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Reconciling evidence and experience in the context of evidence-based practice

Stephanie Alexopulos, DC[1,2]
Carol Cancelliere, DC, PhD[3,4]
Pierre Côté, DC, PhD[3,4]
Silvano Mior, DC, PhD[1,4]

Reconciling evidence and experience in the context of evidence-based practice

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KEY WORDS: EBM, EBP, evidence-based medicine, evidence-based practice, Expert Evidence, Research Evidence, chiropractic

Rapprochement des données probantes et de l'expérience en contexte de pratique fondée sur des données probantes

(JCCA. 2021;65(2):132-136)

MOTS CLÉS : médecine fondée sur des données probantes, pratique fondée sur des données probantes, témoignages d'experts, résultats de recherche, chiropratique

In this commentary, we discuss what is meant by evidence-based practice, how we can reconcile our clinical experience with research evidence, and how we can integrate patient preference and circumstance in our clinical decisions. We do so by answering a series of questions commonly asked by clinicians and present examples, in an effort to clarify key principles of evidence-based practice.

Briefly, how can one describe evidence-based medicine (EBM), or more broadly, practice (EBP)?

EBP is all about doing what is best for the patient. The concept of EBM dates before the mid 19th century in Paris[1], and is not unique to any one health care profession[2]. It was Sackett *et al*.'s commentary in 1996 that formalized its definition as, *"The conscientious, explicit, and judicious use of current best evidence in making decisions about the care of the individual patient."*[1] They explained that best evidence is based on clinically relevant research from basic sciences, but particularly from patient-centered, empirical clinical research that validates diagnostic tests and identifies safe and effective treatments. They recognized the role of clinicians' experience, which is acquired over time with increasing clinical practice, and en-

[1] Canadian Memorial Chiropractic College
[2] Institute for Health Policy, Management and Evaluation, University of Toronto
[3] Faculty of Health Sciences, Ontario Tech University
[4] Institute for Disability and Rehabilitation Research, Ontario Tech University and CMCC

Corresponding author: Stephanie Alexopulos, Canadian Memorial Chiropractic College, 6100 Leslie St., Toronto, Ontario. M2H 3J1.
e-mail: salexopulos@cmcc.ca

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hanced with the awareness of individual patient's context and preferences.

How are the varying conditions and personal circumstances unique to patients considered in EBM?

Sackett *et al*.[1] noted that the concept of EBM is dynamic and should change with advancing new knowledge. In 2002, Haynes *et al*.[3] introduced a fourth component that captures the uniqueness of the patient's clinical state and circumstances, and advanced the original model to one that is more prescriptive. The revised model recognizes that depending on the purpose of the patient seeking care, clinical decisions vary.[4] For example, someone seeking a diagnosis is managed differently than one seeking care; or someone seeking to return to work is managed differently than one seeking to complete a marathon. So, the clinician needs to integrate each of the components to optimize patient care.

In clinical practice, we have found that some patients have a particular preference for a treatment that research evidence may suggest is ineffective, or want a diagnostic test, for example an x-ray or MRI, when it's unlikely to be of benefit and may be more harmful. How do we manage such preferences?

This is a very good and challenging question. As clinicians, regardless of what field of health care we practice, ethical obligations must be upheld, including, first and foremost, to do no harm. What is often forgotten is that harm is not always physical harm to a patient. For example, neglecting to disclose information or doing what a patient wants despite evidence to the contrary can lead to unforeseen harm. Managing patient expectations is crucial as it can impact their recovery, outcomes, and overall well-being.[5,6] Thus, engaging the patient, as described in the ShaDES framework below, may assist in an honest and open conversation of their preferences.

The model captures clinical experience and patient perspectives but how is "best available research evidence" interpreted?

First, our patients and the public have a right to know "what works." We learn about what works through data collected *systematically* and *transparently – evidence* (research and clinical). Let's differentiate between these two types of evidence:

a. *Research evidence:* Evidence acquired through basic science is *theoretical* (e.g., physiological, biological). Evidence we acquire through experimentation [e.g., randomized controlled trials (RCTs)] is *empirical;* studies conducted under ideal conditions assess efficacy, while effectiveness studies are conducted under real life conditions. Efficacy does not imply effectiveness, and this distinction is often forgotten.[7] Theoretical evidence must be supplemented by empirical evidence. In other words, a treatment may have a particular response in the lab, but this response needs to be confirmed in larger clinical trials that test whether the intervention improves patients' clinical outcomes.

For example, the effects of spinal manipulative therapy (SMT) have been reported in laboratory studies to affect the viscero-somatic responses in both animals and humans.[8-10] Case studies have reported possible positive effects on heart rate and blood pressure after SMT, supporting a potential influence on the autonomic nervous system.[11] For a condition like hypertension, a high-quality randomized effectiveness pilot trial found that SMT does not have an effect on modulating blood pressure, thus questioning SMT's potential influence on the autonomic nervous system.[12,13]

b. *Clinical evidence* (from clinicians and patients): Clinical evidence is not a substitute for research evidence. Clinical evidence can be used to 1) help select among evidence-based treatment options for patients, and 2) generate hypotheses when research evidence is unavailable. It should be collected using systematic, transparent, and unbiased methods. For example, a clinician might say: *"I treated 30 patients with spinal manipulation alone for persistent cervicogenic headache and all of them reported clinically important improvement on the visual analogue scale."* That is evidence that can be used to generate hypotheses about the possible effect of SMT; however, it cannot be used to infer that SMT benefits patients. Reaching a trustworthy and reliable conclusion can be difficult without scientific evidence. It is not the same as saying, *"in my experience, spinal manipulation alone is effective for persistent cervicogenic headache."* That is opinion.

While clinical evidence may suggest that a patient is improving with one's care, these observations do not allow one to make inferences about the cause of the improvement. Improvement could be attributed in part, to natural history and other contextual factors associated with the

clinical encounter (e.g., reassurance, education, being listened to, or positive expectations of improvement related to the treatment). For example, spinal manipulation is an effective intervention in managing patients presenting with neck pain.[14] However, there is limited research directing practitioners how they should perform SMT, the dosage and duration of care. This is when the clinician's clinical experience and judgement is used to modulate the force, speed, direction, patient position, practitioner's body and hand position. Although the practitioner's clinical experience and judgment qualities are fundamental principles of EBP, it should be in context with the other elements.

So, we have research evidence and clinical evidence. Is one more informative than the other?

Research evidence is not the same as clinical evidence. There is a hierarchy of research evidence which is often depicted as a pyramid. Some types of evidence are considered better than others and are thus placed at the top of the pyramid. This top tier of evidence includes rigorous meta-analysis and systematic reviews, followed closely with high quality randomized controlled trials. These types of studies are placed at the top because their methods limit the risk(s) of bias, allowing us to be more confident in their conclusions.[15] As we move down the pyramid, the level of confidence in the results decreases because there is more room for error or biases. These errors and biases limit the inferences that can be made about the effectiveness of a treatment. Finally, clinical evidence should not supersede research evidence. Research evidence and clinical evidence are complementary to one another. As illustrated in the above example, available research evidence should guide the clinician on appropriate patient management and lend openness to interpretation, so that practitioners can modify how they uniquely manage patients without disregarding evidence.

As a clinician, my instinct is still to rely on my clinical experience. How does clinician experience differ from research or clinical evidence?

Clinician experience is important. However, clinician experience alone may lead to invalid clinical decisions because it relies on memory, which is not perfect and tends to selectively remember facts.[15,16] Second, experience does not control for contextual or other factors that can impact patients' outcomes. Without a control group, we are apt to see these improvements as successes, and incorrectly infer benefit from the intervention, in which ineffectual, or even potentially harmful practices propagate. Third, many of the conditions treated by chiropractors are self-resolving, giving the false impression that we helped a patient when in fact we may have not. Even conditions that are not self-resolving tend to wax and wane. Patients tend to seek care when they feel their worst, so by simple regression to the mean, they are likely to improve after we see them. Fourth, we may have different experiences and opinions. How do we judge whose experience or opinion matters? And even consensus of opinions does not automatically make them correct. Instead, we should use experience to fine-tune evidence-based answers, not to dismiss evidence altogether.

Since clinicians provide a service, how can they deny a patient what they want (deny them care if they are seeking it)?

This is where things usually become grey for most clinicians. One approach to answering this question is to discuss informed consent, shared decision making, and code of ethics. Informed consent respects patient autonomy and is an essential prerequisite in clinical practice.[17] We know informed consent is required from all patients after they have been provided with all necessary and relevant information. But the clinician is responsible to disclose such information to the patient in a way they understand and accept the risks and benefits of the proposed care. A shared decision-making process should be established between the clinician and patient with the best interest of the patient in mind.[18] The onus is on the clinician to engage patients in the decision-making process, balancing equally all components of EBP (i.e., research evidence, patience preference, clinical experience, and context). Finally, we have an ethical responsibility as clinicians to appropriately inform, provide, or refer out for best evidence treatments to patients and first, to do no harm. Providing care or diagnostic procedures shown to be ineffective or have greater risk than benefit is inappropriate and unethical. So, it is important to explain the benefits and limitations of the available evidence and avoid misleading patients.

Providing evidence-based patient-centered care can improve patient outcomes[19] and potentially decrease healthcare costs[20]. For example, compared to usual care,

evidence-based care (informed by practice guidelines) is cost-effective for the management of acute LBP.[21] As a clinician, evidence-based practice makes sense; but to implement it into daily practice is not always easy. Some feel it is too prescriptive, thus not allowing them to use their clinical experience. But by focusing on *"putting the patient needs first"*, the attention can be directed at educating patients, motivating them to shift their behaviors, and changing their expectations. Clinicians should continuously challenge their clinical observations by staying current on emerging best evidence to deliver evidence-based patient-centered care to their patients.

So, how can clinicians engage the patient in this decision-making process?

