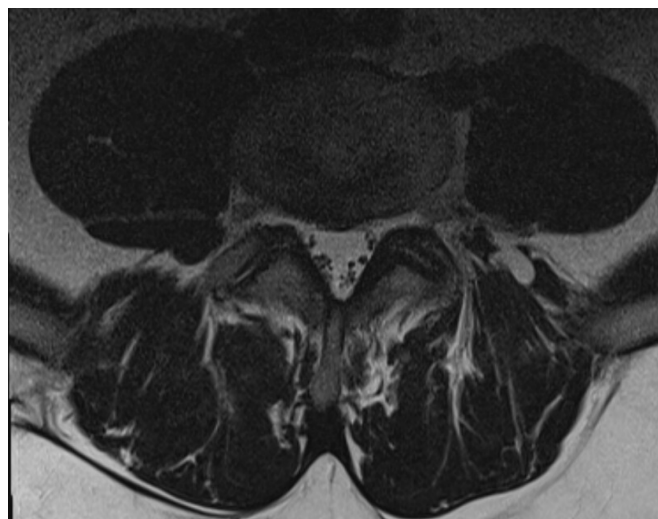
lumbar spinal manipulation was judiciously introduced into the established treatment approach with controlled force application, guided by patient tolerance. The rationale for incorporating HVLA was based on the patient's preference, the absence of compressive pathology on MRI (i.e., scan-negative status), and his demonstrated neurological stability following less forceful treatments.

The following week, the patient returned for his fifth visit, which involved a planned re-evaluation. An updated Back Bournemouth questionnaire resulted in a score of 29/70, which represented a 41% clinical improvement from his baseline score of 49/70. Improvements from

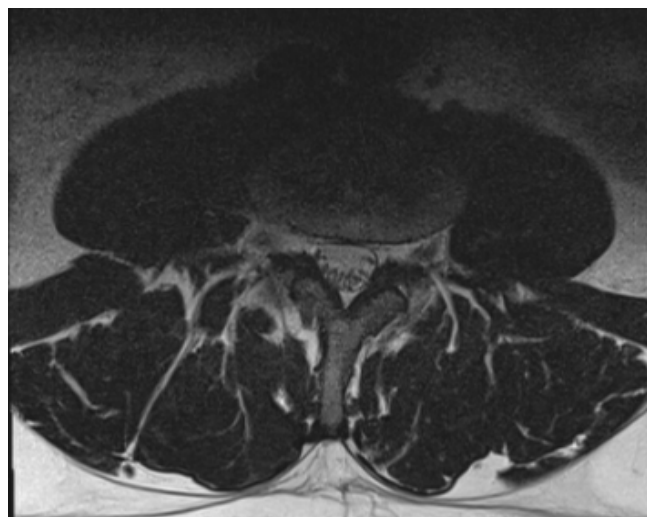
baseline were also observed in the Defense and Veterans Pain Rating Scale (DVPRS) outcomes and his pain intensity was a 5/10, representing a clinically meaningful reduction in pain compared with his initial pain intensity of 8/10 at the chiropractic intake (Table 2).^{13–15} He also reported a complete resolution of his leg pain and bladder dysfunction as well as mild improvement of his groin hypoesthesia. Updated neurological exam findings remained unchanged with continuation of diminished sensation in the left L5 and S1 dermatomes. Multimodal treatment continued at this fifth visit, unchanged from the previous visit.



A: L5 intervertebral disc level



B: L4 intervertebral disc level



C: L3 intervertebral disc level

Figure 3.

Axial T2-weighted lower lumbar MRI images on the date of the chiropractic intake.

At his sixth visit, the patient continued to report an improvement in back and thigh pain and now denied any bladder dysfunction. He also explained how his groin hypoesthesia was improving, stating how he had a “70% return in sensation,” with only minor residual burning and tingling. Enhanced sexual function was also described, secondary to this improved sensation. He denied any adverse effects from the prior treatments, and chiropractic care continued, unchanged from the previous visit.

One week later, he returned for his seventh visit. His symptoms were unchanged from the previous visit apart from continued improvement of his groin sensation; he now described a complete return of normal groin sensation. He also noted how he felt these improvements coincided with improvements to his psychological well-being and overall quality of life. Chiropractic treatment was again provided on this seventh visit without modification. Following this seventh visit, the patient was transitioned

Table 2.
Outcome measures at baseline and reevaluation.

Outcome Measure	Baseline	Reevaluation	Improvement
DVPRS			
Pain Intensity	8/10	5/10	38%
Pain Interfering with Activity	8/10	3/10	63%
Pain Interfering with Sleep	7/10	4/10	43%
Pain Affecting Mood	9/10	2/10	78%
Pain Contributing to Stress	9/10	3/10	67%
Back Bournemouth Questionnaire			
Total Score	49/70 (70%)	29/70 (41%)	41%

DVPRS, Defense and Veterans Pain Rating Scale (0/10 = None, 10/10 = As bad or as much as possible)

to an as-needed status (i.e., PRN); however, a telephone follow-up call was scheduled for two weeks to monitor his status.

Following unsuccessful contact at this two-week follow-up, it was discovered that the patient had recently been incarcerated. Communication was established via the county jail's online communication system. While incarcerated, the patient experienced a significant exacerbation of his symptoms, with axial and radicular pain returning to his baseline 8/10 intensity. Additionally, he noted the recurrence of significant groin hypoesthesia and bilateral lower extremity paresthesia but denied any recurrence of bladder dysfunction. He attributed his symptom recurrence to various environmental and psychosocial stressors, specifically limited mobility, increased anxiety, and sleeping on a rigid detention bunk. Postural recommendations and self-management strategies were provided via the facility's communication system. These recommendations included frequent positional changes, supine pelvic tilts, and wall squats. The patient was further instructed in self-directed lumbar decompression and traction maneuvers specifically adapted for his restricted environment (Figures 4 and 5). The patient's release date from the detention facility remains uncertain at the time of writing this report. However, he was advised to return to the chiropractic clinic

for reevaluation and possible initiation of a renewed course of care upon his release.

Discussion

There is a lack of robust guidance regarding the optimal management of chronic scan-negative CES, but a safety-first approach is recommended when managing individuals with progressive neurological deficits.⁸ Chiropractors are instructed to exercise extreme caution and guardedness when patients exhibit signs or symptoms suggestive of CES, as a delay in neurosurgical referral risks serious neurologic consequences.¹⁶ It is vital that clinicians distinguish between scan-positive and scan-negative presentations of CES, as the appropriate management strategies differ significantly between the two subtypes. This report highlights the nuance diagnosis of chronic scan-negative CES, and the potential role chiropractors may play for such cases in an interdisciplinary setting.

Clinicians should screen for red flags by identifying CES-associated signs and symptoms that include severe LBP, radicular pain, altered bowel or bladder function, reduced sensation in the perineal region, loss of sexual function, hyporeflexia, or sensorimotor loss in the lower extremities. Given their limited diagnostic accuracy, identification of such red flag findings should prompt fur-



Figure 4.
*Lumbar decompression
positioning*



Figure 5.
Lumbar self-traction

ther evaluation via an immediate MRI.^{17,18} This limitation is underscored by the findings that senior neurosurgical trainees demonstrated only 56% accuracy in predicting scan-positive CES based solely on clinical findings.¹⁹ It is also important to avoid overreliance on imaging, as discrepancies between clinical assessment and radiologic findings may lead to overtreatment or mismanagement. This diagnostic caution is supported by evidence that

clinical findings and radiological data fail to correlate in over 50% of suspected CES cases.²⁰ It has been suggested that patients who display progression of CES symptoms over a few hours or days should undergo immediate imaging (i.e., same day), whereas CES symptoms progressing over a period of weeks should receive urgent imaging (i.e., within five days).^{8,21} An informed clinical diagnosis of scan-positive CES requires the integration of clinic-

al signs and symptoms with imaging evidence of cauda equina compression, a finding that warrants emergency surgical decompression to prevent permanent neurological deficits.²² Although the optimal timing of surgical intervention remains debated, the current standard is decompression within 48 hours.^{23,24}

While scan-positive CES is well-characterized with a conceptually straightforward pathology and clear treatment protocol, scan-negative CES represents a complex deviation from this norm. Even though the pathophysiology of scan-negative CES remains poorly understood, a retrospective study suggests that scan-negative patients often exhibit an underlying vulnerability, demonstrated by high rates of psychiatric comorbidities and functional neurological disorders.¹¹ In vulnerable individuals, acute pain may trigger a predisposition toward functional disorders, resulting in recurrent physical symptoms that mimic an emergent surgical condition. The authors of this report theorize that this patient's high level of psychosocial stressors (e.g., housing instability and mental health conditions) may have served as an underlying amplifier for his chronic CES symptoms. Understanding the nuances of scan-negative CES is crucial for validating patient symptoms, communicating the underlying cause, and effectively addressing the comorbidities that may perpetuate the problem. Approximately 11% of undiagnosed patients enter a cycle of recurrent acute episodes and resource-intensive negative scans,¹¹ while the underlying functional vulnerability remains unaddressed.

Clinicians should recognize that overlapping conditions may complicate the presentation of clinical features suggestive of CES, while maintaining a safety-first approach to avoid the potentially devastating outcomes of delayed investigation. Differential diagnoses to consider in patients with CES symptoms include inflammatory, vascular, infective, medication-induced, neoplastic and neurodegenerative disorders.²⁵ Conus medullaris syndrome (CMS) is an uncommon condition that subtly mimics CES, due to overlapping clinical features. CMS results from injury at the conus medullaris, which is at the T12–L2 spinal level, whereas CES arises from insult to the nerve roots below the conus medullaris. The differentiation of these conditions via contrast-enhanced MRI is essential to establish an accurate diagnosis and guide effective management.²⁶ Similarly, an uncommon

inflammatory cause of CES is spinal arachnoiditis, characterized by inflammation of the arachnoid membrane surrounding the cauda equina, in contrast to the more common compressive etiologies such as disc herniation.²⁷

In this case, an ED referral was warranted based on the emergence of bladder dysfunction and progression of the patient's chronic symptoms. After ruling out cauda equina compression, a safety-first approach to chiropractic care involved detailed symptom-focused questioning and frequent neurological monitoring to ensure stability of neurologic symptoms. Close observation is recommended to detect any progression of CES-like symptoms for providers involved in treating back or leg-pain; specifically: changes in bowel or bladder function, sexual function, saddle anesthesia, or lower extremity weakness.²¹ This case describes the cautious and graded application of manual treatments, informed by the patient's clinical response, and preferences. The authors of this report hypothesize that such manual therapies may have improved pelvic hemodynamics or reduced venous congestion in the cauda equina, which is a proposed mechanism in functional or ischemic forms of CES, but acknowledge that this remains highly speculative.²⁸

Patients with LBP commonly seek care from chiropractors, making the failure to diagnose CES a significant source of medicolegal liability for the chiropractic profession.²⁹ However, the literature indicates that spinal manipulation is not an established risk factor for causing CES and is medically accepted as a conservative treatment option for lumbar disc herniation.^{29,30} Although existing research on the use of spinal manipulation in patients with chronic CES is extremely limited, a recent study identified no increase in risk of CES, bladder catheterization and bowel incontinence among adults with lumbar spine disorders receiving spinal manipulative therapy.³¹

In this particular case, meaningful improvements were observed following a carefully monitored course of care. The improvements observed in this individual case cannot be attributed directly to chiropractic treatment and likely reflect natural symptom fluctuations as well as the combined effects of multidisciplinary care, particularly mental health services, contributing to psychosocial stabilization. Nonetheless, this case highlights the importance of vigilant red flag recognition, timely referral, and

interdisciplinary collaboration when managing patients with suspected chronic CES in chiropractic settings.

Limitations

Case reports inherently have several limitations. This report describes a single course of chiropractic care, and the observed outcomes may not be generalizable to other clinical situations. This case involved a multimodal treatment approach over an extended period with various uncontrolled factors, which may have influenced the clinical course. Most importantly, this report is not designed to establish the safety or efficacy of the described clinical approach and should not be considered evidence to support its application in other cases of CES.

Summary

This report describes the chiropractic evaluation and management of a U.S. Veteran with chronic LBP and progressive neurological features consistent with chronic scan-negative CES. Prompt recognition of red flag findings, including bladder dysfunction, groin hypoesthesia, and sexual dysfunction, led to appropriate referral for emergency imaging and facilitated interdisciplinary co-management.

Under a safety-first framework of close neurological monitoring, the patient achieved meaningful improvements in pain, function, and neurological symptoms. These improvements were associated with enhanced physical and psychosocial well-being. Although the management of chronic CES remains poorly defined in the literature, this case suggests that chiropractors may safely contribute to the interdisciplinary management of selected scan-negative CES patients, when red flags are appropriately identified, referral pathways are respected, and treatment is individualized. Further research is needed to clarify best practices for interdisciplinary management of chronic CES and the role of conservative care.

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Authors' contributions

SH delivered clinical care, recorded outcomes and obtained the patient's consent for publication. SH, CBR, and SMS developed the study design and coauthored the manuscript. Each of the authors met criteria for authorship and approved the final submission.

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Appendix 1.

Full radiology report from the lumbar spine MRI on the date of the chiropractic intake.