Engaging patients in the decision-making process can be challenging. In general, it involves two approaches, clinician-driven (paternalistic), in which the clinician directs the decision with little input from the patient, or a shared approach, wherein the clinician and patient come to a mutual decision of what next to do. In the latter approach, applying a practical framework like 'Shared Decision Evidence Summary (ShaDES) may facilitate clinical decisions.[22] Being guided by the ShaDES framework provides a step-by-step process that can assist the clinician in their decisions without neglecting important patient specific contextual factors.[22] The ShaDES framework is grounded in critically appraising a clinical scenario and developing and answering a clinical question using the best available evidence. This includes 4 steps. The clinician: 1) builds the clinical and psychological scenario that informs the plan of management and considers patient preferences; 2) uses this information to inform their literature search to retrieve and then critically appraise the related evidence; 3) synthesizes the evidence to assist in decision making; and 4) enters into shared decision making wherein the patient expresses their preference of the options provided.[22] The ShaDES framework encourages clinicians to consider the clinical and psychosocial issues that can impact a patient-clinician interaction, which in turn may improve a clinician's ability to utilize all available information to guide their management.

If the patient is still uncertain about the various treatment options, they can feel overwhelmed. In this case the clinician could consider helping or nudging the patient to a particular decision based on their understanding of the patient's context (i.e., preferences and situation). However, in the event of limited available evidence, there can also be uncertainty from the clinician's perspective of whether they can help the patient. In this case, it may be best to consult with a colleague or refer the patient for a second opinion.

How to stay up to date with emerging evidence as a practicing chiropractor.

It is challenging for practicing chiropractors to stay up to date with constantly emerging literature and to differentiate good from poor quality studies. This is why busy clinicians should focus their attention on reviewing high-quality systematic reviews and clinical practice guidelines. One option is to regularly review the work of the Canadian Chiropractic Guideline Initiative (CCGI)[23] which provides an up to date and open access to numerous evidence-based tools (such as articles, clinician summaries, patient handouts, videos, and forms) to assist clinicians with the diagnosis and management of patients.[23] We recommend Cochrane as an additional resource as it is an international network, not-for-profit organization that provides high-quality information about health decisions to be made.[24] They gather and summarize the best evidence from research within their Cochrane library, to help clinicians make an informed decision.[24] Other resources include Choosing Wisely Canada, which is a campaign to help clinicians and patients engage in conversations about unnecessary tests, treatments and procedures.[25] For clinicians, the British Medical Journal has created a 'best practices' tool providing clinical decision support for health professionals.[26] Another resource targeted to patients, but can be used by clinicians, are patient decision aids created by the Ottawa Hospital Research Institute (OHRI) that provide information about treatment options and outcomes to guide patients in the shared decision making process.[27]

In closing, the purpose of our commentary is to help guide clinicians on evidence-based practice and how that applies to their patient management. By understanding differences in terms such as evidence-based medicine, research evidence versus clinical evidence, and clinical experience, we hope we have clarified how clinicians can use these aspects in their day-to-day practice. Finally, the suggestions we have made about various resources should

be sought out by clinicians to keep them up to date with the evidence.

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The chiropractor's role in primary, secondary, and tertiary prevention of suicide: a clinical guide

Zachary A. Cupler, DC, MS[1]
Clinton J. Daniels, DC, MS[2]
Derek R. Anderson, PhD[2]
Michael T. Anderson, DC, MS[1]
Jason G. Napuli, DC, MBA[3]
Megan E. Tritt, MSW, LCSW[1]

Objective: *To provide the practicing chiropractor foundational knowledge to enhance the understanding of relevant primary, secondary, and tertiary public health measures for suicide prevention.*

Methods: *A descriptive literature review was performed using keywords low back pain, neck pain, psychosocial, pain, public health, suicide, suicide risk factors, and suicide prevention. English language articles pertaining to suicide prevention and the chiropractic profession were retrieved and evaluated for relevance. Additional documents from the Centers*

Rôle du chiropraticien dans la prévention primaire, secondaire et tertiaire du suicide : guide clinique

Objectif : *Donner aux chiropraticiens en exercice les connaissances de base nécessaires pour leur permettre de mieux saisir les mesures de santé publique primaires, secondaires et tertiaires servant à prévenir le suicide.*

Méthodologie : *On a fait une revue descriptive de la littérature à l'aide des mots-clés suivants : lombalgie, cervicalgie, psychosocial, douleur, santé publique, suicide, facteurs de risque de suicide et prévention du suicide. On a évalué la pertinence des articles en anglais portant sur la prévention du suicide et la profession de chiropraticien. On a examiné d'autres documents*

[1] Butler VA Health Care System, Butler, PA, USA
[2] VA Puget Sound Health Care System, Tacoma, WA, USA
[3] St. Louis VA Health Care System, St. Louis, MO, USA

Corresponding author: Zachary A. Cupler, Butler VA Health Care System
e-mail: zachary.cupler@va.gov

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Abbreviations

Acceptance Commitment Therapy – ACT
Centers for Disease Control and Prevention – CDC
Cognitive Behavioral Therapy – CBT
Columbia-Suicide Severity Rating Scale – C-SSRS
Dialectical Behavioral Therapy – DBT
Mindfulness-Based Stress Reduction – MBSR
Motivational Interviewing – MI
Post-traumatic stress disorder – PTSD
Social determinants of health – SDOH
Veterans Health Administration – VHA
World Health Organization – WHO

for Disease Control, Veterans Health Administration, and the World Health Organization were reviewed. Key literature from the clinical social work and clinical psychology fields were provided by authorship team subject matter experts.

Conclusion: *No articles reported a position statement regarding suicide prevention specific to the chiropractic profession. Risk, modifiable, and protective factors associated with self-directed violence are important clinical considerations. A proactive approach to managing patients at-risk includes developing interprofessional and collaborative relationships with mental health care professionals.*

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KEY WORDS: suicide prevention, chiropractic, public health, biopsychosocial, primary prevention, secondary prevention, tertiary prevention

provenant de Centers for Disease Control, de la Veterans Health Administration et de l'Organisation mondiale de la santé. Des experts en la matière, membres du comité de rédaction, ont fourni des articles importants sur le travail social clinique et la psychologie clinique.

Conclusion : *Aucun article ne renferme d'énoncé de principe sur la prévention du suicide issu de professionnels de la chiropratique. Les facteurs de risque, les facteurs modifiables et les facteurs de protection associés à l'automutilation sont des aspects importants à examiner. La prise en charge des patients vulnérables d'une manière proactive consiste entre autres à établir et à entretenir des liens de collaboration avec les professionnels de la santé mentale.*

(JCCA. 2021;65(2):137-155)

MOTS CLÉS : prévention du suicide, chiropratique, santé publique, biopsychosocial, prévention primaire, prévention secondaire, prévention tertiaire

Introduction

"Knowing is not enough; we must apply. Willing is not enough; we must do." – Goethe

Chiropractors primarily manage spine-related disorders and other various musculoskeletal complaints.[1,2] Chronic pain is a frequent chief complaint which has associations to suicidal self-directed violence.[3–5] Concerningly, suicide is a major global health predicament and an important cause of mortality and morbidity with nearly 800,000 deaths annually.[6,7] Self-directed violence accounts for 1.4% of all deaths worldwide and was the eighteenth leading cause of death in 2016[8], while in Canada, the suicide rate declined by 24% from 1981 to 2007 and has remained stable through 2017[9]. Worldwide, males have been found to complete suicide three times more often than females, while females far exceed males in the number of attempts of suicidal self-directed violence.[10] Apart from a small survey[11] assessing chiropractic interns and doctors of chiropractic near Toronto on their knowledge of a suicide lethality scale and patient management questionnaire and a recent call to action[12], there is no literature describing suicide prevention efforts specific to the chiropractic profession.

Suicide preparatory behavior and suicidal self-directed violence has been conceptualized as a continuum[13] and is a stigmatized issue for many people including health care professionals[14]. Similar to pharmacists[15], occupational therapists[16], and audiologists[14], chiropractors should consider their broader role in the health care delivery system with relation to suicide prevention. The chiropractor's didactic education and clinical training includes considerations of the biopsychosocial components of health.[17] This suggests chiropractors may play a role in identifying behavioral health risk factors and coordinating appropriate referrals to other members of the health care team.[18]

Foundational suicide prevention knowledge for the chiropractor includes understanding myths and appropriate terminology (Table 1). Historically, there have been inconsistencies in the terminology used to communicate about suicide, suicide attempts, and self-directed violence in the peer-reviewed literature and in public messaging.[19] Terms such as 'parasuicide' and 'suicide survivor' were used regularly in the literature but have since been deemed unacceptable terms.[19,20] The National Center for Injury Prevention and Control, Division of Violence Prevention, part of the Centers for Disease Control (CDC), has estab-

lished uniform nomenclature to improve communication between clinicians and researchers (Table 2).[20] There are also several myths and stereotypes that may hinder successful suicide prevention efforts (Table 3).[21–25] By recognizing the existence of personal bias and stigmatizing attitudes, chiropractors have the opportunity to improve communication with communities and patients at risk of suicide-related behaviors.

The purpose of this descriptive review is to provide the practicing chiropractor foundational knowledge to enhance the understanding of primary, secondary, and tertiary suicide prevention. Organized by public health

Table 1.
Uniform definitions for self-directed violence and suicide[20]

Self-directed violence	Behavior that is self-directed and deliberately results in injury or the potential for injury to oneself. *(This does not include risk-taking activities such as parachuting, gambling, excessive speeding in a motor vehicle, or substance abuse.)*
Suicidal self-directed violence	Behavior that is self-directed and deliberately results in injury or the potential injury to oneself. There is evidence, whether implicit or explicit, of suicidal intent.
Suicide attempt	A non-fatal self-directed potentially injurious behavior with any intent to die as a result of the behavior and may or may not result in injury.
Interrupted self-directed violence – by self	A person takes steps to injure self but is stopped by self prior to fatal injury
Interrupted self-directed violence – by other	A person takes steps to injure self but is stopped by another person prior to fatal injury. The interruption can occur at any point during the act such as after the initial though or after the onset of behavior
Preparatory acts	Acts of preparation towards making a suicide attempt, but before the potential for harm has begun. This can include anything beyond a verbalization or thought, such as assembling a method or preparing for one's death by suicide.
Suicide	Death caused by self-directed injurious behavior with any intent to die as a result of the behavior

Table 2.
Unacceptable self-directed violence terms and recommended acceptable terms[20]

Completed suicide	Implies achieving the desired outcome whereas those involved in the mission of "reducing disease, premature death, and discomfort and disability" would view this event as undesirable. *Recommended Term: suicide*
Failed attempt	Negative impression of the person's action, implying an unsuccessful effort aimed at achieving death *Recommended Term: suicide attempt or suicidal self-directed violence*
Nonfatal suicide	"Suicide" includes a death while "nonfatal" indicates no death occurred *Recommended Term: suicide attempt*
Parasuicide	Formally, used to refer to a person's self-directed violence whether or not the individual had an intent to die *Recommended Term: non-suicidal or suicidal self-directed violence*
Successful suicide	Implies achieving a desired outcome whereas those involved in the mission of "reducing disease, premature death, and discomfort and disability" would view this event as undesirable *Recommended Term: suicide*
Suicidality	Often used to refer simultaneously to suicidal thoughts and suicidal behavior. These phenomena are vastly different in occurrence, associated factors, consequences, and interventions so they should be addressed separately. *Recommended Term: suicidal thoughts and suicidal behavior*
Suicide gesture, manipulative act, suicide threat	Each of these terms gives value judgment with a pejorative or negative impression of the person's intent. They are usually used to describe an episode of nonfatal, self-directed violence. *Recommended Term: non-suicidal or suicidal self-directed violence*

prevention level, this paper aims to provide the chiropractic profession with a unified resource for the following: 1) factors associated with suicide self-directed violence relevant to common conditions seen in the chiropractic office, 2) how to communicate with the patient about self-directed violence and suicide intentions, 3) how to identify a patient at risk for suicidal self-directed violence through an evidence-based assessment, and 4) considerations for interprofessional collaboration and referral.

Methods

We performed a descriptive review using PubMed. We searched from index inception through April 2021. Search terms included *low back pain, neck pain, chiropractic, psychosocial, pain, public health, suicide, suicide risk factors,* and *suicide prevention*. Additional relevant texts and documents from the CDC, Veterans Health Administration (VA), and the World Health Organization (WHO) were also reviewed. Pertinent articles from the author's libraries were included. Key literature from the clinical social work and clinical psychology fields were provided by authorship team subject matter experts (D.A., M.T.).

Inclusion criteria

Articles describing suicide prevention in terms of primary, secondary, or tertiary measures were included when they were applicable and relevant to ambulatory health care environments. Clinical studies describing clinical screening, risk factor identification, protective factor identification, or referral for management of suicide risk

Table 3.
Common myths associated with suicide*[22]

Myth	Fact
Suicide only affects individuals with a mental health condition	Many individuals with mental illness are not affected by suicidal thoughts and not all people who attempt or die by suicide have mental illness. Relationship problems and other life stressors such as criminal/legal matters, persecution, eviction/loss of home, death of a loved one, a devastating or debilitating illness, trauma, sexual abuse, rejection, and recent or impending crises are also associated with suicidal thoughts and attempts.
Once an individual is suicidal, he or she will always remain suicidal	Active suicidal ideation is often short-term and situation-specific. Those with mental illness, the proper treatment can help to reduce symptoms. The act of suicide is often an attempt to control deep, painful emotions and thoughts an individual is experiencing. While suicidal thoughts may return, they are not permanent and an individual with previously suicidal thoughts and attempts can go on to live a long life.
Most suicides happen suddenly without warning	Warning signs, verbal and/or behavioral, precede most suicides.
People who die by suicide are selfish, cowardly, or just looking for attention, and take the easy way out.	Typically, people do not die by suicide because they do not want to live—people die by suicide because they want to end their suffering. Individuals who experience suicidal ideations do not do so by choice. They are not simply, "thinking of themselves," but rather they are going through a very serious mental health symptom, often associated with at least one mental health condition, or a difficult life situation.
Talking about suicide will lead to and encourage suicide.	There is a widespread stigma associated with suicide and as a result, many people are afraid to speak about it. Talking about suicide not only reduces the stigma, but also allows individuals to seek help, rethink their opinions, and share their story with others.
Someone who is suicidal is determined to die	Suicidal people are often ambivalent about living or dying. People are often looking for a way to stop their emotional and physical pain.
People who talk about suicide do not mean to do it.	People who talk about suicide may be reaching out for help or support. A significant number of people contemplating suicide are experiencing anxiety, depression, and hopelessness and may feel that there is no other option.
Someone making suicidal threats won't really do it	Those who talk about committing suicide or express thoughts about wanting to die are at risk and need attention
Asking a person if he/she is thinking about suicide will put the thought in his/her head and prompt to try it	If you know a person is depressed or in crisis, asking if they are thinking about suicide is actually helpful, giving them a chance to talk, which can be the first step toward finding help and solutions.
Medications and therapy are of little help	Treatment can work, whether it comes in the form of therapy, medication, or in combination

*Although, the nuances of specific societal and cultural variations surrounding suicide perception preclude us from addressing all myths for the purposes of this paper.

were considered relevant. The search was limited to English language articles only.

Exclusion criteria

Articles were excluded if they pertained to inpatient, acute care settings, and were not directly related to ambulatory health care environments. Due to the practice scope of a majority of chiropractors[2], studies focused on pharmacologic intervention for the management of risk factors (e.g., depression) were beyond the focus of this project and were excluded.

Results

No articles reported a position statement regarding suicide prevention and management specific to the chiropractic profession. We identified 93 articles relevant to the implementation of public health approaches, suicide prevention, risk factor screening, or crisis management strategies for musculoskeletal providers.

Discussion

Suicide is more than a mental health problem. It is a public health crisis that can, and must, be prevented by all health care providers. Chiropractors have previously demonstrated interest in public health efforts in the areas of physical activity promotion[26], smoking cessation[27], and most recently the COVID19 pandemic[28]. Making suicide prevention a priority in one's community and professional practice means considering the chiropractor's role at the primary, secondary, and tertiary prevention levels.

Risk, modifiable, and protective factors associated with self-directed violence and spinal pain

Similar to low back pain, suicide and self-directed violence are associated with numerous psychiatric comorbidities, social, and occupational circumstances; thus the need to consider the entire person through the context of biopsychosocial framework.[17,29,30] Spinal disorders, chronic pain[31], and self-directed violence appear to overlap for several comorbid conditions such as depression[29,32], pain catastrophizing[33], and post-traumatic stress disorder (PTSD)[34]. The chiropractor should be cognizant that risk factor associations do not equate to absolute risk and correlation for suicidal self-directed violence. For suicide factors, there are several key definitions to consider:

1) Risk factors are characteristics or conditions of the patient that have been found to have a statistical relationship to the presence of self-directed violence[22,35];
2) Dynamic or modifiable factors are characteristics or conditions of the patient that have been found to have a statistical relationship to the presence of self-directed violence and can be targeted for treatment or intervention (e.g., medication for depression, new employment)[36];
3) Protective factors are characteristics or conditions of the patient that have been found to have a statistical relationship to the absence of self-directed violence[22,35].

The literature suggests chiropractors have the potential to impact modifiable factors for self-directed violence related to opioid use.[37–40] Non-pharmacological care for chronic pain, including chiropractic services, has been found to reduce the likelihood of suicide risk factors and potentially play a protective role for self-directed violence in active military members who transitioned care to VA.[41] Chiropractors should also be concerned with risk factors that may present alongside of a spinal pain complaint. Depression has been identified during consensus statements for the chiropractic profession and interprofessional panels as a key clinical condition to routinely screen for, in particular with older adults.[42,43] Meanwhile, PTSD has also been evaluated as a co-occurring condition in the chiropractic office and appears to have a negative correlation with outcomes from care for neck or back pain.[34,44–46] Finally, poor coping strategies may play an important role in both low back pain chronicity and suicidal ideation.[47,48]

Primary suicide prevention: social determinants of health and health promotion

Public health primary prevention intends to address risk factors in susceptible populations and can emphasize social determinants of health (SDOH).[13] SDOH are defined as the conditions in which people are born, grow, live, work, and age, and are further shaped by the distribution of money, power, and resources at global, national, and community levels.[49] Upstream disease prevention in healthy individuals and populations, through the identification of SDOH barriers, has historically been considered

a key component of chiropractic wellness care.[18,50] At the primary prevention level, chiropractors should be knowledgeable of SDOH and regularly incorporate them into evaluations and care planning.[51] Health disparities born out of the inequalities in SDOH contribute to self-directed violence risk.[52] While suicide may have a basis in depression or substance abuse, the simultaneous contribution of risk comes from social factors like community breakdown, loss of key social relations, economic depression, or political strife.[53] Self-directed violence risk factors are further magnified by emotional states like hopelessness and impulsiveness.[54,55]

Lifestyle behaviors have been shown to have positive and negative relationships with suicide prevention.[55] In understanding the various risk factors and protective factors for self-directed violence, chiropractors can target SDOH (Table 4). For example, smoking cessation counseling is supported as a means to target primary prevention of suicide as multiple cohorts have found a dose-response association between smoking and risk of suicidal self-directed violence.[56] Physical activity, another promotable health behavior in the chiropractor's office, has been associated with lower rates of suicidal ideation in both adolescents and adults.[57–61] Moreover, depression is a predictor of risk for suicide[29,62] and it is very likely depressive symptoms may initially be identified in the chiropractor's office as it relates to spinal pain through yellow flag screening[17, 32].

Making judgments about a person's suicide risk factor status requires effective communication skills that incorporates empathy, compassion, and nonjudgmental listening.[63] At the heart of this action is promoting the knowledge that all suicides are potentially preventable, and, with appropriate skills, chiropractors can take the opportunity to address the whole person by considering SDOH. Assisting the patient in overcoming their complaint of spinal pain may function as an indirect protective factor for risk of suicidal self-directed violence. An episode of acute low back pain, as a painful experience, may be managed to resolution through education, practitioner-directed interventions, therapeutic exercise, and reassurance. In this instance, the chiropractor has the opportunity to assist the patient in cultivating self-efficacy, problem-solving, and coping strategies which are translatable skill sets.

Suicide prevention education and training for chiropractors and chiropractic students are additional targets for primary prevention strategies. To date, suicide preven-

Table 4.
Risk, dynamic, and protective factors associated with self-directed violence.[22,35,36]

Risk Factors	Dynamic (Modifiable) Factors	Protective Factors
• Family history of suicide • History of previous suicide attempt(s) • Psychiatric disorders (i.e. depression, anxiety disorder, bipolar disorder, schizophrenia, personality disorder) • Substance use disorder (i.e. alcoholism, substance abuse) • Post-traumatic stress disorder • Delirium • Hopelessness • Marital status • Sexual minority • Occupational status • Military service • Chronic medical illness (i.e. diabetes, cancer, HIV/AIDS, chronic pain) • Childhood adversity • Rural residence • Firearms	• Active psychological symptoms • Hopelessness • Suicidal ideation • Suicidal communication • Suicidal intent • Treatment adherence • Substance use • Psychiatric admission • Psychosocial stress • Problem-solving deficits • Emotional turmoil	• Social support and relationships • Family connectedness • Positive coping strategies • Subjective well being • Pregnancy and parenthood • Religious or spiritual beliefs

tion education has been under-described and limited in medical training.[63] Continued development of integrated clinical training opportunities[64], continuing medical education[65], and interprofessional collaboration with other health care disciplines are critical to expanding exposure to suicide prevention education.