Reason for Study: Rule out cauda equina in patient with gradually progressive urinary incontinence and erectile dysfunction, intensifying back and thigh pain, normal gait, and a negative upper motor neuron screen
Technique: Multiplanar, multisequence T1-weighted and fluid-sensitive sequences of the lumbar spine from T12 to S2 before and after administration of intravenous contrast.
Comparisons: none
Findings
Spinal Canal: The conus terminates at L1. The conus medullaris and cauda equina are unremarkable. No enhancing masses within the spinal canal. No epidural abscess.
Alignment: 3 mm retrolisthesis of L3 on L4.
Bone Marrow: Five non-rib-bearing lumbar vertebral bodies are assumed. No gross fractures or bone lesions. No bone marrow replacement or abnormal enhancement.
Disk Levels/Facets: T12-L1: Unremarkable.
L1-L2: Disk desiccation. Small disk bulge. No significant spinal canal or foraminal narrowing.
L2-L3: Disk desiccation. Small disk bulge and facet hypertrophy. Minimal spinal canal stenosis. No significant foraminal stenosis.
L3-L4: Disk desiccation and facet hypertrophy with disk bulge, resulting in mild spinal canal stenosis. No significant foraminal stenosis.
L4-L5: Disk bulge and facet hypertrophy with minimal spinal canal stenosis. Mild bilateral foraminal stenosis.
L5-S1: Disk bulge with superimposed right eccentric disk protrusion. Moderate disk space height loss with disk desiccation. Mild spinal canal stenosis severe left and moderate right foraminal stenosis.
Musculature: Normal. No edema, abnormal enhancement, or fatty atrophy.

Gouty arthritis and cryotherapy in a manual practitioner: an imaging case review

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Lauren Tollefson, DC, DACBR¹

Gout is a common inflammatory joint disease typically diagnosed in the first metatarsophalangeal joint. However, its atypical involvement of axial and peripheral joints can pose challenges in its diagnosis and treatment. We present imaging findings of a 67-year-old male with long-standing polyarticular gout managed with pharmacological interventions and cryotherapy. This case explores the effects of cryotherapy as an adjunct for pain management in gouty arthritis, suggesting its potential therapeutic value in reducing inflammation and improving return to activities of daily living as well as an overview of technique alteration that manual therapists may employ.

(JCCA. 2026;70(2):249-253)

KEY WORDS: chiropractic, cryotherapy, diagnostic imaging, gout, gouty arthritis

Arthrite goutteuse et cryothérapie chez un praticien en thérapie manuelle: étude de cas d'imagerie

La goutte est une maladie articulaire inflammatoire fréquente, généralement diagnostiquée au niveau de la première articulation métatarso-phalangienne. Cependant, l'atteinte atypique des articulations axiales et périphériques peut compliquer son diagnostic et son traitement. Nous présentons les résultats d'imagerie d'un homme de 67 ans atteint d'une goutte polyarticulaire de longue date, prise en charge au moyen de traitements pharmacologiques et de la cryothérapie. Ce cas examine les effets de la cryothérapie comme traitement d'appoint de la douleur associée à l'arthrite goutteuse et laisse entrevoir son intérêt thérapeutique potentiel pour réduire l'inflammation et favoriser la reprise des activités de la vie quotidienne. Il présente également un aperçu des adaptations techniques auxquelles les thérapeutes manuels peuvent recourir.

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MOTS CLÉS: chiropratique, cryothérapie, imagerie diagnostique, goutte, arthrite goutteuse

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Conflicts of Interest:

The authors have no disclaimers, competing interests, or sources of support or funding to report in the preparation of this manuscript.
The involved patient provided consent for case publication.

Case presentation

A 67-year-old male with long-standing polyarticular gout, first diagnosed in 2003, initially involving the first metatarsophalangeal joint, presented with gradual progression to the right shoulder, elbow, wrist, and hand. Pain was non-radiating and throbbing, rated 9/10 at peak and 5–6/10 on average. Flare-ups would occur more than twice yearly, lasting up to 1.5 months, with asymmetric swelling, erythema, warmth, and fevers up to 105°F requiring hospitalization. Managed by a rheumatologist,

symptoms improved with cryotherapy, colchicine, and prednisone. Ice was applied for 15-minute intervals every two hours during the first two days, improving swelling, range of motion, and sleep. Uloric (febuxostat), elderberry, and tart cherry extract were ineffective. As a practicing chiropractor, the patient would modify adjusting techniques during flare-ups using drops, instruments, and thumb maneuvers.

Recent imaging of the right hand and wrist (Figure 1), right elbow (Figure 2), and bilateral foot series (Figure 3)

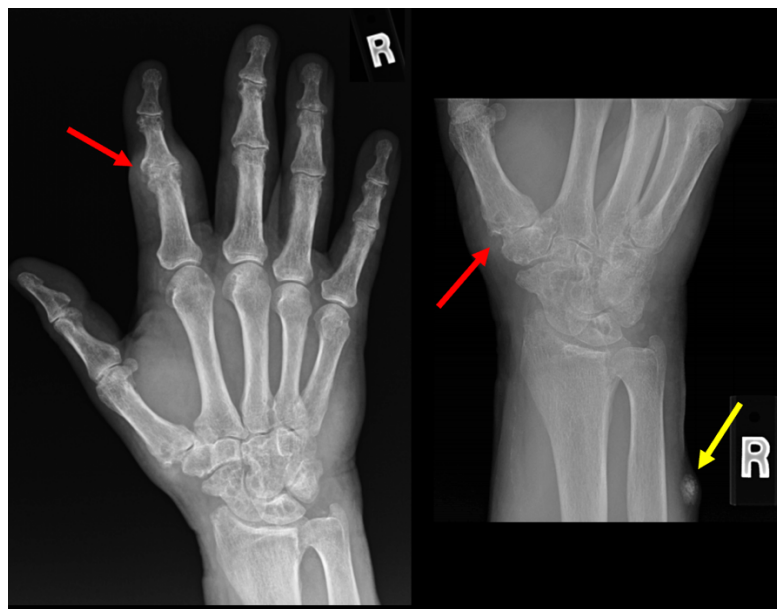
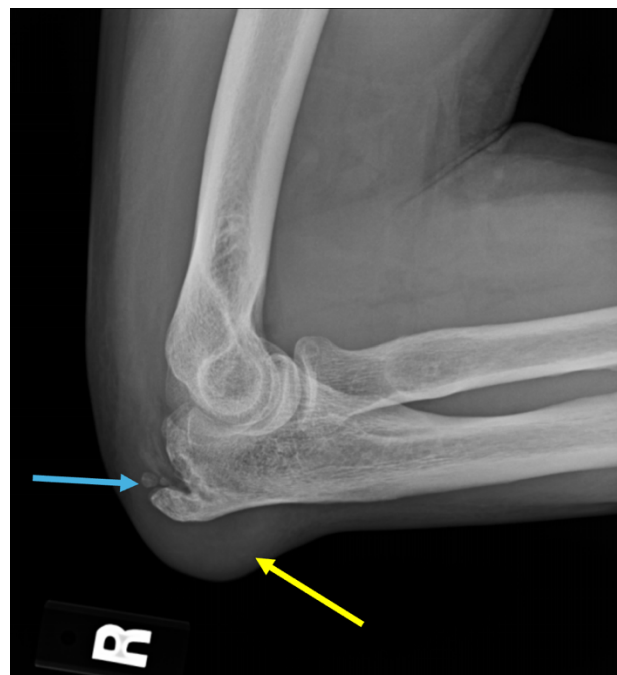


Figure 1.
PA right hand and PA right wrist radiographs. Eccentric erosions with overhanging margins and dense soft tissue swelling present at multiple joints, most notably the second proximal interphalangeal and first carpometacarpal joints (red arrows). A focus of tophaceous deposition with secondary calcification medial to the ulna (yellow arrow).

Figure 2.
Lateral right elbow radiograph. Olecranon bursitis (yellow arrow) with triceps enthesopathy and soft tissue calcification (blue arrow).



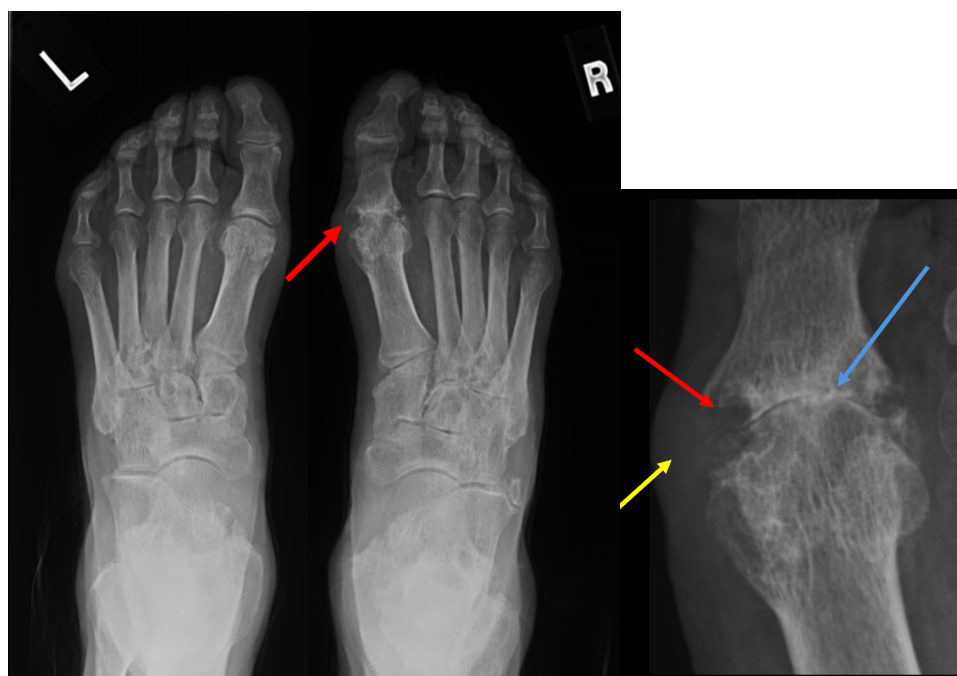


Figure 3.
Bilateral dorsoplantar foot radiographs with magnified view of the right first metatarsophalangeal joint. Asymmetric distribution of erosions with overhanging margins, most notably at the first metatarsophalangeal joint on the right (red arrow), dense soft tissue swelling (yellow arrow), and loss of joint space due to secondary osteoarthritis (blue arrow).

demonstrated juxta-articular erosions with overhanging margins, soft tissue swelling, periarticular tophi, and diffuse degenerative changes, consistent with typical gout imaging findings.

Discussion

The pathophysiology of gout is marked by deposition of monosodium urate crystals within peri and intra-articular spaces as a result of hyperuricemia.^{1,2} The crystals induce

an inflammatory response characterized by the release of IL-1 β by macrophages and monocytes, initiating a cascade rich with TNF- α and IL-6.^{1,3} The cytokine milieu allows for further recruitment of immune and endothelial cells, promoting joint inflammation and damage.⁴ This damage to the joint results in the key characteristics of the imaging findings of gouty arthritis as outlined in Table 1 and the differences in monoarticular and polyarticular gout flare-ups in Table 2.

Table 1.

Key radiographic findings of gout on x-ray and the typical anatomic location involved.¹⁰

Typical radiographic findings	Typical anatomic location
Juxta-articular erosion with overhanging edge	1st metatarsophalangeal (MTP) joint
Calcified soft tissue tophus	1st MTP joint Over the Achilles tendon
Bursitis	Olecranon bursa
Joint effusion	Tibiotalar joint
Soft tissue calcification	Prepatellar soft tissues

Table 2.
Key clinical differences to distinguish manifestations of monoarticular and polyarticular gout.^{11,12}

Gout subtype	Key clinical distinctions
Monoarticular gout	• 85-90% of cases. • Abrupt and severe onset. • Primarily lower extremity joints. • First metatarsophalangeal joint commonly first involved.
Polyarticular gout	• 3-14% of cases. • Slow and gradual onset. • Initial lower extremities joint involvement and later upper extremity joint involvement. • More common in patients with longstanding disease.

Cryotherapy

Cold-induced neuropraxia, along with physiological effects such as vasoconstriction, myorelaxation, anti-inflammatory, and antioxidative responses, have been well documented with cryotherapy in conditions like rheumatoid arthritis and osteoarthritis.^{5,6} While research on cryotherapy in gout remains limited, its application may yield similar therapeutic benefits. Cooling tissues to a depth of 2-4 cm reduces nerve conduction velocity and increases the activation threshold of nociceptors, thereby providing analgesic relief.⁷ Contrary to common belief, cryotherapy can be safely used for extended durations and offers benefits beyond the acute phase of injury.⁷ Studies have shown that cryotherapy can reduce arterial blood flow to the treatment area by up to 38% and soft tissue blood flow by 26%, contributing to reduced swelling and increased pain tolerance.⁷ Furthermore, the development of tophi in gout has been associated with impaired movement and reduced muscle strength.⁸ In an experimental gout-induced Wistar rat model, cryotherapy led to a significant restoration of muscle strength, returning to levels comparable to those observed prior to gout induction.² These findings suggest cryotherapy may aid in functional recovery by providing analgesic relief and decreased inflammation. In clinical application, chiropractors and other providers should consider incorporating it within multimodal pain

management, educating patients on its benefits to enhance mobility and support return to daily activity.