Secondary suicide prevention: risk screening and identification

Secondary prevention is oriented towards high-risk populations for self-directed violence thoughts and behaviors.[13] It requires systematic processes designed to identify individuals who may be at high risk of suicide and to work with the patient and/or support persons to reduce risk factors and promote protective factors. Behavioral health providers receive extensive training regarding the identification and treatment of patients at-risk and patients actively suicidal, but most patients who will experience suicidal ideation are receiving care outside of the behavioral health setting.[66–68] Primary care has become a setting of interest surrounding suicide prevention, but ambulatory care and specialty clinics can offer the same support and intervention. As portal-of-entry providers, chiropractors are in a similar position to be in clinical contact with patients months prior to preparatory behavior, a suicide attempt, or suicide.

There is a significant opportunity and moral obligation during this time to identify and connect patients to needed public health resources or behavioral health treatment. The provision of education and connection when it matters could lead to early prevention, detection, and management as necessary. Gatekeeper training is one formal approach used in suicide prevention training for primary care providers and emergency room physicians.[69,70] Suicide prevention training for health care providers is believed to impact important factors related to suicide prevention – knowledge, perceptions about suicide prevention, reluctance, and self-efficacy – and that changes in these factors can influence intervention behavior.[69]

While the primary reason to present to the chiropractor is typically due to spine-related disorders[2], co-morbidities relevant to the patient's health status may warrant further investigation or immediate referral. A firm understanding of acceptable language (Tables 1 and 2) and communication related to self-directed violence is critical to preparing for future clinical encounters. Building screening processes into intake and evaluation is a simple way that chiropractors may strive to identify a patient at-risk for suicide-related behavior. For example, a review of systems within intake paperwork that queries the patient's experiences with depression, anxiety, PTSD, substance use disorder, and other mental health concerns can open the door to further investigation and conversation. A patient that has selected a mental health symptom or condition requires further inquiry to the status of their current mental health care, or lack thereof. This may play a crucial role in encouraging them to seek the support they need all the while cultivating patient-centered care. There are numerous unidimensional and multidimensional psychosocial screening tools available for the busy chiropractor's office that evaluate risk factors associated with self-directed violence and also assessment tools specific to suicidal self-directed violence (Table 5).[71–79] For example, in a multiyear cohort study of US veterans, Finley *et al*. observed veterans with various combinations of clinical characteristics including PTSD, chronic pain, and traumatic brain injury.[80] They observed interactions among specific clinical characteristic co-occurrences significantly increased the risk of suicide ideation, suicide attempt, and suicide ideation and attempts.

In 2016, The Joint Commission recommended health systems consider evaluating suicide risk in all patients and in all settings.[7] There are many ways to ask about suicidal thoughts or feelings during a medical appointment and this will likely vary by the individual chiropractor. Contrary to popular belief, questions related to suicidal thoughts does not promote suicide or self-harm action.[24,81] Some suggest a comprehensive question designed to assess for current or historical suicidal thoughts/feelings. For example, Bongar and Sullivan recommend the following: "*Have you, at any time in your life, ever done anything that anyone could have possibly interpreted as self-destructive or even suicidal?*"[82] Other providers may feel more comfortable with a succinct and direct form of inquiry such as "*Have you had any thoughts about suicide or harming yourself in any way?*" For those that prefer standardized methods of screening and are comfortable doing so, the Columbia-Suicide Severity Rating Scale (C-SSRS) is a widely available questionnaire designed to assess suicide risk level across a wide variety of medical settings using a standardized tool.[75]

The frequent nature of an active care plan with a chiro-

practor for the management of spine-related disorder may lend itself to the development of strong provider-patient rapport, trust, and a therapeutic relationship that allows the patient to feel more comfortable communicating mental health concerns than with their other health care providers. It is imperative that the practicing chiropractor is ready to recognize the patient in crisis (or trending towards crisis) and that their clinic should have standard operating procedures (e.g., national resources, referral pathways, and community resources) in place to assist these at-risk patients expeditiously (Appendices 1, 2, 3). The chiropractor may identify evidence for risk of self-directed violence with a review of systems, intake of history, or yellow flag screening tools on evaluation or at follow-up care when managing spinal complaints. Asking direct questions to the patient about current or recent

Table 5.
Assessment tools for screening for self-directed violence risk and risk factors[*,#]*

Assessment tool	Tool description
Columbia Suicide Severity Rating Scale (C-SSRS)[75]	Designed to assess suicide risk level across a wide variety of medical settings. 3 to 8-item tool, depending on the answers provided
Fear-Avoidance Beliefs Questionnaire (FABQ)[79]	Unidimensional assessment for fear of pain caused by physical activity that leads to a catastrophizing response. 16-item tool with a 7-item work subscale and a 4-item physical activity subscale
General Anxiety Disorder-7 (GAD-7)[76]	Unidimensional assessment of generalized anxiety disorder, a distinctly separate domain than depression 7-item tool
Optimal Screening for Prediction of Referral and Outcome Yellow Flag (OSPRO-YF)[73]	Multidimensional assessment of risk and protective factors drawn from 11 psychosocial screening questionnaires and 136-items 17-item tool with a 6-item negative mood subscale, 6-item fear avoidance subscale, 5-item passive coping subscale
Pain Catastrophizing Scale (PCS)[72]	Unidimensional assessment of catastrophic thoughts as it relates to pain (i.e. rumination, magnification, feeling helpless). 13-item tool with a 4-item rumination subscale, 3-item magnification subscale, and 6-item helplessness subscale
Pain Self-Efficacy Questionnaire (PSEQ)[77]	Unidimensional assessment of self-efficacy when in pain. 10-item tool
Patient Health Questionnaire – 9 (PHQ-9)[71]	Unidimensional assessment for presence and severity of depression and depressive symptoms through 9 domains. 9-item tool *Patient is asked directly if they have had thoughts that you would be better off dead or of hurting yourself in someway.*
Subgroups for Targeted Treatment Back Screening (SBT)[78]	Multidimensional assessment screening for factors associated with disability in the primary care setting. 9-item tool with a 4-item physical subscale and a 5-item psychosocial subscale
Tampa Scale for Kinesiophobia Scale (TSK)[79]	Unidimensional assessment for degree of fear of movement and reinjury 17-item tool with a 6-item harm factor subscale and a 7-item activity avoidance factor subscale
West-Haven Yale Multidimensional Pain Inventory-Interference Subscale (WHYMPI/MPI-INT)[74]	Multidimensional assessment of pain interference in various areas of life in the social, occupational, and relational domains. 52-item tool with 12 subscales – 5 subscales assess dimensions of pain, 3 subscales assess perception pain impact on significant other, and 4 subscales assess pain impact on function and activities

* Consideration of patient burden as well as clinic preparedness to handle responses to assessments should play a role in assessment tool selection.

\# Caution is advised in interpreting a single assessment tool as an indication of risk of suicide, unless the tool specifically screens for suicide risk (i.e. C-SSRS), rather assessment tools are components of a comprehensive clinical picture that includes patient history, multiple assessment tools, and physical examination. For example, a high score on a GAD-7 alone does not necessarily indicate suicide risk, despite high generalized anxiety.

suicidal thoughts or feelings can aid to build a safe, caring space, and de-stigmatize self-directed violence and self-harm while advocating for utilization of available resources.[83–85] In the clinic, patients identified as high risk for self-directed violence or who endorse suicidal ideation require additional systematic secondary prevention intervention, typically beyond the training and comfort of the chiropractor. When available, a referral to a trusted behavioral health provider is recommended and the follow-up often includes individual risk assessment and safety/treatment planning designed to provide ongoing support for the patient to reduce risk factors and promote protective factors.

The response to a patient demonstrating suicidal behavior will also vary depending upon each provider's level of training, as well as their specific environment of care. For example, chiropractors practicing in a large, interdisciplinary team may have access to direct referral to a mental health provider for additional assessment and safety planning. In these settings, for example VA, providers often have the option of referring a patient directly to the Emergency Department (usually for high-risk) or to a same-day access/walk-in mental health clinic for more comprehensive evaluation.

For providers practicing independently in private practice or more remote settings, there may likely be fewer options and additional barriers to facilitating a smooth transition to mental health care for evaluation. Clinicians faced with these challenges may benefit by proactively generating a list of local mental health providers and resources rather than wait until an emergent situation arises at the clinic. A prepared list of resources is one way to increase efficiency in coordinating care for a patient experiencing suicidal behavior. Although time limitations are a barrier, providing a warm handoff (e.g., contacting the mental health provider while the patient is in the office) is generally recommended[86, 87] and may help to improve care coordination and a greater likelihood of follow up. Finally, there are 24/7 resources available to all clinical care providers and patients, such as the Crisis Services Canada Hotline. This resource can provide immediate consultation for patients or providers needing services or information. Appendix 1 contains Canadian and United States national resources for crisis hotlines, Appendix 2 contains 24/7 online forum and chat access resources, and Appendix 3 provides adolescent and pediatric resources.