Impact of gout on physical and manual tasks

Tophi in upper and lower limb joints alter joint mechanics, leading to gait changes, reduced muscle strength, and biomechanical foot impairments that limit daily activities.⁸ Healthcare practitioners relying on strength and precision such as chiropractors, physiotherapists, and surgeons may need to modify clinical techniques during flare-ups to mitigate pain while ensuring optimum patient care. Chiropractors with reduced grip strength during flare-ups may need to utilize low-force adjustments, instrument-assisted methods, Thompson drop tables, or flexion-distraction protocols.⁹

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Key messages:

- Gout pathophysiology is driven by hyperuricemia leading to monosodium urate crystal deposition in peri- and intra-articular tissues which results in the characteristic imaging findings of gout.
- Imaging findings of gout consists of juxta-articular erosions with overhanging margins, soft tissue swelling, periarticular tophi, and diffuse degenerative changes later in the disease.
- Symptomatology of gout includes periodic flare-ups of joint pain, swelling, and erythema and may progress to systemic symptoms such as fever and fatigue.
- Cryotherapy produces cold-induced neuropraxia and physiological effects which may reduce pain, enhance mobility, and facilitate patient return to daily activities.
- Manual therapists diagnosed with gout may need to modify techniques during flare-ups.

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Rare anatomical variant of a duplicate renal vein traversing through the L1 vertebral body in a U.S. Veteran presenting with spine pain: an imaging case review

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In this imaging case review, we provide an account of a rare anatomical variant that was discovered incidentally during a routine computed tomography (CT) scan and subsequently confirmed with magnetic resonance imaging (MRI). This case marks the first description of a duplicated renal vein traversing through a lumbar vertebral body, an unusual anatomical phenomenon that has not been previously reported in the medical literature.

(JCCA. 2026;70(2):254-258)

KEY WORDS: low back pain, chiropractic, case report, vascular anomaly, renal vein, vertebral body

Variante anatomique rare d'une veine rénale dupliquée traversant le corps vertébral de L1 chez un vétéran américain présentant des douleurs rachidiennes: étude de cas d'imagerie

Dans cette étude de cas d'imagerie, nous décrivons une variante anatomique rare découverte fortuitement lors d'une tomodensitométrie (TDM) de routine, puis confirmée par imagerie par résonance magnétique (IRM). Il s'agit de la première description d'une veine rénale dupliquée traversant un corps vertébral lombaire, phénomène anatomique inhabituel qui n'avait encore jamais été signalé dans la littérature médicale.

(JACC. 2026;70(2):254-258)

MOTS CLÉS: lombalgie, chiropratique, rapport de cas, anomalie vasculaire, veine rénale, corps vertébral

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Conflicts of Interest:

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The involved patient provided consent for case publication.

Case presentation

A 60-year-old male veteran was referred to the VA Puget Sound chiropractic clinic by their neurologist for evaluation of chronic low back pain (LBP) secondary to military service, along with a secondary complaint of intermittent bilateral anterior thigh pain. His medical history was significant for Parkinson's disease, diagnosed two years earlier, and his body mass index (BMI) was 31.7. The patient rated their chief complaint impact on Pain, Enjoyment of Life, and General Activity (PEG) with scores of 6/10, 8/10, and 7/10, respectively. Walking was described as aggravating his LBP but was not limited due to pain.

A review of the patient imaging records revealed a well-corticated curvilinear lucency in the L1 vertebral body that appeared to contain a duplicated left renal vein on lumbar computed tomography (CT) scan (Figures 1 and 2). Lumbar magnetic resonance imaging (MRI) was conspicuous for a probable venous lake with a prominent draining vein again associated with the L1 vertebral body (Figure 3). On examination, the neurological assessment was significant for sway during Romberg test, observation of bilateral hand tremors, and diminished sensation of the plantar surface of the right foot, which was attributed to a prior foot surgery. Lower extremity muscle stretch reflexes and myotomes were intact bilaterally. Lumbar range of

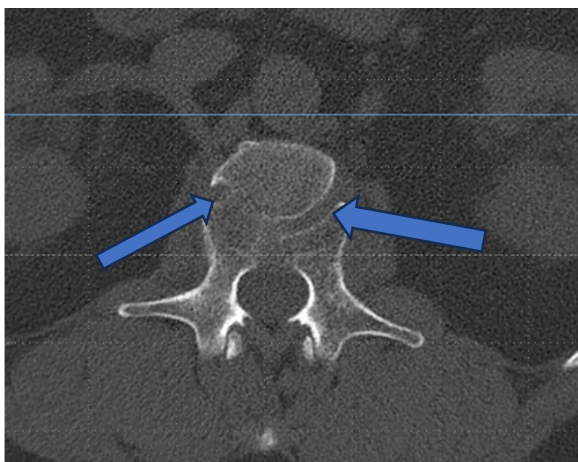


Figure 1.

Axial non-contrast CT images in bone window demonstrating a well-corticated intraosseous channel within the L1 vertebral body (indicated with arrows).



Figure 2.

Sequential axial non-contrast CT images of the lumbar spine and abdomen in soft-tissue window. Arrows indicate probable duplicate left renal vein.

motion (ROM) was minimally reduced with flexion and reproduced his chief complaint of LBP. ROM was also markedly decreased with lumbar extension. Additionally, lumbopelvic orthopedic tests (i.e., passive straight leg raise, prone hip internal/external rotation, and prone sacroiliac extension) localized pain to the lumbar spine without radiation.

The patient was diagnosed with mechanical non-specific lumbar pain and a trial of chiropractic care with a combination of thoracic high-velocity low-amplitude (HVLA) spinal manipulation, lumbar flexion-distraction manipulation, myofascial release, and exercise prescription was completed. The patient was treated for five visits over four months, with a resolution of his chief complaint, and the patient was transitioned to an as-needed care plan. No adverse events occurred.

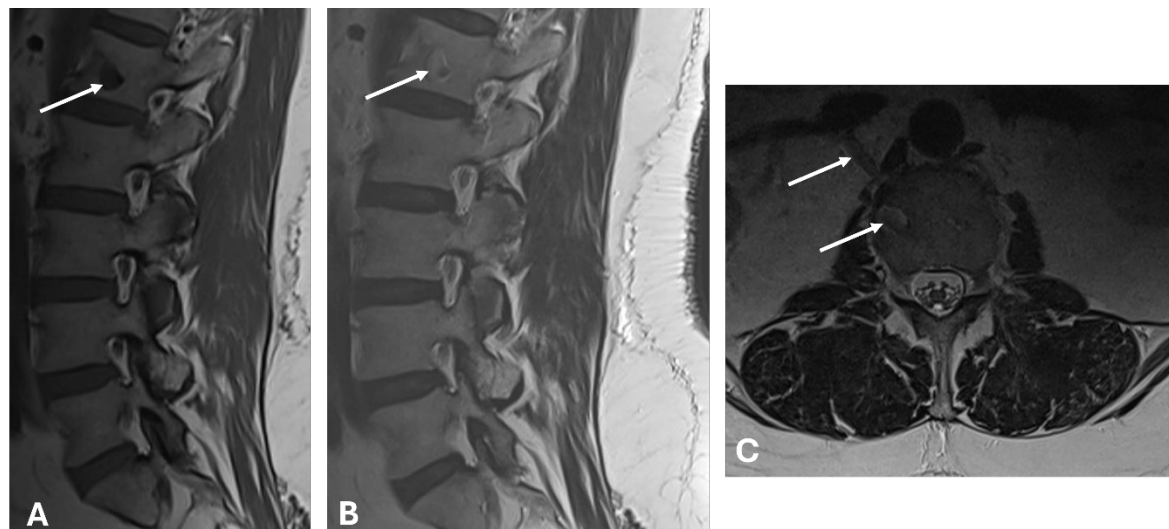


Figure 3.

Sagittal T1-weighted (A), T2-weighted (B), and Axial T2-weighted (C) magnetic resonance images (MRI) of the lumbar spine. Note the vascular structure coursing through the vertebral body (arrow) is hypo-intense on T1 and hyper-intense with areas of mixed low-intensity on T2-weighting, consistent with slow venous flow.

Discussion

Anatomical variants are not uncommon and are often discovered incidentally on diagnostic imaging.¹ In typical embryonic development, renal veins form in weeks 6-8 from an anastomosis between supracardinal veins and subcardinal veins at the level of L1-L2 vertebrae.² Initially, each renal vein forms from this anastomosis as a dorsal and ventral limb. The dorsal limb typically degenerates and the ventral limb typically persists as the definitive renal vein. The definitive left renal vein typically traverses anterior to the abdominal aorta and lumbar vertebrae, where it connects to the inferior vena cava. Renal developmental variations are common³ and may include the renal vein traveling posterior to the abdominal aorta and/or duplicating into multiple veins. The developmental interpretation of such variants is generally attributed to variability in the original supracardinal-subcardinal anastomosis and/or persistence of the dorsal limb of the fetal renal vein.⁴ A meta-analysis of pooled data from surgical reports, imaging, and cadaveric studies by Hostiuc *et al.* described posterior traversing renal vein, also known as a retro-aortic renal vein, as estimated to be present in 3% of individuals.³ A reported 16.7% of individuals have duplicated renal veins, and 3.5% have circum-aortic renal veins

(one vein traverses anteriorly to the aorta and one posteriorly). Anomalies of the renal vein, which originate during the embryologic stage of development, have an estimated prevalence ranging from 0.3% to 16.6%, occurring more commonly on the right side than the left.^{3,5,6} To our knowledge, this report is the first to describe a duplicated renal vein that traverses through a vertebral body.

The duplicated left renal vein traversing the L1 vertebral body in this case was likely temporally associated with the developmental processes of vertebrae formation. The first appearance of a segmental pattern in vertebrates is segmentation of paraxial mesoderm into somites in weeks 3-4 of development.⁷ At that time, intersegmental blood vessels pass through the cleft between sequential somites. Subsequently in weeks 5-6, the somite sclerotomes recombine to fuse the caudal half of one somite with the cranial half of the next successive caudal somite to begin forming definitive vertebrae via endochondral ossification.⁷ As definitive vertebrae form, intersegmental blood vessels are associated with each developing vertebral body which forms at each original inter-somite cleft. Although presumably very rare and not previously described, the potential temporal overlap in renal vein development and vertebral body resegmentation creates

a developmental opportunity for a persistent dorsal limb of the left renal vein to be enveloped by the endochondral ossification of the L1 vertebral body as described here. The duplicate left renal vein anastomoses with the L1 basivertebral vein within the L1 vertebral body (Figure 1).

Despite the incidental nature of finding these variations, they can be clinically important and may present a potential contraindication to manual therapies. Melka *et al.* similarly reported a vascular anomaly, with a vertebral artery tortuosity that resulted in cervical vertebral body erosion mimicking neck pain.⁸ The anomaly in our case appeared to be incidental without significantly impacting the clinical presentation of the patient. While vascular injuries associated with spinal manipulation are very rare,^{9,10} the unique presentation of this renal vein war-

ranted consideration of venous compression syndromes (e.g., Nutcracker syndrome) and exercising caution with manual therapies.¹¹

Chiropractic clinical practice guidelines recommend an individualized approach to risk assessment.^{12–14} We opted not to pursue high-velocity, low-amplitude spinal manipulation to the lumbar region due to the known presence of the anomaly. Flexion-distraction manipulation,¹⁵ myofascial manual therapy, and exercise were applied to the lumbar region without adverse event. While it appears to be unlikely that duplicated renal veins pose a direct safety concern to manual therapy providers, the clinical implications are not well understood, and we felt the vessel traversing a vertebral body warranted extra caution. The key imaging features and etiologies of this condition are presented in Table 1.

Table 1.
Key imaging features and proposed etiologies of duplicate renal vein.

Key Imaging Features • Well-corticated curvilinear lucency within the L1 vertebral body identified on CT • Duplicated left renal vein traversing the L1 vertebral body • Communication with the basivertebral venous system within the L1 vertebral body • T1 hypointense and predominantly T2 hyperintense signal characteristics on MRI, consistent with slow venous flow • Absence of destructive osseous changes or marrow replacement
Proposed Etiologies • Persistence of the dorsal embryonic limb of the left renal vein • Variability in the supracardinal–subcardinal venous anastomosis • Temporal overlap between renal vein development and vertebral resegmentation • Envelopment of a persistent venous structure during endochondral ossification of the developing L1 vertebral body
Key Messages • A duplicated left renal vein traversing the L1 vertebral body represents an exceedingly rare anatomical variant. • To our knowledge, this is the first reported description of an intraosseous duplicated renal vein within a lumbar vertebral body. • CT and MRI demonstrated imaging findings consistent with a benign congenital vascular anomaly. • The anomaly may reflect persistence of embryonic venous structures during vertebral body development. • Recognition of vascular variants is important for diagnostic interpretation and may influence procedural or manual therapy decision-making.

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U.S. Veteran with dural ectasia secondary to severe axial spondyloarthritis: imaging case review

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Zachary E. Scott, DC¹

Cases detailing dural ectasia from severe axial spondyloarthritis are limited in published literature. This report documents the rare and complex presentation of a 65-year-old male to a chiropractic clinic. Imaging and clinical features as well as differential diagnosis are summarized.