Secondary suicide prevention: comprehensive evaluation and safety planning overview

While it is beyond the expectation of a chiropractor to conduct a comprehensive evaluation, it is useful to share knowledge of next steps for educating patients and/or loved ones. Once a patient is connected with a qualified mental health professional, they will likely participate in a comprehensive risk assessment that includes detailed inquiry regarding psychosocial history, mental health treatment history (pharmacological and non-pharmacological), past/current risk and protective factors, and treatment planning. Ideally, if suicide risk is accurately stratified, the patient is triaged to a clinically appropriate level of care and is given the necessary treatment referrals, while incorrect stratification may result in harm to the patient due to inappropriate recommendations, exposure to an inaccurate level or dose of care, or a lack of referral for appropriate treatments.[88]

When a patient is deemed to be at an elevated risk for self-directed violence or suicide, the standard practice also may include comprehensive safety planning. Safety planning is a collaborative process conducted with the patient to create a "plan" that often includes identification of triggers/warning signs, internal coping strategies, support contacts (family, friends, professional) for quick access, and methods of increasing environmental safety (e.g., limiting access to lethal means). Safety plans are considered a best practice and used as part of a variety of psychological therapies. Typically, the safety plan is provided to the patient and is included in their medical record so that other providers may have access to this resource if needed. A recent randomized controlled trial in active duty Army soldiers found those in either response planning groups had a 76 percent reduction in attempts, a decline in ideation, fewer overall inpatient hospital stays, and a reduction in negative emotion states compared to the control safety contract group.[89]

Depending on an patient's category of risk, there are numerous levels of care that may be appropriate for a patient with elevated suicide risk, including inpatient hospitalization, intensive outpatient programs (individual/group therapy 3 to 4 times per week), as well as engagement in weekly, outpatient, evidence-based treatments such as cognitive behavioral therapy (CBT), acceptance commitment therapy (ACT), or dialectical behavioral therapy (DBT).[90–95] There is a growing consensus in the

suicide behavior literature that treatment interventions should address coping deficiencies and symptoms of psychological distress in patients who have attempted suicide.[96]

Tertiary suicide prevention: integrated settings and chiropractic services

Tertiary prevention approaches aim to intervene with patients with a history of self-directed violence. The goals of these prevention efforts are to mitigate subsequent occurrences of self-directed violence through reducing the impact and progression of the established disease (e.g., suicide ideation or prior suicide attempt) by eliminating or reducing disability and suffering while maximizing potential quality of life years.[97, 98] In epidemiological terms, tertiary prevention aims to reduce the number and/or impact of complications. Specific for suicide prevention, aftercare[99] describes care for the individual while postvention[100] considers communities and loved ones. In parallel with secondary suicide prevention efforts, it is imperative that chiropractors develop the procedures that would enhance the connection with community-based organizations and mental health professionals. For the chiropractor, it is prudent to be cognizant of patients who have previously endorsed suicidal thoughts or engaged in self-directed violence. Both secondary and tertiary prevention efforts can function to support and enhance protective factors through skill building and treating painful complaints (Table 4).

Collaboration and team-based approaches to care have been developed in health care systems. In some instances, chiropractors are members of physical medicine and rehabilitation departments, chronic pain programs, pain management teams, or surgical departments.[101,102] Interprofessional team-based care contributions by chiropractors and behavioral health clinicians may optimize the psychosocial considerations.[18] Community-based teaching clinics for chiropractic students have demonstrated interprofessional care delivery for complex case management that includes mental and behavioral conditions in low-income populations.[103, 104] Meanwhile, the vast majority of chiropractors are in private practice and are at a significant disadvantage for collaborating with behavioral health specialists. A case example of co-located clinics for a chiropractor, family physician, and mental health professional highlights potential communication and referral pathways for anxiety and chronic tension-type headache.[105]

Whether co-located or more fully integrated, a growing body of research indicates that collaborative behavioral-primary care results in improved patient outcomes.[89] Interprofessional training for mental and behavioral health collaboration with chiropractors is largely unreported at this time and is a potential opportunity to enhance the chiropractor's role in evidenced-based tertiary suicide prevention.

In either a private practice or hospital-based chiropractic clinic, there are a variety of interventions that have demonstrated success in managing chronic musculoskeletal pain conditions in the setting of comorbid mental health conditions, such as prior suicide attempts or a history of suicidal ideation. Similar in framework to Gliedt *et al*.[18], there are several treatments and case management strategies for spinal-related disorders that may be considered by chiropractors that aim to promote coping skills and self-efficacy. These strategies include mindfulness-based stress reduction (MBSR), concepts of motivational interviewing (MI), and CBT (*Note: The delivery of these interventions are dependent upon scope of the individual's licensing jurisdiction*). Each can be incorporated into a visit as an adjunct to manual and exercise therapies and happen to reinforce concurrent mental health interventions.[99] Treatment with MBSR or CBT, compared with usual care, resulted in greater improvement in back pain and functional limitations with no significant differences in outcomes between MBSR and CBT.[106] These findings suggest that MBSR and/or CBT may be an effective treatment option for patients with chronic low back pain with an associated risk of comorbid risk of suicidal self-directed violence.[107, 108]

As noted in secondary prevention for high-risk patients, behavioral health specialists employ the same tools contextualized for suicide prevention. CBT in particular has been shown to be effective in treating mental health disorders with chronic pain[109], and CBT alone reduces suicide attempts, suicidal ideation, and hopelessness compared with other treatments[110]. Evidence also supports DBT for treating suicidal ideation and behavior.[111] The DBT approach combines elements of CBT, skills training, and mindfulness techniques with the aim of helping patients develop skills in emotional regulation, interpersonal effectiveness, and distress tolerance.[88]

Every state in the United States—as well as federal agencies, including the VA, Department of Defense, and Substance Abuse and Mental Health Administration—has fostered a community-based approach to suicide prevention.[88,94] Similarly in Canada, the Federal Framework for Suicide Prevention was published in 2016 and sought to align federal suicide prevention efforts with provinces, territories, Indigenous organizations, non-governmental organizations, and communities to prevent suicide.[112] We encourage chiropractors to participate in community-based interventions that are endorsed by local or national public health organizations. Organizing a monthly group session or supporting current community-based interventions to prevent risk factors, promote protective factors, and mitigate suicide behaviors (Table 4) is a potential unique manner for chiropractors to address SDOH for tertiary prevention. Presenting on a variety of topics, as an expert in public health, can be beneficial and encourage the overall community to live a better quality of life. Chiropractors can consider incorporating this approach into individual practices by partnering with larger established health care systems, county health departments, and other private organizations to build a proactive approach to reducing future suicidal occurrences through a community network.

There are also national and local public health organizations for chiropractors to join as members. For example, the American Public Health Association (APHA) has a suicide prevention special interest group. Several other APHA sections, including Chiropractic Health Care, Public Health Education and Health Promotion, and Occupational Health and Safety, provide chiropractors with resources to further assist in the development of a community-based approach to suicide prevention.[113] A chiropractor's county, province, and/or state funded crisis line, task force, or coalition is likely in need of volunteers. For example, Butler county in Pennsylvania, United States, maintains a local branch of 'Prevent Suicide PA'.[114]

Potential barriers to suicide prevention in the chiropractic office

While a patient endorsing thoughts of self-directed violence or reporting plans to perform self-directed violence are an unexpected clinical encounter in the chiropractic office, the implementation of suicide prevention efforts in the office do result in several logistical concerns. Additional assessment tools, scoring, and interpretation of screening tools is an additional burden to both the patient and the chiropractor. The chiropractic office is likely to have a certain flow or pace (e.g., appointment time) for new and follow-up patient care. Whereas a patient who flags for risk factors of suicide will require impromptu focus and time for potential further assessment or intervention. Standard operating procedures would serve the office well to include established contact lists with available resources, something else that requires frequent updating and verification of information accuracy. This may be difficult in a solo provider office and in offices where patient care is busy with little time built in between patient visits. Careful planning is necessary to provide the appropriate care for these instances with empathy, validation, and support and avoiding the appearance of being rushed with a very sensitive topic. Practitioners may have to allocate additional time to each of their treatment sessions just in case something like this were to come up. One should look inward and reflect on clinic flow to determine the feasibility of addressing suicide prevention screening in the chiropractic office.

Limitations

The objective of this descriptive report left little room to devote to the discussion of special populations such as children, adolescents, or geriatrics as well as the relationship of culture and ethnicity as they associate with suicide-related behavior. As this was a descriptive overview, there are many scenarios that were not covered that uniquely represent specific types of chiropractic practice or particular patient scenarios. There are resources available nationally and locally, which could not be highlighted due to limitation of space.

Further, the authors caution against the implementation and clinical application of suicide prevention in the chiropractor's office using only this clinical guide to navigate the process. This article serves as introduction and starting point to a nuanced and life-threatening condition. Additional training and workshops should be sought to gain confidence to address this clinical concern. Many of the organizations provided in the appendices are key sources for supplementary education and training opportunities (Appendices 1, 2, 3).

Conclusion

Biological, psychological, social, and cultural factors all have a significant impact on the risk of suicide and spine-related disorders. The chiropractic profession unknowingly has played a role in suicide prevention, particularly the primary and secondary prevention levels, through education and counseling behavior change related to SDOH and treatment of painful conditions. It is a chiropractor's responsibility to recognize patients at risk of self-directed violence and engage in primary and secondary suicide prevention; however, it is beyond the expectation of the chiropractor to conduct suicide risk evaluation and to address a suicide crisis independently. It is of moral and ethical obligation that we suggest a minimum level of competency to screen for risk factors related to self-directed violence. Efforts to implement standard operating procedures, including community and national resources, referral pathways, and establishing relationships with the behavioral health community, enhance the opportunities for chiropractors to contribute to the mitigation of this public health crisis.

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Appendix 1.
*National crisis hotlines**

Crisis Hotline Title	Crisis Hotline Description	Crisis Hotline Contact Information
CANADA		
Centre for Addiction and Mental Health (CAMH)	Canada's largest mental health teaching hospital and one of the world's leading research centres in its field.	Phone: 1-833-456-4566 (24/7) Website: http://www.camh.ca/
Crisis Text Line	The Crisis Text Line is a free text messaging resource offering 24/7 support to anyone in crisis.	Short Message Service (SMS): Text HOME to 741741 (24/7) Website: https://www.crisistextline.org/
The Canada Suicide Prevention Service	Crisis Services Canada evolved out of the Canadian Distress Line Network – a national network of existing distress, crisis and suicide prevention line services that has been engaging members since 2002.	Phone: 1-833-456-4566 (24/7) SMS: Text 45645 (4PM-Midnight) Website: https://www.crisisservicescanada.ca/en/
UNITED STATES		
National Suicide Prevention Lifeline	The National Suicide Prevention Lifeline is a national network of more than 150 local crisis centers. It offers free and confidential emotional support around the clock to those experiencing a suicidal crisis.	Phone: 800-273-8255 (24/7) Online chat: https://suicidepreventionlifeline.org/chat/ (24/7) Website: https://suicidepreventionlifeline.org/
Substance Abuse and Mental Health Services Administration's (SAMHSA) National Helpline	The Substance Abuse and Mental Health Services Administration's (SAMHSA) national helpline offers confidential treatment referrals in both English and Spanish to people struggling with mental health conditions, substance use disorders, or both.	Phone: 800-662-HELP (4357) (24/7) Website: www.samhsa.gov/find-help/national-helpline Support for those who are deaf or hard of hearing: Text to Telephone (TTY): 800-487-4889 (24/7)
The Trevor Project	The Trevor Project offers crisis intervention and suicide prevention to lesbian, gay, bisexual, transgender, queer, and questioning (LGBTQ) youth through its hotline, chat feature, text feature, and online support center.	Phone: 866-488-7386 (24/7) SMS: Text START to 678678 Online Chat: TrevorCHAT Website: https://www.thetrevorproject.org/
The Veterans Crisis Line	The Veterans Crisis Line is a free, confidential resource staffed by qualified responders from the Department of Veterans Affairs. Anyone can call, chat, or text — even those not registered or enrolled with the VA.	Phone: 800-273-8255 and press 1 (24/7) SMS: Text 838255 (24/7) Online chat: www.veteranscrisisline.net/get-help/chat (24/7) Website: www.veteranscrisisline.net Support for those who are deaf or hard of hearing: 800-799-4889

*Access to these resources may vary by country.