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KEY WORDS: axial spondyloarthritis, dural ectasia, cauda equina syndrome

Vétérain américain présentant une ectasie durale secondaire à une spondylarthrite axiale sévère: étude de cas d'imagerie

Les cas d'ectasie durale attribuable à une spondylarthrite axiale sévère sont peu nombreux dans la littérature publiée. Le présent rapport décrit la présentation rare et complexe d'un homme de 65 ans dans une clinique chiropratique. Les caractéristiques radiologiques et cliniques ainsi que le diagnostic différentiel sont résumés.

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MOTS CLÉS: spondylarthrite axiale, ectasie durale, syndrome de la queue de cheval

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Conflicts of Interest:

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The involved patient provided consent for case publication.

Case presentation

A 65-year-old white male U.S Navy veteran presented to the chiropractic clinic with complex medical history of HLA-B27+ radiographic axial spondyloarthritis (r-ax-SpA) initially diagnosed in 1994. While he was treated with disease modifying anti-rheumatic drugs (DMARDs) early in the course of the disease, it remained mostly unmanaged following unfavourable response to medications. The veteran later underwent surgical placement of an intrathecal (IT) pump in 2006 to alleviate symptoms secondary to axial spondyloarthritis (axSpA). Continued progression of diffuse ankylosis subsequently led to dural ectasia and arachnoiditis resulting in symptoms of cauda equina syndrome including fecal retention, sexual dysfunction, and right lower extremity weakness. The veteran underwent surgery consisting of multilevel laminectomy from L1-L2 to L5-S1 to alleviate these symptoms alongside placement of a lumboperitoneal shunt in 2022.

At time of presentation to the chiropractic clinic in 2025, the veteran's chief complaint was diffuse axial stiffness and immobility alongside bilateral lower extremity radiating paresthesia, muscle spasming, fasciculations, and weakness. As many of his daily activities were hindered by these symptoms, the veteran's goals for treatment were to identify additional treatment options for his pain and to prolong need for future wheelchair use. At time of presentation, the veteran utilized a four-wheel rollator for ambulation assistance.

Upon examination, the veteran demonstrated intact upper extremity reflexes, strength, and sensation, while lower extremity deep tendon reflexes were absent and sensory deficits were present affecting the circumference of his legs bilaterally from his knees to the plantar and dorsal aspects of his feet. Tremor or fasciculations were absent at examination. All cervical and lumbar ranges of motion were markedly reduced.

His most recent lumbar magnetic resonance imaging (MRI) from August of 2025 prior to chiropractic consultation revealed distension of the thecal sac with scalloping involving the lamina and facets from L2 downward, consistent with dural ectasia (Figure 1). These findings were grossly similar to MRIs obtained in April 2024 and May 2022. The previously placed lumboperitoneal shunt remained intact, entering the spinal canal at L2-L3 and terminating at the L1-L2 level. Intrathecal baclofen pump remained intact as well. Nerve roots of the cauda equina

appeared laterally displaced along the walls of the thecal sac consistent with arachnoiditis. Thin marginal syndesmophytes, Romanus lesions with 'shiny corners', and vertebral body squaring were observed throughout the lumbar spine, with evidence of fusion at the spinous processes tips, consistent with the patient's history of axSpA. The remainder of the lumbar spine showed no significant disc bulging, herniation, spinal stenosis, or neuroforaminal stenosis.

Given the veteran's complex presentation with multiple contraindications to spinal manipulation (IT pump presence, shunt presence, severe ankylosis, and dural ectasia), he was given the alternative option of a short trial of acupuncture in the chiropractic clinic. The veteran opted for this, and four visits were completed over an eight-week period. The veteran reported decreased pain and tension that lasted for a week following each treatment, along with the feeling that his gait was smoother during ambulation with the four-wheel rollator. Upon completion of the fourth visit within the chiropractic clinic, the veteran opted to continue acupuncture treatment and was referred to the service line for a full trial of care.

Discussion

This case describes a complex presentation of late stage axSpA progression with a rare neurologic complication of dural ectasia secondary to the disease. Axial spondyloarthritis is a seronegative, multisystem, inflammatory disease characterized by inflammation of the axial skeleton affecting 0.3-1.4% of the global population.¹ This condition can be further classified into radiographic (r-ax-SpA) and non-radiographic (nr-axSpA) manifestations.^{2,3} While both subgroups tend to have similar clinical presentations, they are distinguished by the presence of definitive sacroiliitis on plain film imaging. As the disease progresses, chronic inflammatory processes can lead to abnormal new bone formation affecting the sacroiliac joints and entheses in the spine, potentially leading to diffuse syndesmophyte formation which bridges adjacent vertebral bodies resulting in ankylosis.⁴

Further uncommon complications, such as dural ectasia are seen in severe and untreated cases. This occurs secondary to chronic inflammation and is visualized as erosion and/or scalloping secondary to enlargement of the dural sac.⁵ Increased pressure from this enlargement can lead to nerve root compression and damage resulting

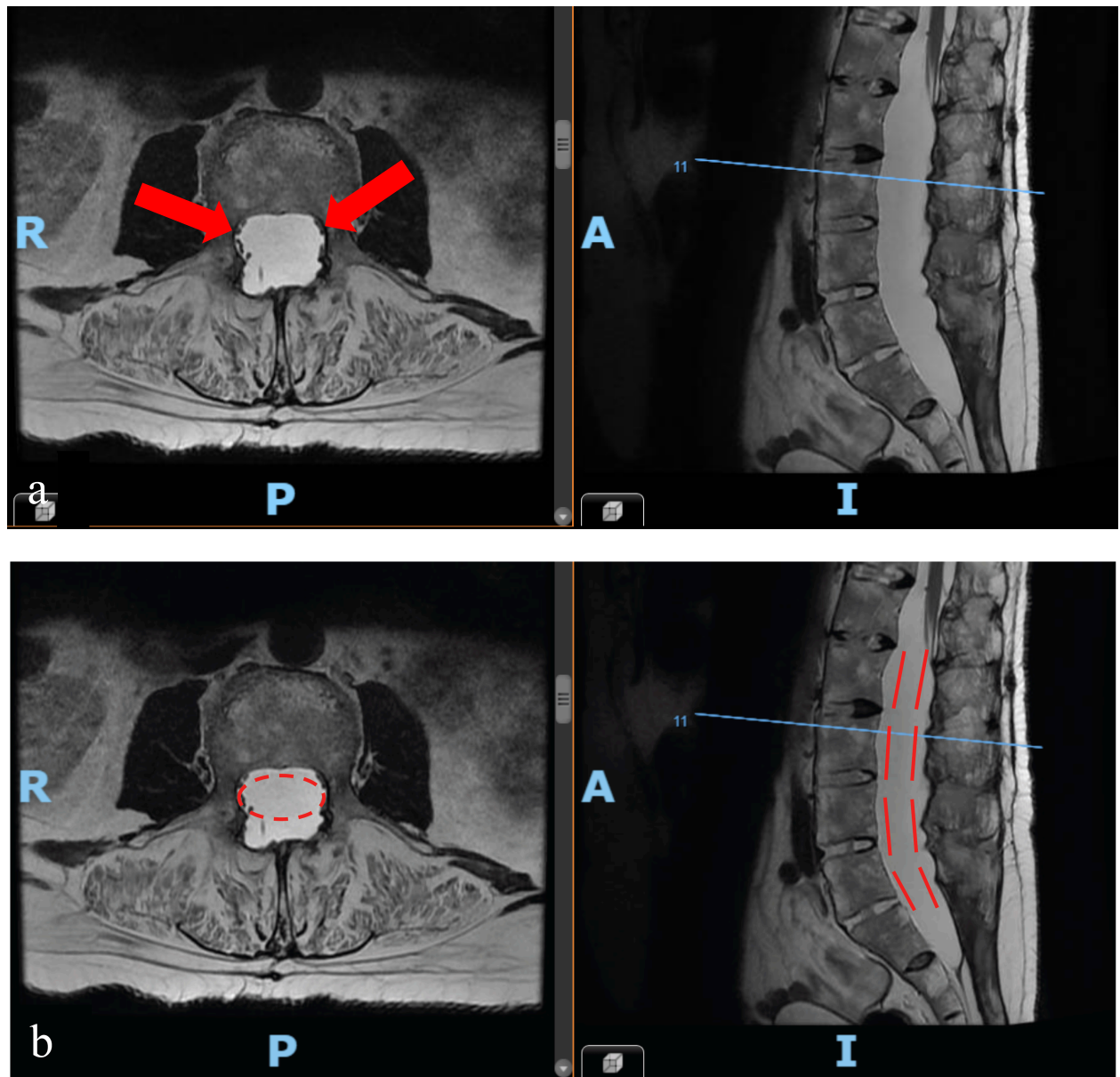


Figure 1.

- (a) T2 weighted lumbar spine MRI demonstrating dural ectasia and subsequent arachnoiditis (red arrows).
 (b) Red dashed line approximates normal canal volume on axial and sagittal views.

in the development of cauda equina syndrome features, termed “CES-AS Syndrome”.^{6,7} Prevalence of dural ectasia is unknown, but it has also been associated with conditions including Marfan Syndrome and osteogenesis imperfecta, as well as status-post trauma and surgical

interventions. One differentiating feature of dural ectasia in axSpA is involvement of the dorsal aspect of the spinal canal, while other causes typically involve the ventral aspect. The key imaging features of dural ectasia are provided in Table 1.

Table 1.
Key imaging features of dural ectasia

- Enlargement/Widening of the dural sac
- Vertebral (osseous) scalloping
 - Dorsal aspect of spinal canal involvement with axial spondyloarthritis
 - Ventral aspect of spinal canal involvement (posterior vertebral body scalloping) with Marfan Syndrome and other causes
- Subsequent arachnoiditis of cauda equina

Only one case of dural ectasia managed within a chiropractic clinic has been reported in the literature, which involved treatment to a separate spinal region and was not secondary to axial spondyloarthritis.⁸ Reporting of this condition in a chiropractic care setting is limited both by the presence of dural ectasia and complications associated with conditions or factors which may lead to its development. Treatment considerations should be case-by-case, but are likely to be largely limited to a myofascial and pain management focus.

Key Messages:

- Dural ectasia is a complication of various systemic diseases including axial spondyloarthritis that often leads to serious neurological deficits including cauda equina syndrome.
- Treatment in the acute phase is primarily surgical decompression, while in the chronic phase is focused on pain management.
- While common chiropractic treatment of spinal manipulation is contraindicated, treatments including myofascial release, massage therapy, and/or acupuncture may be considered based on the patient's specific presentation.

Abbreviations:

axSpA	axial spondyloarthritis
CES-AS	Cauda Equina Syndrome in Ankylosing Spondylitis
DMARDs	disease-modifying anti-rheumatic drugs
IT	intrathecal
MRI	magnetic resonance imaging
nr-axSpA	non-radiographic axial spondyloarthritis
r-axSpA	radiographic axial spondyloarthritis

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CONFERENCE PROCEEDINGS

The inaugural Canadian Chiropractic Association Research Day (CCAIRD): fostering collaboration and dissemination in the Canadian chiropractic research community

Diana De Carvalho, DC, PhD

Kent Stuber, DC, PhD

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The Canadian Chiropractic Association Research Day (CCAIRD) is an initiative designed to bring together researchers, clinicians, educators, and leaders to share knowledge and highlight innovative research. The inaugural CCAIRD was held on April 30, 2026, at the CCA National Convention & Tradeshow NCT 2026 in Halifax, Nova Scotia. Created to provide an opportunity for researchers to present their work and exchange ideas, the event included oral presentations on project updates and study protocols, as well as a reception with poster presentations. By bridging the gap between emerging evidence and clinical practice, the CCAIRD serves as an important platform for fostering meaningful collaboration, inspiring future research partnerships, and advancing patient care across Canada.

(JCCA. 2026; 70(2):263-285)

KEY WORDS: chiropractic, research

ACTES DE CONFÉRENCE

Première Journée consacrée à la recherche de l'Association chiropratique canadienne (CCAIRD): favoriser la collaboration et la diffusion des connaissances au sein du milieu canadien de la recherche en chiropratique

La Journée consacrée à la recherche de l'Association chiropratique canadienne (CCAIRD) est une initiative visant à réunir des chercheurs, des cliniciens, des membres du personnel enseignant et des dirigeants afin de favoriser l'échange de connaissances et de mettre en valeur des travaux de recherche novateurs. La première édition de la CCAIRD s'est tenue le 30 avril 2026, à l'occasion du Congrès national et salon des exposants 2026 de l'Association chiropratique canadienne, à Halifax, en Nouvelle-Écosse. Créé afin d'offrir aux chercheurs l'occasion de présenter leurs travaux et d'échanger des idées, l'événement comprenait des présentations orales portant sur l'avancement de projets et des protocoles d'étude, ainsi qu'une réception assortie de présentations par affiches. En rapprochant les nouvelles données probantes de la pratique clinique, la CCAIRD constitue une importante tribune qui favorise des collaborations porteuses, stimule la création de futurs partenariats de recherche et contribue à l'amélioration des soins aux patients partout au Canada.

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MOTS CLÉS: chiropratique, recherche

Ten Myths of Back Pain in Older Adults that can Lead to Ineffective and Harmful Care

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Background: *Low back pain (LBP) is one of the most disabling conditions in older adults and among the costliest interms of healthcare expenditures. Many factors contribute to the disability and high costs of LBP in older adults, but one of the most preventable is the spread of misinformation and unhelpful attitudes, beliefs, and behaviors. These are often perpetuated by family, friends, social media, pharmaceutical companies, other industries, and healthcare providers. Myths about back pain foster false attitudes, beliefs, and behaviors that lead to inappropriate, costly, and sometimes harmful treatments. Such myths can result in psychological consequences, including fear of movement, poor self-efficacy, low motivation, anxiety, stress, and depression- all of which further perpetuate disability. The purpose of this paper is to dispel ten common myths of LBP in older adults, with the goals of changing attitudes, beliefs, and behaviors to reflect a more positive and evidence-based approach among practitioners and public. The aim is also to motivate practitioners to educate their older patients based on the best available evidence.*

Methods: *This paper presents a narrative review and clinical expert commentary grounded in the author 's extensive experience in clinical practice and research related to low back pain in older adults. A targeted literature search was conducted to identify evidence supporting the author's statements and recommendations. The search included peer-reviewed sources such as PubMed, Google Scholar, and the Cochrane Library covering publications to April 15th, 2025. Key search terms included "low back pain," "older adults," "myths," "misinformation," and "ineffective treatments".*

Results: *This review identified ten myths—such as the belief that LBP is inevitable with aging, that imaging is required in older adults, that bed rest or activity avoidance aids recovery, or that medications, injections, and surgery are effective first line options. Evidence refutes these claims, showing that:*

- *LBP is not inevitable with aging. While common, its prevalence peaks before retirement and then declines.*
- *Most LBP in older adults is non serious and not caused by structural abnormalities.*
- *Routine imaging does not improve outcomes and often contributes to overtreatment.*
- *Physical activity, movement, and self management improve function and reduce disability.*
- *Pharmacological and surgical approaches provide limited benefit and carry significant risk in older adults.*

Discussion: *The findings highlight that LBP misinformation is a major, preventable driver of poor outcomes and unnecessary healthcare costs. For chiropractors, the implications are substantial: practitioners play a pivotal role in myth busting, patient education, and delivering evidence based, function focused care. By discouraging overmedicalization—particularly imaging, opioids, injections, and surgery—chiropractors can help older adults adopt healthier beliefs, remain active, and engage in self directed pain management. The review emphasizes the importance of interdisciplinary collaboration, reassurance, and empowerment to counter fear based narratives and age related bias in LBP care.*

Conclusions: *Dispelling common myths about back pain in older adults is essential to improving outcomes, reducing harmful or ineffective care, and promoting evidence aligned clinical practice. Chiropractors and other practitioners who challenge outdated beliefs, encourage movement, and prioritize conservative management can significantly enhance quality of life for older adults with LBP.*

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The tailoring, implementation, and evaluation of the spinemobility boot camp program for degenerative lumbar spinal stenosis at an inner-city community clinic. A mixed methods approach

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Background: *Degenerative lumbar spinal stenosis (DLSS) is a highly prevalent, disabling condition among older adults and the leading reason for spine surgery in this population. A 6 week self management “Boot Camp” program developed at Mount Sinai Hospital has demonstrated large and sustainable improvements in walking tolerance, pain, and function in randomized clinical trials and longitudinal studies. However, these studies excluded individuals from underserved communities, despite evidence that these populations, such as LGBTQ+ individuals, newcomers to Canada, and those experiencing homelessness, face higher risk, greater disability, and more barriers to care. To address this gap, the Canadian Memorial Chiropractic College (CMCC), in partnership with Dr. Carlo Ammendolia, established the Spinal Stenosis Clinic at the Reikai Centre (RC) to deliver the Boot Camp Program to underserved groups.*

Objectives: *(1) Explore how DLSS affects individuals from underserved communities; (2) tailor the Boot Camp Program to the needs of this population; (3) implement and evaluate the adapted program at the Reikai Centre CMCC teaching clinic.*

Methods: *A sequential mixed methods design is being used. First, we are conducting semi structured interviews at baseline and immediately post-treatment with a convenience sample of 15 DLSS patients aged 50-years or older attending the RC Clinic. We are conducting a thematic analysis to identify and summarize patient perspectives*

on the lived experience of DLSS. The findings from our qualitative phase will guide the intervention mapping process to tailor the Boot Camp program to the needs of this population. Second, we will conduct a prospective cohort study of 75 consecutive DLSS patients who will complete the tailored program at the RC clinic. Outcomes will be collected at baseline, 6 weeks, and 3, 6, and 12 months. Our primary outcome will be physical function (i.e., Zurich Claudication Questionnaire) and our secondary Outcomes will be pain intensity, disability, and depression.

Results: *We have completed nine interviews with qualitative data collection expected to be completed by May 2026. To date, participants describe DLSS as profoundly affecting physical, emotional, and social well being. Common themes include mobility limitations, loss of independence, fear of symptom exacerbation, and social withdrawal. Financial strain emerged as a dominant concern, with many participants unable to afford ongoing treatment and relying on limited income from Old Age Security/Canada Pension Plan. Overall, participants responded positively to the Boot Camp Program, valuing its focus on education and self management. They emphasized the need for individualized pacing, strategies for flare ups, and enhanced follow up and support for program adherence.*

Discussion: *Preliminary findings show that DLSS imposes multidimensional burdens on underserved populations, magnified by financial insecurity and limited access to supportive healthcare. The Boot Camp Program appears acceptable and empowering, offering a financially sustainable and patient centered approach. Tailoring the program to accommodate fluctuating symptoms, psychosocial stressors, and limited resources may enhance engagement and outcomes.*

Conclusion: *Early qualitative data support the relevance and acceptability of a tailored DLSS Boot Camp Program for underserved communities. Future quantitative evaluation will determine its clinical effectiveness. Tailoring conservative spine care programs may reduce disability and improve access for underserved individuals disproportionately affected by DLSS.*

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Women's health and chiropractic care: A meta-research analysis

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Background: Chiropractic care plays a key role in women's health however the breadth of information has not kept up with clinical needs as women's health is often understudied. There has been a call to increase women's health research agenda. To assist the chiropractic profession, we conducted a meta-research analysis of a corpus of peer-reviewed publications on chiropractic management of women's health with a view to informing the identification of research priorities.

Methods: A search strategy was employed to capture articles that included 1) conditions specific to females and participants of the studies were included in chiropractic research or attending a chiropractic clinic for treatment and 2) consisted of one or more authors that held a chiropractic qualification. All article metadata were entered into an Excel spreadsheet. Publication genre, author affiliations and number of indexed and non-indexed publications was determined through a consensus of two researchers. Thematic analysis VOSviewer and a lexical analysis through WordSmith Tools were used to find noun/noun phrases commonly used and statistically over-represented words. Gephi V1.0 was used to map coauthor collaborations as well as sub-community collaboration. Bibliometric was utilized in mapping transnational and interinstitutional collaborations.

Results: Two hundred and forty-three publications were included; 37% of the publications were case studies/series, 20% were reviews (narrative, systematic and meta-analysis), 6% were clinical trials and cohort studies

and 2% were RCTs. 78% of included studies were from indexed journals. Twenty-two words were identified to be statistically significantly over-represented. Twenty-two percent of the publications had a single author, and 285 of the total 407 authors only appeared in a single publication. Ninety-nine unique institutions were highlighted along with 49 private practices. Nineteen countries of affiliation were also found associated with chiropractic care in women's health, greatest international collaboration was associated with Canada, United States, Ireland and Australia.

Discussion: A meta-research analysis was conducted of a corpus of peer-reviewed publications on chiropractic management of women's health with a view to informing the identification of research priorities. We retrieved 243 publications that satisfied our inclusion criteria, and among these the dominant genres comprised case studies and case series, followed by various types of review articles. Thematic analysis demonstrates that back pain, pelvic pain and breast cancer have been the most common topics. However, there has been an evolution away from condition specific papers and a disease focus (early 2000s) towards promotion of good health, including during pregnancy and the post-partum period (present day). Collaboration at the transnational, inter-institutional and author levels is restrained. In sum, there is not yet evidence of a cohesive research network with the common goal of advancing chiropractic care and promoting excellence in women's health research.

Conclusions: Research on women's health continues to lag in health care, and chiropractic care is no exception. Understanding what research has been conducted in the chiropractic profession to date is the first step in determining an appropriate research agenda in women's health for the chiropractic profession.

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Prevalence of cervical spine instability in former collision sport athletes

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Background: *Occult cervical spine instability remains an incompletely understood clinical entity. It has been suggested that the condition may be underrecognized, particularly in individuals who present with chronic neck pain, headache, vestibular complaints, or a remote history of cervical trauma in the absence of overt abnormalities on routine imaging. No universally accepted gold standard exists for diagnosis, though flexion-extension radiography, dynamic MRI, stress imaging, and intraoperative motion assessment have been proposed. Clinical findings, such as ligamentous laxity, segmental hypermobility, or neurological symptoms, may suggest instability; however, they are often nonspecific. Athletes participating in collision sports, such as football, rugby, and hockey, may be at an elevated risk due to cumulative microtrauma and high-velocity impacts. Meanwhile, congenital or acquired cervical stenosis may predispose individuals to transient neurological symptoms, even in the absence of radiographic abnormalities.*

Methods: *This retrospective study will involve chart and imaging review of former collision-sport athletes with at least four years of sport participation and a history of chronic or episodic neck pain. Lateral cervical spine flexion-extension radiographs will be independently analyzed using the posterior vertebral body tangent line and Cobb angle methods to assess intersegmental angu-*

lar displacement. Sagittal translation will be determined by measuring excessive translation between the endplates during flexion and extension. Prevalence estimates will be generated for each measurement approach, and inter-method agreement will be evaluated.

Results: *The primary objective of this retrospective investigation is to quantify the prevalence of radiographic findings consistent with occult cervical instability among symptomatic former collision-sport athletes. Secondary objectives include comparing the posterior tangent line and Cobb angle measurement approaches to determine their relative clinical utility in identifying abnormal cervical motion. We hypothesize that a high prevalence of occult cervical spine instability will be observed in symptomatic former collision-sport athletes and that meaningful differences will exist between the posterior tangent line and Cobb angle measurement methods, highlighting one approach as potentially more clinically useful.*

Discussion: *Findings from this study may enhance understanding of the long-term cervical spine consequences of collision sport participation and inform clinical screening, imaging strategies, and management approaches for athletes presenting with persistent neck pain. Additionally, results may help identify the most clinically useful radiographic method for detecting occult cervical instability and assist in recognizing individuals at higher risk for developing a spinal cord injury.*

Conclusions: *This work will address critical gaps in the epidemiology and assessment of occult cervical instability in collision-sport athletes and support more informed clinical decision-making.*

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Change in symptoms of older adults following chiropractic care: Active surveillance reporting system to identify adverse events

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Background: Musculoskeletal conditions are more common and severe in older adults and are the primary reason for visiting a chiropractor. While previous studies reported adverse events (AEs) following specific chiropractic techniques, no safety studies have focused on AEs experienced by older adults following a chiropractic visit. Our primary aim was to assess change in symptoms and identify AEs in older adults after a chiropractic treatment visit. Our secondary aim was to explore patient, provider and intervention characteristics associated with symptom changes.

Methods: Data were collected using an observational clustered case series design. An active surveillance reporting system prospectively collected data on symptom changes in patients aged ≥ 65 years following a chiropractic visit. Participating patients completed three electronic surveys recording symptoms before, immediately after, and 2–5 days following treatment. Participating providers completed one electronic survey recording treatment interventions. New and worsening symptoms were considered AEs. Associations between patient, provider and intervention characteristics and AEs were examined using logistic regression.

Results: A total of 511 older adults (mean age 71.9 years; 61.5% female) participated. The most common reason for seeing a chiropractor was low back pain (50.9%). Before treatment, 1187 symptoms were reported, with discomfort/pain being the most frequent (67.3%). Immediately after treatment, 66.8% of symptoms improved, 31.8% were unchanged, and 1.5% worsened; 8.4% of patients reported new symptoms (overall AEs 10%). Two to five days after treatment, 1.8% reported worsening and 15.5% reported new symptoms (overall AEs 15.9%). Female sex, baseline pain and multisite pain, comorbidities, headaches and use of pain medication were associated with higher odds of experiencing AEs after the visit.

Discussion: This is the first study to describe the change in symptoms and their severity experienced by older adult following a chiropractic visit. Discomfort/pain and stiffness were the most commonly reported AE, which is consistent with the ones reported in the general adult population. Overall, there is limited evidence regarding the incidence of symptom worsening, not only within chiropractic and older adults, but in the broader health care. While this may reflect greater focus on positive outcomes, or the unquestionably positive trend of most patients experiencing improvement, it may also reflect underreporting or lack of monitoring of worsened symptoms. Differences in frequency of AEs in this study could be due to differences in timing of AE assessment.

Conclusions: Most older adults experience improvement after chiropractic care, while a minority report new or worsening symptoms. Higher odds of experiencing AEs after chiropractic care may be related to baseline pain, comorbidities, headaches, medication use and female sex. Identifying these factors can inform patient education and monitoring strategies to enhance safety and quality of care.