Appendix 2.
*Online forums and crisis support resources**

Resource	Resource Description	Resource Contact Information
ADAA Online Support Group	With more than 18,000 subscribers worldwide, the Anxiety and Depression Association of America's online support group is a safe, supportive place to share information and experiences.	Website: https://adaa.org/adaa-online-support-group
Befrienders	Global network of 349 emotional support centers around the world. It offers an open space for anyone in distress to be heard. Support is available via telephone, text message, in person, online, and through outreach and local partnerships.	Website: https://www.befrienders.org/
BetterHelp	Connects people with licensed, professional therapists online for a low, flat fee. Therapy is available whenever you need it.	Website: https://www.betterhelp.com/
IMAlive	IMAlive is a virtual crisis center. It offers volunteers who are trained in crisis intervention. These individuals are ready to instant message with anyone who needs immediate support. IMAlive is a virtual crisis center. It offers volunteers who are trained in crisis intervention. These individuals are ready to instant message with anyone who needs immediate support.	Website: https://www.imalive.org/
Self-Injury Outreach and Support	An international outreach organization offering a variety of resources for those who self-injure, including guides, stories, and methods for day-to-day coping	Website: www.sioutreach.org
Suicide Stop	A one-stop resource center aimed at assisting people who are dealing with suicidal or self-destructive tendencies. It is also tailored to provide essential information and tips for individuals who want to help someone else.	Website: www.suicidestop.com/suicide_prevention_chat_online.html
TrevorSpace	TrevorSpace is an online international peer-to-peer community for LGBTQ young people and their friends.	Website: https://www.trevorspace.org/
7 Cups of Tea	An online resource that offers free, anonymous, and confidential text chat with trained listeners and online therapists and counselors. With over 28 million conversations to date, it's the world's largest emotional support system.	Website: https://www.7cups.com/

*Access to these resources may vary by country.

Appendix 3.

*Adolescent and pediatric suicide prevention support resources**

Resource Title	Description	Crisis Hotline Contact Information
CANADA		
Kelty Mental Health Resource Center	Parents and caregivers can find a variety of information and resources relating to mental health issues affecting children and young adults	Website: www.keltymentalhealth.ca/
Kids Help Phone	Kids Help Phone is Canada's only 24/7, national support service. Offerings include professional counselling, information and referrals and volunteer-led, text-based support to young people in both English and French.	Phone: 1-800-668-6868 (24.7) Short Message Service (SMS): "CONNECT" to 686868
NEED2 Suicide Prevention, Education & Support	Online support network for Canadian youth up to 30 years. The site offers a number of different methods of digital communication to meet the needs of youth in crisis.	Website: www.youthspace.ca (6 pm – 12 am PT): SMS: (778) 783-0177 (6 pm – 12 am PT)
UNITED STATES		
JED Foundation	A nonprofit organization that exists to protect the emotional health and prevent suicide of our nation's teens and young adults. JED equips these individuals with the skills and knowledge to help themselves and each other, and encourages community awareness, understanding, and action for young adult mental health.	Website: https://www.jedfoundation.org/events/parents-action-fall-seminar-emotional-well-begins-home/
National Alliance on Mental Illness	Helping a loved one with mental illness can be challenging but knowing where to begin is an important first step. The National Alliance on Mental Illness offers family members and caregivers specific guidance on a variety of issues, including how to help prevent suicide.	Website: https://www.nami.org/Find-Support/Family-Members-and-Caregivers/Preventing-Suicide
Society for the Prevention of Teen Suicide	Helps parents and educators raise awareness about youth suicide and attempted suicide through the development and promotion of educational training programs. The site also offers resources for teenagers who are contemplating suicide.	Website: https://www.sptsusa.org/
Teen Health	Helps parents decide whether their child's behavior is just a phase or a sign of something more serious	Website: https://teenshealth.org/en/parents/emotions/
THRIVE app	Designed by the Society for Adolescent Health and Medicine. It helps guide parents in starting an important dialogue with their teenage children on a variety of health and wellness topics	App: https://www.adolescenthealth.org/About-SAHM/Healthy-Student-App-Info.aspx
To Write Love on Her Arms	A nonprofit that aims to help people struggling with depression, addiction, self-injury, and suicide by connecting them with the appropriate hotlines, resources, and online communities through its blog and social channels.	Website: https://twloha.com/

*Access to these resources may vary by country.

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Gender diversity in chiropractic leadership: a cross-sectional study

Ayla Azad, DC, MBA[1]
Michele Maiers, DC, MPH, PhD[2]
Kent Stuber, DC, MSc[1]
Michael Ciolfi, DC, MBA, DBA[3]

Background: *The purpose of this cross-sectional study was to compare the number of males and females in leadership positions, and whether there is a relationship between gender and degrees held in those positions, within chiropractic academic institutions, national regulatory bodies and the most widely representative national professional associations in the United States and Canada.*

Methods: *Publicly accessible websites from chiropractic institutions and organizations were used to collect data. Pearson χ^2 tests of independence were conducted to determine the relationship between gender (male vs. female) and other variables, including position (principal vs secondary), and chiropractic and other advanced professional degrees.*

Results: *A total of 107 leaders were identified across*

La diversité de genre dans les postes de direction en chiropratique : étude transversale

Contexte : *Cette étude transversale visait à comparer le nombre d'hommes à celui de femmes occupant des postes de direction, et à savoir s'il existe un lien entre le sexe et les diplômes détenus par les titulaires de postes dans les établissements d'enseignement de la chiropratique, les organismes nationaux de réglementation et les associations professionnelles nationales les plus reconnues aux États-Unis et au Canada.*

Méthodologie : *Des données ont été recueillies dans les sites Web accessibles au public des établissements chiropratiques. Des tests d'indépendance du shi-carré ($\chi 2$) ont été effectués pour établir le rapport hommes-femmes et le lien avec d'autres variables, notamment le rapport entre les postes de directeur principal et les postes de directeur adjoint, les diplômes en chiropratique et des diplômes d'études avancées.*

Résultats : *On a recensé au total 107 directeurs de*

[1] Canadian Memorial Chiropractic College
[2] Northwestern Health Sciences University
[3] University of Bridgeport

Corresponding author: Ayla Azad, Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, ON M2H 3J1
Tel: 416.899.6139
E-mail: dr.aylaazad@gmail.com

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institutions and organizations. Under one-third of leaders (30.8%) were identified as female. Males were more likely to be in principal leadership roles (86.2%) and more likely to be in a secondary leadership position (62.8%).

Conclusion: *Male leaders significantly outnumber female leaders in both principal and secondary leadership positions within American and Canadian chiropractic institutions. Strategies should be developed to include gender diversity within all chiropractic organizations.*

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KEY WORDS: Chiropractic, Diversity, Leadership, Gender

cliniques et d'organismes. Moins d'un tiers des titulaires de ces postes de direction (30,8 %) étaient des femmes. Les hommes étaient plus susceptibles d'occuper des postes de directeur principal (86,2 %) et des postes de directeur adjoint (62,8 %).

Conclusion : *Les hommes sont nettement plus nombreux que les femmes à occuper des postes de directeur principal ou de directeur adjoint dans les cliniques chiropratiques américaines et canadiennes. On devrait élaborer des stratégies visant à assurer la diversité des sexes dans toutes les cliniques chiropratiques.*

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MOTS CLÉS : chiropratique, diversité, leadership, genre

Introduction

Chiropractic, the largest complementary and alternative health care profession in North America, has traditionally been male-dominated.[1] Many health care professions, including chiropractic, do not represent the population they care for with regard to sex.[1] According to the National Board of Chiropractic Examiners 2019 survey data, 67.3% of American chiropractors are male and 31.8% are female, while 57.4% of the patients seen by chiropractors are female.[2] Data from Canada is similar, with 65% of practicing chiropractors identifying as male, and 59% of chiropractic patients being female.[3,4]

It is increasingly acknowledged that a healthcare work force should reflect the gender and racial diversity of the population it serves.[1,5] Doing so leads to improved public health "by increasing access to care for underserved populations and increasing opportunities for these populations to see practitioners with whom they share a common culture".[5] Recent years have demonstrated trends of positive growth in both the proportions of females attending chiropractic schools and providing chiropractic care in practice.[1,2] As health professions become more "feminized", Levinson *et al*.[6] predict that "notable changes may emerge in 4 domains: the patient–physician relationship, the local delivery of care, the societal delivery of care, and the medical profession itself". These changes include an increased focus on patient-centered, collaborative care and where care is delivered as women are more likely to serve uninsured patients and poor and underserved communities. As for the profession itself, Levinson *et al*. contend that women are changing the medical profession as they "have forged new pathways to allow physicians to balance career and family responsibilities."[6]

Research examining gender disparities in medical education noted a unique cultural shift in medical education in 2017, the first year that the number of women enrolled in US medical schools exceeded the number of men.[7] While these shifts should represent an opportunity for positive social change and increased representation of women in healthcare professional leadership, the WHO Global Health Workforce Network Gender Equity Hub reports that women remain substantially under-represented in management, leadership and governance.[8] This is reflected in one 2018 study, which reported that while women comprise the majority of the healthcare workforce, they hold only 19% of hospital CEO positions, and head only 4% of healthcare companies.[9] A study of healthcare educational institutions yielded similar results, with women accounting for 13% (137/1018) of department leaders at the top 50 National Institute of Health-funded medical schools.[10]

While data suggests meaningful gains in gender equity

among chiropractic students and practitioners in North America, there have been no studies to date that examine gender diversity in chiropractic leadership. This study evaluates the distribution of men versus women in leadership positions in chiropractic institutions in the United States and Canada. We also explored whether there is a relationship between gender and possessing a chiropractic degree or an advanced degree in those positions.