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C-prior – Implementation of the MAINTAIN instrument for patients with spinal pain: Study protocol for a randomized clinical trial

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Background: *Spinal pain is a highly prevalent condition affecting a large part of the population. Chiropractic maintenance care (MC) is a management strategy intended to prevent spinal pain recurrent episodes and deterioration by treating patients at pre-planned intervals. A previous study showed that patients identified as a Dysfunctional subgroup by the West Haven-Yale Multidimensional Pain Inventory (MPI) and receiving MC had fewer days with bothersome LBP. This suggests MC may have superior effectiveness in this subgroup of patients. The MPI, however, is not practical for daily clinical practice, prompting the development of the MAINTAIN instrument. This study aims to: 1) assess the effectiveness and cost-effectiveness of stratified MC using the MAINTAIN instrument, and 2) assess the fidelity and procedure compliance of implementing the MAINTAIN instrument.*

Methods: *This pragmatic randomized clinical trial will recruit 225 consecutive patients (18-65 years old) with significant (>30 days in the past 12 months) recurrent*

spinal pain presenting to chiropractic clinics. After the initial 3 weeks (6 visits) of chiropractic care, patients will be randomized to receive either Stratified MC or Standard Chiropractic Care. Stratified MC: patients will complete the MAINTAIN instrument and be stratified to MC or symptom-guided care (clinicians' judgment). Patients in the Standard Chiropractic Care arm will receive standard treatment based on the chiropractor's judgment. The primary outcome is the total number of days with activity-limiting pain measured at 12 months. Secondary outcomes include the number of missed working days and loss of work productivity due to pain, pain intensity, disability, health-related quality of life, perceived improvement, and implementation of MAINTAIN instrument outcomes. An intention-to-treat protocol and Generalized Estimating Equations (GEE) linear regression models will be used for analysis. TRIAL STATUS Protocol version 1.0. The trial is ongoing, and participants (chiropractors and patients) are being recruited. Study recruitment started in November 2023 and is anticipated to continue until May 2026. Data collection is expected to be completed in July 2027.

Discussion: *This study investigates the impact of using a clinical instrument to identify patients with recurrent spinal pain to target those who benefit most from a chiropractic MC approach. Strict inclusion criteria should ensure a suitable target group, and frequently collected repeated measures should provide accurate outcome assessment. The study is pragmatic and includes standard clinical procedures facilitating the generalizability and transferability of the results into clinical practice.*

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Primary care for musculoskeletal disorders: A cross-sectional survey

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Background: Musculoskeletal (MSK) disorders account for 162 million disability-adjusted life years globally (5.6% of global burden). In Ontario, over one-quarter of adults consulted physicians for MSK conditions, corresponding to 5.6 million annual primary care visits. While previous studies compared physiotherapists and physicians, limited evidence exists on diagnostic concordance between chiropractors, emergency physicians, and general practitioners. This study compares differential diagnosis and clinical management for MSK disorders across these providers using clinical vignettes.

Methods: A 87-question cross-sectional survey with validated hypothetical case scenarios was sent to chiropractors, general practitioners, and emergency physicians or the Mauricie area in the province of Quebec. Participants provided differential diagnoses and management strategies (imaging, referral, pharmacological/ rehabilitation treatment) for 12 clinical vignettes covering MSK, non-critical, and critical medical conditions. Responses were compared to evidence-based guidelines. Descriptive statistics and chi-square tests assessed between-provider differences.

Results: Forty-nine chiropractors and 58 medical

doctors (39 family physicians, 19 emergency physicians) completed the survey. Chiropractors demonstrated appropriate diagnosis in their differential for MSK disorders (93.5%), comparable to family physicians (94.2%) but superior to emergency physicians (88.8%). For non-critical conditions, emergency physicians (93.9%) and family physicians (90.8%) outperformed chiropractors (76.3%). On critical conditions, all providers showed lower accuracy (chiropractors 75.4%, family physicians 74.6%, emergency physicians 84.7%).

Discussion: Chiropractors and family physicians achieved comparable diagnostic accuracy for MSK conditions, supporting their equivalent role as first-contact practitioners. Chiropractors' reduced performance on noncritical medical conditions appropriately reflects scope-of-practice boundaries. Notably, family physicians' similar performance on critical conditions suggests MSK-specific education gaps may affect all primary care providers, not just chiropractors.

Conclusions: Chiropractors and family physicians demonstrate comparable diagnostic accuracy for MSK disorders, supporting an interprofessional primary care approach. Appropriate scope-of-practice recognition by chiropractors on non-MSK conditions validates their clinical judgment. These findings support reorganizing primary care delivery for MSK disorders, with potential benefits for healthcare efficiency and patient accessibility. Future research should examine management concordance and patient outcomes to optimize interprofessional collaboration.

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Force–time characteristics of hip high velocity, low amplitude manipulation in asymptomatic adults: With and without a drop piece

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Background: Approximately 7% of patients seek chiropractic care for hip pain. The drop-piece technique makes up 6.3% of the total chiropractic techniques used in Ontario. However, the characteristics of forces during hip high-velocity low amplitude (HVLA) manipulation and how they change when a drop-piece is used remain unknown. As such, this study aimed to describe the force-time characteristics of an HVLA hip manipulation (HVLAHM) with and without a drop-piece.

Methods: Twenty chiropractic students (22–28 years; 60% female) with asymptomatic hip joints were recruited. Each participant received 3 whip HVLAHM with a drop-piece on one leg and 3 HVLAHM without a drop-piece on the other leg by one of two practicing chiropractors. Force-time characteristics were collected for each HVLAHM using the Force-Sensing Table Technology (FSTT®) and analyzed descriptively. HVLA-HM does not follow the typical force-time patterns of posterior-to-anterior spinal manipulation. Therefore, slow-motion videography was used to match force-time graphs with the corresponding phases of the manipulation. Descriptive statistics were calculated for each outcome variable, including mean/median, standard deviation, and 95% confidence intervals.

Results: Overall, two peak forces were observed during HVLAHM (with and without drop-piece). On average, HVLAHM with drop-piece had a 1st peak force in-

itiation of 40N (± 19), peak force of 637N (± 218), time to peak of 53ms (± 26), loading rate of 10763N/s (± 5042) and 2nd peak force of 197N (± 85). HVLAHM without drop-piece had a 1st peak force initiation of 36N (± 23), peak force of 567N (± 290), time to peak of 63ms (± 22), loading rate of 9465N/s (± 5966) and 2nd peak force of 197N (± 82).

Discussion: Prior research on hip mobilizations found that forces averaging 68.6N (± 2.9) were effective in improving range of motion in hip osteoarthritis patients. In contrast, our study examined force characteristics of HVLA-HM in asymptomatic participants and identified the mean first peak force at 637N (± 218) with the drop-piece and 567N (± 290) without the drop-piece. This is possibly as a result of using HVLA instead of mobilization. Previous studies investigating spinal manipulation force-time characteristics without drop-piece reported peak forces ranging from 17N to 1,213N and time-to-peak thrust force ranging from 12ms to 938ms. Our results align within this range but highlight the distinct force dynamics of hip manipulations compared to spinal manipulations. A unique finding of this study was the identification of two peak forces during HVLA-HM, a characteristic not reported in previous spinal manipulation studies without drop-piece tables. The presence of a dual-peak in our study may differ from what was observed during toggle recoil manipulation of cervical spine since they were observed in both drop-piece and non-drop-piece manipulations at very similar force (197N). This is most likely related to the whip action manipulation used in our study inducing body bouncing causing the similar second peak in both drop-piece and non-drop-piece manipulations.

Conclusions: This is the first study looking at the force-time characteristics of HVLAHM with and without drop-piece. Forces during these techniques present different characteristics, with slightly higher peak forces and loading rates during HVLAHM with drop-piece at the patient-table interface.

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Psychological well-being among Canadian chiropractors: A cross-sectional questionnaire-based study

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Background: *Healthcare professionals commonly experience mental health disorders, often at greater rates than the public. Such disorders can contribute to increased work attrition, low job satisfaction and decreased productivity. However, little is known about the mental health and well-being of the Canadian chiropractic profession. Therefore, we aimed to address this gap by exploring the mental health and well-being of Canadian chiropractors and students.*

Methods: *We used a cross-sectional design to survey Canadian chiropractors and students between February 2023 and April 2023. We adapted the Canadian Medical Association's questionnaire with permission to reflect specific roles of chiropractors and align with previous Canadian Chiropractic Association's (CCA) surveys. The questionnaire included demographic and practice-related data, as well as 5 key concepts related to psychological well-being: Mental health and well-being, Anxiety, Burnout, Depression, and Suicidal ideation. All members of the CCA (n=7,135) and students from the Canadian Memorial Chiropractic College (n=792) and Université du Québec à Trois-Rivières (n=220) were invited to anonymously participate via email message with link to questionnaire. Descriptive statistics were tabulated and inferential statistics conducted on each psychological test stratified by gender, age, years and type of practice, and geographic location. From these data, most-at-risk and least-at-risk profiles were constructed.*

Results: *A total of 2,109 usable responses were re-*

ceived (26% response rate). The majority identified as male, white and without disability. Respondents identifying as practicing chiropractors and students represented 92.6% and 4.5% of the sample, respectively. From the mental health continuum, 57.8% of Canadian chiropractors reported to be flourishing, while 5.3% languishing. Chiropractors reported experiencing varying levels of mental health issues, including burnout (33.2%), anxiety (22.0%), and lifetime depressed mood (36.8%). Most notably, 26.7% of responding chiropractors reported having lifetime suicidal ideation. Respondents identifying as having a disability (20%) or being students reported more unfavourable scores across all psychological measures. The most at-risk profile for a Canadian chiropractor is a young female practitioner (under 31) with less than 5 years of experience. In contrast, the least at-risk profile is an older male (over 60) with 31 or more years of practice experience.

Discussion: *This is the first comprehensive evaluation of mental health and wellness in the Canadian chiropractic profession. In general, participating chiropractors reported to be in good well-being and mental health, with over 90% reporting high emotional, social and psychological well-being. Lifetime anhedonia and depressed mood were reported by 41.3% and 36.8%, respectively. Our findings suggest there are mental health and wellness challenges among Canadian chiropractors; however, a greater proportion of chiropractors report to be flourishing, fewer languishing and less reported burnout and anxiety compared to those in other health professions. Despite the lower response rates to questions about recent (15%) and lifetime (54%) suicidal ideation, it was disconcerting that positive responses were noted and similar to those in other professions.*

Conclusion: *Our findings provide valuable benchmarks evaluating the mental health and well-being of Canadian chiropractors. Further research is required to assess how outcomes are affected by occupational situations, behavioural factors and social supports.*

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Using intervention mapping to develop a smartphone app to support selfmanagement for lumbar spinal stenosis: Development and usability testing

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Background: Lumbar spinal stenosis (LSS) is a leading cause of disability among older adults, resulting in reduced walking capacity. Supported self-management is the recommended first-line treatment; however, current approaches do not adequately address behavioural barriers to increasing physical activity. Consequently, only 4% of individuals with LSS achieve recommended daily physical activity levels. A comprehensive in-person 6-week Boot Camp program demonstrated improvements in pain and walking capacity, but its effect on physical performance in daily life remains unknown. Digital health interventions, such as smartphone applications, offer a scalable and accessible means of delivering evidence-based care and may overcome barriers related to cost and provider accessibility. We aimed to systematic-

ally develop the Spinemobility app, a self-management mobile health intervention for individuals with LSS, using the Intervention Mapping (IM) framework, and to evaluate its initial usability.

Methods: We applied the first four IM steps: (1) conducted a needs assessment, (2) developed program objectives, (3) selected theory-based methods and practical strategies, and (4) designed the intervention. The needs assessment included stakeholder consultations with individuals with lived experience of LSS and an informal literature review to identify barriers to conventional self-management. An interdisciplinary IM team, including clinicians, behavioural scientists, app developers, and patients, guided development through consensus. Behaviour change techniques were integrated into app features. Usability testing involved seven participants (three stand-alone users and four using the app alongside the in-person Boot Camp program). Participants completed weekly semi-structured interviews, which we analyzed thematically to identify features they valued and areas requiring refinement.

Results: The needs assessment identified internal and environmental barriers. In response, we developed an app incorporating educational resources, SMART (Specific, Measurable, Achievable, Relevant and Time-bound) goal setting, structured exercise progression, tailored motivational messaging, real-time activity tracking, community forums, and gamification. Usability testing showed that participants valued real-time feedback, clear instructions, and personalization. Feedback on motivational messaging and gamification was mixed; some participants found these features encouraging, whereas others

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did not. Participants recommended improving the layout, increasing the detail of progress charts, and enhancing tracking accuracy. Stand-alone users expressed a desire for features that facilitate communication with healthcare professionals.

Discussion: Using a structured, participatory approach, we developed the Spinemobility app to promote physical activity among individuals with LSS. Usability testing showed that participants appreciated most features but identified several areas requiring refinement to improve engagement and functionality. Future work will

involve further development to optimize its use as a stand-alone intervention or in combination with in-clinic care, feasibility testing to inform a subsequent randomized controlled trial (RCT), and ultimately evaluation of effectiveness in an RCT.

Conclusion: By integrating research evidence, behavioural theory, clinical expertise, and end-user perspectives, the Spinemobility app was designed to be both patient-centred and aligned with best practices for digital behavioural health intervention development.

The association between chronic back problems and poor sleep quality among Ontarian adults aged 60 years and older: A cross-sectional study analyzing the Canadian Community Health Survey 2015–2016

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Background: *The risk factors of poor sleep quality remain understudied in aging populations. Chronic back problems (CBP), a leading cause of disability, may contribute to poor sleep quality. Firstly, we determined the prevalence of poor sleep quality. Secondly, we investigated the association between chronic back problems and poor sleep quality, controlling for covariates. Lastly, we explored the interaction between sleep apnea and chronic back problems with respect to their association with poor sleep quality.*

Methods: *We analyzed data from Ontarians ≥ 60 years in the 2015–2016 Canadian Community Health Survey (CCHS). We estimated the prevalence (95% confidence*

interval (CI)) of poor sleep quality. We investigated the association between CBP and poor sleep quality to compute prevalence ratios (PR) and 95% CI, controlling for covariates. We explored the interaction between CBP and sleep apnea in their association with poor sleep quality using four combined exposure categories.

Results: *Overall, 52% (95% CI 50–54) of participants reported sleeping <7 h or ≥ 9 h, 18% (95% CI 16–19) reported trouble going to or staying asleep, and 13% (95% CI 12–14) rarely or never had a refreshing sleep. After controlling for covariates, CBP was associated with sleeping outside of recommended guidelines (PR = 1.19 (95% CI 1.11–1.27)), trouble going to sleep or staying asleep (PR = 1.54 (95% CI 1.32–1.79)), and rarely or never having refreshing sleep (PR = 1.45 (95% CI 1.20–1.79)). Sex- and age-stratified analyses suggest that the association between chronic back problems and trouble going to sleep or staying asleep may be higher among males (PR = 1.92 (95% CI 1.50–2.46)) and adults 80 years and older (PR = 1.91 (95% CI 1.37–2.67)). No interaction was found between CBP and sleep apnea.*

Conclusions: *We found that CBP is associated with poor sleep quality among Ontarians ≥ 60 years. Future studies should investigate CBP as a potential risk factor for poor sleep quality*

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Chiropractor supply and the inverse care law: An ecological analysis of Canadian health regions

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Background: Chronic back problems (CBP) are a common reason for seeking healthcare in Canada, with chiropractors being the second most consulted providers. However, the geographic distribution of chiropractors and its association with population characteristics remain poorly understood. We examined the geographic distribution of chiropractor supply across Canadian health regions and identified population characteristics associated with variations in supply.

Methods: We conducted an ecological study of 102 Canadian health regions using data from the Canadian Community Health Survey (CCHS 2021) and the Canadian Chiropractic Association (CCA 2021) membership database. We computed the supply of chiropractors at the health region level as the number of practicing chiropractors per 100,000 population. We created choropleth maps using ArcGIS Pro 3.6.0 to visualize geographic distribution of chiropractors, CBP prevalence, and supply-to-need ratios. We used negative binomial regression with population offset to assess associations between population characteristics (e.g., age, sex, immigration status, cultural or racial origin, household income, geographic area, general health, and chronic conditions) and chiropractor supply. We present supply ratios (SRs; 95% CI), indicating how chiropractor supply changes per one percentage point increase in each characteristic.

Results: In 2021, there were 8,159 chiropractors who were members of the Canadian Chiropractic Association (mean age 45.3 years, SD=12.3; 59.5% male). Most

chiropractors worked in urban areas (85.7%). Provincial supply ranged from 10.7 per 100,000 population in Prince Edward Island to 29.9 per 100,000 in Alberta. Higher chiropractor supply was associated with higher proportions of immigrants, urban populations, higher proportion of self-reported depression, highest income quintile, higher levels of physical activity, and higher proportion of individuals in very good health. Lower supply was associated with a higher proportion of individuals between the ages of 50-64 years and in lower-middle income quintile (Q2); and higher proportion of individuals reporting diabetes, hypertension, physically inactive, and in good health. The association with proportion of individuals reporting chronic back problems was imprecise with wide confidence intervals.

Discussion: This ecological study examined where chiropractors practice (supply), not who uses chiropractic services at the individual level. Chiropractors are concentrated in urban, affluent regions with healthier populations, suggesting the inverse care law, namely – communities with the highest health needs have least access to care. This market-driven distribution pattern may reflect the primarily out-of-pocket payment model for chiropractic services in Canada. At the regional level, the association between chiropractor supply and the prevalence of chronic back problems in the population was imprecise, limiting our conclusions about geographic alignment between where chiropractors practice and where musculoskeletal disease burden is highest. Our findings do raise equity concerns, as underserved populations in regions with greater need may have limited access to non-pharmacological pain management options.

Conclusions: The supply of chiropractors varies across health regions in Canada. Chiropractors are primarily concentrated in urban and wealthier regions, and in regions with healthier populations. Health workforce planning should consider prioritizing improvements in the geographic distribution of chiropractors, especially in underserved rural, and lower-income populations.

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When policy drives disability poverty: a qualitative study protocol on the impact of Canada's social assistance policies on persons with disability

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Background: People with disabilities in Canada face disproportionately deep poverty, with 2024 federal statistics showing them falling below official poverty lines in every province and territory. Extra costs for healthcare, supports, and accommodations compound this inequality. We aim to identify: 1) barriers and facilitators to accessing disability assistance programs that persons with disabilities residing in British Columbia, Alberta, and Ontario, including those who experience intersectional oppressions, encounter; and 2) alternative policies that these persons with disabilities living in poverty propose to impact their impoverishment.

Methods: *Study Design:* Interpretive descriptive qualitative study, using an Intersectionality-Based Policy Analysis (IBPA) Framework. The IBPA guiding principles include multi-level analysis, reflexivity, recognition of diverse knowledge and power, and dedication to social justice and equity. *Sample:* Individuals residing in British Columbia, Alberta, or Ontario, who identify as persons with disability (Accessibility Canada Act definition) living in poverty or are a caregiver for an individual with disability, can communicate independently with/without a translator/assistive device, will be eligible. This work involves knowledge co-creation with our community partner Disability Without Poverty (DWP). *Recruitment strategies include:* advertising on DWP's social media/email listserv with 4500 voluntary Canadian subscribers, and snowball and respondent-driven sampling when purposively sampling among Indigenous, gender minorities, and racialized groups. Up to 30 participants will be enrolled. For ethical engagement with Indigenous peoples, we will follow community-specific protocols and the

TCPS 2 guidance. *Data collection:* An interview protocol, adapting descriptive and transformative questions central to the IBPA Framework, will be developed collaboratively with DWP and a six-person Advisory Panel with lived expertise (including an Indigenous member from each of the three provinces). Interested participants will be screened to ensure diverse regional and population demographics. Trained study staff will conduct one 45-60 minute semi-structured, open-ended, recorded interview via Zoom. *Outcome:* The project will contribute to a much-needed evidence base, particularly related to intersectional oppression, helping ensure disability-related poverty is recognized as a structural versus individual impediment. *Data analysis:* We will use thematic analysis to report participants' experiences with disability poverty, recommendations to improve policy, and intersectional oppression. Two research team members will independently listen to/observe participants' interviews, anonymized and transcribed using NVivo. Data will be dual-coded, and using deductive and inductive strategies, codes will be sorted into categories, themes, and sub-themes and revised as necessary. Illustrative quotes will be extracted. DWP and advisory committee members will assist in interpreting study results. Trustworthiness will be ensured using credibility, dependability, transferability, and confirmability criteria.

Results: This novel work explores poverty among disabled people, including across three intersectional axes—gender minorities, Indigenous peoples, and racialized communities—and grounds policy recommendations in the lived experiences of those most affected. This research will take place from April 1, 2026-March 31, 2027. Key milestones include: ethics approval (April/2026); recruitment and data collection (May/2026-January/2027); data analysis (June/2026- PROTOCOLS February/2027); manuscript preparation (March2027-April/2027); knowledge mobilization activities (March 2027-onward).

Discussion: Approximately eight million Canadians live with disabilities, many facing financial barriers to chiropractic care. Our project will expand nationwide to better understand and address these challenges.

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Chiropractic for older adults with spinal conditions: A scoping review

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Background: Spinal conditions are common among older adults and often lead to disability and a reduced quality of life. Older adults make up approximately 16% of chiropractic patients, with spinal complaints being the predominant reason for their visits. A recent increase in chiropractic research activity in this area highlights the need for a comprehensive synthesis of the existing literature. The objective of this scoping review is to map the literature on chiropractic management for older adults with spinal conditions, identify research gaps, and inform healthcare policy.

Methods: This review follows established frameworks and adheres to the PRISMA-ScR reporting guidelines. We searched five electronic databases (OVID Medline, Embase, CINAHL, Index of Chiropractic Literature, and Cochrane Central Register) from their inception to July 2024. After a calibration exercise, two reviewers independently screened titles and abstracts, followed by full texts using Covidence, with a third reviewer resolving any conflicts. Inclusion criteria required that articles be published in peer-reviewed English language journals and feature observational or experimental study designs involving chiropractic management of spinal conditions in older adults (aged ≥ 55). Data were extracted into Microsoft Excel, capturing study design, population, interventions, and outcomes. Findings were synthesized numerically and thematically, using both predefined and emergent themes to map the breadth of the existing literature.

Results: We identified 3289 citations through database searches, screened 3009 titles and abstracts after deduplication, and assessed 106 full-text articles for eligibility. A total of 73 articles were included in this review. The studies, published between 1985 and 2024, were conducted in eight countries, with the majority coming from North America and Australia. We included nine randomized controlled trials (RCTs), nine qualitative and mixed-methods studies, and numerous cohort studies. Most articles focused either on neck or back pain, followed by lumbar spinal stenosis. We identified eight themes: (1) Pain management; (2) Disability prevention; (3) Patient safety; (4) Chiropractic utilization; (5) Access to chiropractic care; (6) Cost-effectiveness; (7) Patient experience; and (8) Characterization of older adult chiropractic patient populations and encounters. An important evidence gap was identified regarding degenerative spinal conditions, as only four studies addressed lumbar spinal stenosis, highlighting a lack of research on chiropractic care for other degenerative or arthritic spinal conditions.

Discussion: The existing literature on chiropractic care for older adults with spinal conditions is growing. Evidence suggests that chiropractic care for older adults with spinal conditions is frequently utilized and generally safe and effective for this population. Patients particularly find benefit from integrated, multimodal approaches to managing their spinal conditions.

Conclusions: Chiropractic care is a commonly used, safe, and effective intervention for older adults with spinal conditions. However, future research must address critical gaps in the evidence on chiropractic care for degenerative conditions and expand geographic diversity to better inform global healthcare policy and clinical practice.

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Alberta chiropractic SelfBack study: patient feedback

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Background: Low back pain (LBP) is an important source of health and economic burden in Canada. Clinical Practice Guidelines recommend exercise and patient education as frontline approaches to LBP. It is imperative to identify accessible, evidence-based methods to deliver such offerings. A potential example is SelfBack, an evidence-based artificial intelligence-driven application developed in Denmark that uses case-based reasoning to offer customized self-management recommendations for LBP patients. The objective of this study was to evaluate the feasibility of distributing the SelfBack app to patients with low back pain in Alberta.

Methods: This feasibility study used an observational design to evaluate the deployment and use of the SelfBack app by Alberta chiropractors and LBP patients. The study received ethics approval from the University of Alberta's Research Ethics Board (REB). All participating patients provided informed consent via REDCap. To be included in the study, patients had to have recurrent and/or persistent LBP for >1 month, be Albertan adults aged 18 or older, have a smartphone with internet access and a working email address, and be fluent in English. Study chiropractors identified and approached potentially eligible patients for study recruitment. Included patients downloaded the SelfBack app to their smartphone and completed an enrollment and onboarding process. Patients also completed questionnaires via REDCap at baseline and at 3- and 6-month follow-up. The data was analyzed using descriptive statistics.

Results: Of the 36 individuals who initiated the study, we included 12 participants who completed the follow-up questionnaire in the analysis. Three participants did not complete the consent process, and 21 did not complete the follow-up questionnaire. At the six-month follow-up, half of the participants (50%) agreed that the SelfBack app helped them manage their pain. Three-quarters of participants indicated that the SelfBack application was easy to use. Most participants (83.3%, n=10) agreed that most people would learn to use the system quickly and that the app's functions were useful (66.7%). Two-thirds of participants indicated confidence in using the app. Most participants (83.3%, n=10) disagreed that they would require technical support to use the app. Seven participants indicated they would use the app frequently. Four participants reported technical issues with accessibility or missing links, and one noted recurring technical failures. One user cited a lack of feedback mechanisms, while another felt the content did not specifically address their unique clinical issues. Three participants specifically highlighted difficulties with the exercise protocols, noting a lack of modifications for those who found the movements too challenging.

Discussion: This feasibility study demonstrated that the majority of included Alberta LBP patients found the SelfBack app easy to use and learn. Several participants found the app helpful for pain management. Future studies should further refine the deployment of the SelfBack app and assess its clinical effectiveness, particularly when compared with usual care or non-care seekers.

Conclusion: While the SelfBack app demonstrated usability for low back pain management in Alberta, the participant attrition and feedback regarding exercise modifications suggest that further refinement and larger clinical trials are necessary.