Methods

This was a cross-sectional study comparing the number of males and females in leadership positions in all chiropractic academic institutions, national regulatory bodies and the most widely representative national professional associations in the United States and Canada. Publicly accessible websites from the following organizations (see Appendix 1) were used:

1. All accredited American and Canadian chiropractic colleges
2. The American Chiropractic Association, Canadian Chiropractic Association, and International Chiropractic Association
3. Chiropractic regulatory and educational accreditation bodies
4. Chiropractic examination agencies

Prior to data collection, the study team established an ad hoc definition of leadership positions within these institutions as "someone who influences the strategic direction of the chiropractic program or profession and is responsible for the day-to-day conduct of the institution's business." Leaders were further divided into "principal position" and "secondary position". The principal leaders were identified by titles including President, Chancellor, Provost, Dean, Executive Director, Chief Executive Officer and chiropractic department head (if within a university setting). Secondary leadership positions were identified by titles including Vice-President, Director and council member.

Prior to commencing data collection, a list of eligible organizations and institutions was compiled and divided into two separate lists. Two teams composed of two investigators each (AA and KS, MM and MC) were each assigned to one of the resulting lists. To avoid conflicts of interest, investigators were not assigned to collect data from any organizations with which they held any affiliation. Each investigator then individually accessed the public websites for each assigned organization, and leaders were identified based on title. Additional data about each leader was extracted from institutional websites, including individual names, title, and if the individual was a chiropractor and/or held a graduate degree (such as MSc, PhD, MBA, etc.). For the purposes of this study, the use of pronouns in biographies as well as names and pictures, were used to classify gender in a binary manner (male or female).

Data was entered into an Excel spreadsheet and reconciled between investigators from each data extraction team by discussion. Data collection took place between January 21 and February 8, 2019. Institutions were searched for on an online search and if data on an individual was not readily available from the institution's website, the investigators used other publicly available information on the individual. As the data used for this study is publicly available, and individuals are not identified in reporting, approval from an ethics committee was not needed. Once consensus within teams was established, all data was combined into one master list for analysis. Descriptive statistics were used to categorize data by gender, position (principal or secondary leadership), chiropractic and graduate degrees, and country. To ensure adequate sample size for analysis of factors by institution, leaders were grouped as belonging to either academic or "other". Pearson χ^2 tests of independence were conducted to determine the relationship between gender (male vs. female) and these variables, as well as position (principal vs secondary) and other variables. Significance was set at $p \leq 0.05$.

Results

Our search identified a total of 107 leaders across institutions and organizations, under one-third of whom (30.8%) were identified as female (see Table 1). In this sample, 29 (27.1%) were in the "principal leadership" position and 78 (72.9%) were in a "secondary leadership" position. Approximately two-thirds of the sample (63.6%) were employed at educational institutions. Nearly 80% (79.4%) were listed as being chiropractors and 43% had a graduate degree.

Table 2 shows cross tabulations between gender (male vs. female) and other variables. Males and females were

Table 1.
Descriptive results

	N=107	%
Gender		
Yes	46	43.0
No	61	57.0
Position		
Principal Leader	29	27.1
Secondary Leader	78	72.9
Chiropractor		
Yes	85	79.4
No	22	20.6
Graduate Degree		
Yes	46	43.0
No	61	57.0
Institution		
Educational	68	63.6
Advocacy	17	15.9
Regulatory	5	4.7
Accreditation	3	2.8
Examination	7	6.5
Accreditation & Regulatory	7	6.5
Country		
U.S.A.	88	82.2
Canada	19	17.8

Table 2.
Cross-tabulations between gender and other variables

	Female (N=33)		Male (N=74)		
	N	%	N	%	p-value*
Chiropractor					
Yes	18	54.6	67	90.5	<0.0001
No	15	45.5	7	9.5	
Graduate Degree					
Yes	20	60.6	26	35.1	0.01
No	13	39.4	48	64.9	
Institution					
Educational	19	57.6	49	66.2	0.4
Other[1]	14	42.4	25	33.8	
Country					
U.S.A.	24	72.7	64	86.5	0.09
Canada	9	27.3	10	13.5	

*p-value from a Pearson χ^2 test of independence
[1] Other includes leading national advocacy, regulatory, accreditation and examination agencies, as listed in Appendix A

distributed evenly across the institution types. Male leaders were more likely to be chiropractors compared to female leaders (p<0.0001), and female leaders were more likely to hold a graduate degree compared to males (p=0.01). There was a higher proportion of females in leadership positions in Canada when compared to the United States, but this difference was not statistically significant.

Table 3 contrasts proportions of identified leaders in principal vs. secondary leadership positions relative to other variables. Males occupied 86.2% of principal leadership positions and 62.8% of secondary leadership positions when compared with 13.8% and 37.2% respectfully held by females, making males significantly more likely to be in such leadership positions (p=0.02). Individuals in the leadership positions of these institutions were significantly more likely to be chiropractors (p<0.0001). Having a graduate degree was not associated with holding the principal or secondary leadership positions.

Table 3.
Cross-tabulations between principal leadership positions compared to secondary leadership positions and other factors.

	Principal Position (N=29)		Secondary Position (N=78)		
	N	%	N	%	p-value*
Gender					
Female	4	13.8	29	37.2	0.02
Male	25	86.2	49	62.8	
Chiropractor					
Yes	27	93.1	58	74.4	0.03
No	2	6.9	20	25.6	
Graduate Degree					
Yes	12	41.4	34	43.6	0.8
No	17	58.6	44	56.4	
Institution					
Educational	21	72.4	47	60.3	0.2
Other[1]	8	27.6	31	39.7	
Country					
U.S.A.	24	82.8	64	82.0	0.9
Canada	5	17.2	14	18.0	

*p-value from a Pearson χ^2 test of independence
[1] Other includes leading national advocacy, regulatory, accreditation and examination agencies, as listed in Appendix A

Discussion

Our study highlights the underrepresentation of women in leadership positions among chiropractic organizations in the United States and Canada. The ratio of males to females in leadership positions does not reflect contemporary gender distribution of chiropractic patients or students, but does mirror the gender imbalance within the chiropractic profession as a whole. The current disproportion among leaders may be an artifact of past gender imbalances in the profession, when fewer women entered the profession and, as an extension, resulted in fewer women with the professional experience needed to be leaders today. It is also likely that societal and professional gender bias has and continues to influence the underrepresentation of women in leadership positions. Expectations of leaders, and the perception of leadership qualities in women compared to men, are influenced by society's perception of gender traits and has been cited as a primary contributor of stunted professional advancement for women.[11] This may necessitate additional credentials to substantiate a female candidate's leadership capacity and skillset, a theory that is supported by our findings that women in leadership positions are more likely to have a graduate degree. Conversely, it appears that men are more frequently able to ascend to leadership positions within chiropractic in the absence of additional professional credentials.

Issues of gender inequality in leadership are pervasive. It is well recognized that the advancement of women in leadership positions lags in comparison to male counterparts in all areas of industry, including government, higher education, corporations and medicine.[9,10,12] According to the Global Gender Gap Report in 2020, women represent only 21.7% of corporate managing board positions, and a scant 7.5% of board leadership positions in the United States.[13] In Canada, only 25.8% of directors are female.[14] These gaps persist, in spite of evidence suggesting that having women in leadership positions is good for overall performance of an organization.[15,16] One study found that corporations experience positive returns when female directors are announced[15] and another found that Fortune 500 companies with more women in senior management experience higher returns[16]. A study conducted within the National Health Service (NHS) of the United Kingdom discovered that when women are in prominent board positions (Chair or Chief Executive Officer) they exert a positive influence on hospital service via less clinical negligence costs and achievement of social goals.[17] As with other professions, a lack of women in leadership positions may be adversely impacting the stability and growth of the chiropractic profession. As a recent review in the #LancetWomen initiative concluded, "the overall pattern of gender equality for women in science, medicine, and global health is one of mixed gains and persistent challenges".[18]

In Kanter's seminal work on gender bias, Kanter showed treatment in the workplace prevented women from holding leadership positions, and underscored views on leadership styles as barriers for advancement that still hold true till today.[19] Contemporary literature suggests that traditional gender roles may continue to affect how women are viewed in the workplace, the choices available to them, access to role models, and the ways in which communication and leadership styles are perceived.[19] Entrenched cultural stereotypes about the leadership abilities of men versus women operate formally within organizations through biased policies and review processes, resulting in a disadvantage for women to the point of slowing career advancement.[20]

Women's lack of advancement into leadership positions has been referred to as a "leaky pipeline" or a labyrinth[21,22], and as a "broken rung"[23] in the analogy that professional progress is a ladder. The biggest obstacle women face on the path to senior leadership is at the first step to a manager-level position. For every 100 men promoted and hired to manager, only 72 women are promoted and hired. This "broken rung" results in more women getting stuck at the entry level. Not surprisingly, men end up holding 62% of manager-level positions, compared with just 38% held by women.[23] Our data appear to reflect the "broken rung" phenomenon, with only 37.2% of secondary leadership positions held by women. This "broken rung" has upstream effects, as women are also underrepresented in our sample in "top positions". Further research is needed to explore to what extent the "broken rung" phenomenon has impeded women's assent to leadership positions within chiropractic.