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Perimenopausal women with chronic low back pain and chronic neck pain and satisfaction with chiropractic care

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Background and objectives: *Perimenopause, typically occurring between the ages of 45 and 55 years of age, is a complex biological transition that is characterized in part by declines in muscle mass and bone density. Musculoskeletal (MSK) symptoms such as chronic low back pain (CLBP) and chronic neck pain (CNP) are common among women during the perimenopausal period and can be difficult to treat. It is therefore important to understand how patients in this phase of life experience their MSK-focused healthcare, including care delivered by chiropractic practitioners. To assess this, we used data from women with CLBP or CNP collected from US chiropractic clinics to describe pain conditions for which they sought care, and to evaluate care satisfaction.*

Methods: *We conducted secondary analysis using data from over 2000 patients from chiropractic practices in 6 states, collected in 2016-2017 for a study about the appropriateness of care for CLBP and CNP. Patients completed surveys at entry (baseline) and three months. We used demographic items assessing age and gender (collected at baseline), reported location of pain (CLBP, CNP or both), rating of pain in the past 6 months (scale of 1 to 10, at baseline), and patient's satisfaction with care (5-point Likert; 1="excellent" and 5="poor") at three months. Satisfaction scores were treated as a continuous variable. Pain location, pain rating and satisfaction scores were described and compared for women who were premenopausal (under age 40), perimenopausal (40-65) and postmenopausal (over age 65); we used logistic regression to evaluate differences in care satisfaction ($p < 0.05$).*

Results: *1,323 women completed both baseline and 3 month follow up data; 30% were premenopausal, 57% were perimenopausal and 13% were postmenopausal. Seventy percent of respondent experienced both CLBP and CNP. Having CNP only was more common for premenopausal aged women (15%) and perimenopausal aged women (15%) than for postmenopausal women. 24% of women postmenopausal experienced CLPB only compared to 14% and 13% of premenopausal and perimenopausal women, respectively. Pain intensity scales for women experiencing CNP was 3.1 and 3.3 for CLBP, with no statistical significances across the three age categories. At 3 months, most patients were satisfied with their care, and the differences were small in magnitude. However, premenopausal women were significantly less satisfied (average satisfaction score=1.65; possible range 1 to 5, lower score indicates greater satisfaction) with their care than perimenopausal women (average score=1.54); and perimenopausal women were less satisfied with their care than postmenopausal women (average score=1.47), although the difference did not reach statistical significance.*

Discussion: *We found a greater number of premenopausal women and perimenopausal women experience CNP only, whereas a greater number of postmenopausal experienced CLBP. We also observed significant differences in satisfaction across age groups. Chiropractic patients are generally satisfied with the care they receive; our findings also align with other research focused on other medical professions showing that older patients were more satisfied with their physicians.*

Conclusion: *These preliminary findings shed light on healthcare experiences of perimenopausal chiropractic patients, an understudied population. Moving forward we will apply additional approaches to modelling differences in satisfaction, including using odds of high satisfaction as a dependent variable and using multivariate models that control for potential confounders.*

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SDoH-aware AI system design strategies for musculoskeletal rehabilitation: a rapid scoping review

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Background: *Social determinants of health (SDoH) such as income, education, housing, language, social support, and geographic location strongly influence inequities in access to timely and appropriate musculoskeletal (MSK) rehabilitation services. The growing use of artificial intelligence (AI) in digital rehabilitation tools offers potential to improve personalization and reach; however, it remains unclear whether, and how, AI-based tools are designed to address the diverse social and contextual realities of individuals who could benefit from MSK rehabilitation. This gap matters because AI systems risk amplifying health inequities when SDoH are not integrated.*

Objective: *We aim to identify and map technological system-level design strategies used to explicitly address or integrate social determinants of health (SDoH) in AI-based musculoskeletal (MSK) rehabilitation tools.*

Methods: *We are conducting a rapid scoping review following Arksey & O'Malley's framework (refined by Levac), guided by the WHO, Cochrane, and JBI methodologies. Scoping reviews are appropriate for synthesizing literature on emerging complex topics such as AI-driven tools by allowing for efficient descriptions of evidence, charting key concepts, and identifying knowledge gaps.*

We searched MEDLINE, Web of Science, and CINAHL for studies published in 2015 onward, reflecting Healthcare 4.0 (the integration of digital tools into healthcare). A descriptive qualitative analysis will explore how AI-based rehabilitation tools incorporate SDoH. SDOH domains will be organized with the PROGRESS-Plus framework to facilitate categorization across studies. Findings will be mapped by SDoH domain, linking system design strategies (model, logic, user interface) to each domain.

Anticipated findings and timeline: *A narrative synthesis will draw our findings together to show how AI-based MSK rehabilitation tools embed SDoH within their design, identify determinants that are under-represented, and highlight opportunities to advance equity-oriented approaches in musculoskeletal rehabilitation. This rapid scoping review will be completed over approximately 12-16 weeks including screening, data extraction and synthesis. The results of our review will directly inform the design and development of an AI-enabled MSK rehabilitation system under the Rinaldi Research Chair in AI and Rehabilitation. Knowledge translation outputs will be tailored for developers, rehabilitation professionals, policy makers, and academic researchers. Insights from our review may further inform future AI systems that are responsive to the social and contextual realities of diverse patient populations. This rapid scoping review will identify and describe AI system design strategies that adapt to diverse social determinants of health among individuals who could benefit from MSK rehabilitation. By focusing on how AI models, logic, and user interfaces integrate or respond to social determinants of health, our review will support the development of equitable and adaptive digital rehabilitation technologies.*

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Effectiveness of Self Help interventions to reduce work disability: a rapid mixed methods systematic review

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Background: Work-disability is a significant global issue, driven largely by common musculoskeletal and mental health conditions (e.g. back and neck pain, anxiety and depression). These conditions contribute to functional limitations, reduced work or life participation, and reduced quality of life. Self-help interventions are increasingly used to promote autonomy, coping, and access to care, and may offer scalable, cost-effective options for reducing healthcare system burden. However, their effectiveness in occupational contexts remains unclear.

Objective: We aimed to: (1) assess self-help interventions for reducing work-disability and improving health-and workoutcomes in musculoskeletal conditions; (2) ex-

plore related worker experiences; and (3) inform hypotheses about mechanisms of intervention effectiveness.

Methods: Following WHO and Cochrane guidance, we conducted a rapid mixed-methods systematic review, and reported per the PRISMA statement and SWiM guideline. Lived-experience partners provided foundational leadership throughout the project, offering a unique perspective that guided decision making. They led review design and co-interpretation of results, strengthening real-world relevance. We searched MEDLINE, PsycINFO, CINAHL, Cochrane CENTRAL, and the Indigenous Studies Portal. Eligible studies included working-age adults with musculoskeletal, anxiety, and or depressive conditions affecting work/function, and self-directed interventions requiring minimal guidance. Risk of bias was assessed using RoB2, ROBINS-I, CASP and MMAT. Findings were synthesized narratively by conditions, intervention type and outcome domain, using qualitative experiences to contextualize results.

Results: Cognitive behavior therapy reduced short term sick leave for anxiety and depression but showed no clinically important differences for acute non-specific low back pain. Exercise or stretching improved disability and physical quality of life for chronic low back pain, while no clinically meaningful effects were found for education in acute LBP or relaxation for chronic neck pain. Qualitative findings suggested that effectiveness may be influenced by external factors including workplace environment, motivation and support. The mixed-methods integration of the results suggests that the impact of self-help interventions on work participation are possibly shaped by both the nature of the intervention and the context in which it is implemented.

Discussion: This review focused on self-help interventions for musculoskeletal and mental health conditions

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using quantitative and qualitative evidence. Our findings suggest that while self-help interventions are feasible, their effectiveness in reducing work disability remains uncertain. Our mixed methods lens suggests self-help may enhance self-management, coping, and physical functioning in the short term. Our lived-experience partners strengthen the interpretation that workplace participation may not be improved by self-help without workplace or system-level supports that enable ongoing practice and integration into everyday work routines.

Conclusion: Recognizing the limits of current evidence, our findings suggest that self-help interventions

may be more effective when embedded within supportive work environments that encourage self-management. Developed with our advisory group, and aligned with knowledge translation principles, we produced a series of worker-centered key messages on how to improve self-help interventions to reduce work disability that are highly relevant for chiropractors, other health systems actors, researchers, policy makers. Our work highlights the need for system-level supports and future research that prioritizes co-designed, context sensitive research.

Comparative analysis of incident reporting systems in chiropractic care for older adults

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Background: Safety incident reporting systems are essential tools for collecting and analyzing public health data to improve patient safety in ambulatory care. Within chiropractic, two distinct models exist: passive systems like the Chiropractic Patient Incident Reporting and Learning System (CPiRLS), which rely on voluntary provider reports, and active systems like SafetyNET, which utilize systematic, patient-driven data collection. While active systems often yield more accurate incidence proportions, they are resource-intensive compared to more sustainable passive models. The objective of this study is to compare these two systems at a systems level and analyze safety incident (SI) reports specifically in patients aged 65 and older.

Methods: This study employs a qualitative comparative design involving secondary analysis of de-identified data. The structural and functional dimensions of CPiRLS and SafetyNET will be evaluated using the WHO Patient Safety Incident Reporting System: A Self-Assessment framework. This involves mapping system data against six core

categories: reporting environment, rules/content, analysis/investigation, governance, action/ learning, and patient engagement. For clinical analysis, a case sample of incident reports involving patients ≥ 65 years ($n=88$ from CPiRLS; $n=80$ from SafetyNET) will be extracted using a standardized, pilot-tested protocol. Descriptive statistics will be used to compare patient characteristics, incident patterns, and clinical case mixes across both systems.

Results: The study is currently in the data extraction phase, with an anticipated completion date of May 2025. It is anticipated that the evaluation will compare both systems to the WHO Patient Safety Incident Reporting System framework to identify specific structural strengths and limitations. Descriptive statistics will be used to summarize and compare patient characteristics and safety incident characteristics within the older adult population. Furthermore, the analysis will identify and report on similarities and differences in clinical case mix and safety incident patterns across the two systems.

Discussion: Systematically comparing the processes and outputs of active and passive reporting systems helps delineate the best applicability for each model. These findings are expected to inform the development of best practices and standardized protocols for practitioners and policymakers. By shifting focus toward optimized reporting infrastructure, the study aims to advance patient safety and enhance the understanding of chiropractic care outcomes for older adults.

Conclusions: This study will provide a foundational comparison of chiropractic-specific incident reporting systems. The results will highlight how different system designs influence data quality and clinical learning, ultimately contributing to a more robust safety culture within the profession.

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Advancing patient safety in chiropractic: implementation of a passive reporting system in Alberta using the RE-AIM framework

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Background: *Improving patient safety is a priority across health professions, yet the chiropractic profession in Canada currently lacks a national or provincial incident reporting and learning system. This infrastructure gap limits the ability to systematically identify safety concerns, share lessons learned, and cultivate a robust safety culture. The Chiropractic Patient Incident Reporting and Learning System (CPiRLS), a passive reporting platform originally developed in the United Kingdom, offers a solution for capturing safety incidents and near misses. The primary purpose of this study is to evaluate the initial implementation of CPiRLS among chiropractors in Alberta. The objective is to understand the system's real-world applicability, identify factors influencing uptake, and assess its potential to contribute to a sustainable patient safety culture.*

Methods: *This study employs an explanatory sequential mixed-methods design using the RE-AIM framework (Reach, Effectiveness, Adoption, Implementation, Maintenance) to assess the rollout of CPiRLS over a 24-month period. The target population includes all 1,170 licensed chiropractors in Alberta. Phase 1 (Quantitative) involves a baseline safety culture survey, followed by a targeted educational program and a 12-month data collection period using the CPiRLS platform. A post-implementation survey will assess changes in safety culture and system utility. Phase 2 (Qualitative) utilizes semi-structured interviews with approximately 20-30 participants, sam-*

pled based on their level of system engagement ("strong" vs. "weak/non-implementers"). Inductive thematic analysis will be used to explain quantitative findings and identify contextual barriers and enablers to implementation.

Results: *As this is a proposed study scheduled for the 2025-2027 cycle, findings are anticipated. It is hypothesized that the evaluation will identify specific modifications necessary to establish a sustainable patient safety reporting system. While challenges typical of passive surveillance systems, such as underreporting, are expected, the study anticipates generating actionable insights regarding clinician engagement. Reach will be reported through participation rates, and Effectiveness will be measured by the quality and completeness of incident reports compared to existing benchmarks. Adoption will be reported by tracking the proportion and characteristics of practitioners using the system, and Implementation will be assessed by examining the fidelity of system use and any user adaptations.*

Discussion: *This project represents Canada's first chiropractic-specific incident reporting and learning system. By shifting from individual blame to systemic learning, this initiative addresses a critical gap in Canadian chiropractic care. The use of the RE-AIM framework ensures a comprehensive evaluation of how CPiRLS works in a Canadian setting, rather than just if it works. The findings will support the development of evidence-based safety strategies and provide a scalable model for potential national adoption, directly advancing quality assurance and professional accountability.*

Conclusion: *This study will establish foundational patient safety infrastructure for chiropractic care in Alberta. By evaluating the implementation of CPiRLS, this project aims to foster a lasting safety culture and provide a roadmap for expanding reporting systems to other jurisdictions.*

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