Organizations must take critical steps to identify when gender stereotypes are influencing decision making or career advancement of women and challenge them as unjust. Gender discrepancies exist in many organizations that have been embedded within the culture for years or decades without awareness of their impact. This presents

a problem when organizational policies, procedures and practices discriminate against women without awareness. Such discrimination can directly influence organizational hiring practices and the creation of gender salary gaps. Gathering and monitoring data to identify biases in hiring practices and salary inequities is a strategy that can be implemented to track such differences.[24] Diversity in transition research emphasizes the importance of creating tools to systematically measure changes in gender bias within an organizational culture.[25] Research has demonstrated that universities with the most measures for gender diversity implemented their policies four times more than institutions with the fewest number of measures.[26]

The implementation and enforcement of policies that create an equitable environment, including those that speak directly to fairness in hiring, promotions, leaves of absence, and workplace expectations, may be the most critical factor to influence gender equity. [27] Changes to organizational policies should include job designs that are sensitive to gender issues, leadership development that includes issues of gender, and the development of systems to manage diversity.[27] Transparency regarding workload allocation and promotion are important to promote early career support in the presence of gender, race and profession-based bias. [27] Policies should be reviewed and restructured to reflect the value of family caregiving for both women and men, regardless of marital status. Similarly, practices should be examined to ensure they do not directly or indirectly benefit unmarried or childless workers, regardless of gender.[28] In the academic environment, alterations could be made to extend time to achieve tenure/promotion to accommodate maternity leave including the allowance of part-time employment as a segue into full-time after children are older.[29]

Women aspiring to leadership roles should consider mapping out career goals, taking on higher risk/reward projects, and having a mentor.[30] Mentorship and sponsorship programs focused on career development for women should be instituted in chiropractic institutions and organizations. Conferences hosted by chiropractic organizations such as the Association of Chiropractic Colleges and the World Federation of Chiropractic could include presentations and small group sessions that focus on increasing women in leadership positions at chiropractic educational institutions, national/state organizations and governmental advocacy agencies.

Limitations

We acknowledge several limitations of this study. Most notably, we chose to implement a binary classification of gender identification, which does not capture the spectrum of gender identities among individuals. This decision was made in anticipation that data extracted from institutional websites would be limited and possibly represent an incomplete or even inaccurate representation of all person's gender identities. It is also possible that the investigators misinterpreted and subsequently misclassified gender and other variables, and that website information was outdated. Our use of two reviewers to evaluate each website attempted to mitigate that risk. Only American and Canadian institutions were evaluated; hence these findings may not be generalizable to other countries. Furthermore, we attempted to only capture data of leaders in the primary and secondary leadership positions. We did not capture data for those in middle management roles. We also did not collect data on the length of time that leaders had been in their positions.

Future research

As this study is the first to look at the gender distribution of leaders in chiropractic institutions, we anticipate conducting follow-up research to see if the proportion of women in leadership positions in chiropractic institutions changes over time. In doing so, future research should attempt to address the limitations identified above by evaluating more international institutions and consider asking the institutions to participate in data collection to ensure data accuracy. This would also allow for assessment of leadership at multiple levels including middle management. Qualitative studies should be conducted to better understand the barriers and facilitators for women who have obtained leadership positions within chiropractic institutions, and for those trying to reach such positions in their career progressions. Intervention strategies to increase gender equality in chiropractic leadership in individual organizations and institutions should be studied and reported to inform more widespread efforts among the profession.

Conclusions

If the chiropractic profession is to meet the needs of a diverse population, and the changes within its own profession, there must be strategies in place to ensure that diversity, including gender, is represented. Male leaders

markedly outnumber female leaders in both principal and secondary leadership positions within American and Canadian chiropractic institutions. Given the increasing number of female students and practitioners, efforts must be made to similarly shift the gender distribution of chiropractic leadership, better reflecting the patients and professionals they serve.

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Appendix 1.
Organizations surveyed

Type of Organization	Name of Organization
Educational	Cleveland University D'Youville College Keiser University Life University Life University – West Logan University National University of Health Sciences – Illinois National University of Health Sciences – Florida New York College of Chiropractic Northwestern Health Sciences University Palmer College of Chiropractic – Iowa Palmer College of Chiropractic – Florida Palmer College of Chiropractic – West Parker University Sherman College of Chiropractic Southern California University of Health Sciences Texas Chiropractic College University of Bridgeport School of Chiropractic University of Western States Canadian Memorial Chiropractic College Université du Québec à Trois-Rivières
Advocacy	American Chiropractic Association International Chiropractic Association Canadian Chiropractic Association
Regulatory	Federation of Chiropractic Licensing Bodies
Accreditation	Council on Chiropractic Education
Examination	National Board of Chiropractic Examiners Canadian Chiropractic Examining Board
Accreditation and Regulatory	Federation of Canadian Chiropractic

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Overview of conditions seen on a Canadian Memorial Chiropractic College outreach to the Dominican Republic

Patricia Tavares, BSc, DC, FCCOS(C)[1]

Objective: *This study aims to gather information on conditions seen, treatments rendered, and referrals made during a Canadian Memorial Chiropractic College outreach to the Dominican Republic serving those in need.*

Methods: *Data was extracted from templated patient files retrospectively.*

Results: *Spinal, extremity and other/whole body chief complaints accounted for 71.79%, 24.64% and 3.57% respectively in patients ranging in age from 1.5 to 106 years whose data was collected. Mechanical pain accounted for 95.07% of all cervical, 96.81% of thoracic and 91.27% of lumbar spine diagnoses. Various non-mechanical conditions were also encountered.*

Manual therapy was performed in 96.10% of cases. Twenty referrals were made to urgent care, six to a

Aperçu des conditions observées pendant une mission du Canadian Memorial Chiropractic College en République dominicaine.

Objectif : *Cette étude vise à recueillir des données sur les conditions observées, les traitements administrés et les renvois effectués pendant la mission d'un établissement d'enseignement de la chiropratique en République dominicaine, au service des personnes dans le besoin.*

Méthodologie : *Les données ont été extraites de dossiers de patients.*

Résultats : *Les principaux symptômes des patients étaient des douleurs à la colonne vertébrale, aux extrémités et à toutes les parties du corps; elles étaient apparues respectivement chez 71,79 %, 24,64 % et 3,57 % des patients âgés de 1,5 à 106 ans. La douleur mécanique comptait pour 95,07 % de tous les symptômes cervicaux, 96,81 % des douleurs thoraciques et 91,27 % des douleurs lombaires. Divers troubles non mécaniques étaient aussi observés.*

Des thérapies manuelles ont été pratiquées dans 96,1 % des cas. Vingt patients ont été orientés vers des

[1] Department of Clinical Education, Canadian Memorial Chiropractic College

Corresponding author:
Patricia Tavares, Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, Ontario M2H 3J1
Tel: 416 482 2340
e-mail: ptavares@cmcc.ca

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World Spine Care clinic and 46 for further investigation, including local medical doctors or surgery.

Conclusion: *This study reports empirical data collected from an 11-day outreach to the Dominican Republic that provided otherwise unattainable chiropractic care for musculoskeletal complaints.*

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KEY WORDS: chiropractic, conditions, Dominican Republic, outreach, retrospective, short-term medical trips

établissements de soins d'urgence; 6 vers une clinique World Spine Care et 46 vers des médecins de la région pour subir d'autres examens, ou une intervention chirurgicale.

Conclusion : *Cette étude rend compte des données empiriques recueillies au cours d'une mission de 11 jours en République dominicaine au cours de laquelle des soins chiropratiques ont été offerts à des patients qui autrement n'auraient pas pu en bénéficier.*

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MOTS CLÉS : chiropratique, conditions, République dominicaine, sensibilisation, rétrospective, voyages médicaux de courte durée

Introduction

Chiropractic educational institution international outreach trips involving clinicians and interns/students have been carried out for many years. Although there is literature which lists such institutions and the countries that receive these outreach or mission trips[1], to this author's knowledge there has not been any chiropractic educational program that has published, in peer reviewed literature, details of their international outreach programs. Empirical evidence describing conditions seen on any short-term outreach trips is lacking.

Since 2008, Canadian Memorial Chiropractic College (CMCC) has organized annual student outreach trips to the Dominican Republic (DR). These trips address musculoskeletal (MSK) disorders through primary chiropractic care to people in underserved communities across this developing country which has a lack of easily attainable chiropractic care. Locations visited include local community centres, churches and public hospital settings within various cities and villages chosen ahead of time by a host medical doctor. The doctor has been involved with CMCC's outreaches since 2008 and is familiar with the location of underserved communities and their need for MSK/spinal care. The outreach is typically advertised in advance in each host location by local media, describing the event as a free mobile clinic for the treatment of problems with the spine, muscles and other joints of the body.

To narrow the gap in the literature concerning a lack of research on empirical data from such international outreach programs, the objectives of this study are to gather information on what conditions were seen during CMCC's 11-day outreach in 2017 to the Dominican Republic. This information includes aggregated data on musculoskeletal and non-musculoskeletal conditions, as well as treatment rendered, including manual therapy, and, when necessary, referrals, such as for imaging, blood work, surgery or further investigation with an appropriate health care professional within the local health care system. This study may be useful for planning future trips by this or other similar institutions.

Methods

Outreach program clinical processes

In 2017 this outreach team to the DR was comprised of two clinicians, who were employed by CMCC to oversee interns in its clinics, and 12 chiropractic students enrolled at CMCC. The students were interns in the final stages of their internship year who had applied for and met pre-requisites for the outreach trip. Prerequisites for the 2017 outreach included having already met specific clinical requirements of their internship year and providing a letter of intent and letters of reference from inside and outside CMCC. The clinicians who attended the outreach with the interns were not involved in the selection of applicants.

The 2017 CMCC outreach team was supported locally by the bilingual host medical doctor, a nurse and several medical students. The latter served as translators in addition to other local translators.

A number of local volunteers assisted the team. All local volunteers were people who reside in the Dominican Republic. Intake volunteers largely only spoke Spanish. The local medical students and other translators were bilingual and served to help the interns and clinicians with the patient encounters.

For this outreach a standard template intake form was developed in advance in order to accumulate data on a consistent basis. Potential clinical impressions[2](CI)/diagnoses commonly seen in a chiropractic setting, and typically seen in CMCC's own clinics, were listed together with tick boxes to allow for ease of data collection. Any CI/diagnoses not listed could be added in an "other" box. Additional notes could be written as necessary. This allowed for an efficient yet robust collection of data points for purposes of this study.

At each clinic location visited during the outreach, local Spanish-speaking volunteers called each person to sit at a table with them to fill out the first page of the clinical file which included an explanation of chiropractic. They were also informed that their file could be used for research in the future after the group's return to Canada. If the patient consented to this, a signature was obtained, and an identification number was placed on the consent form and also on the patient intake file pages. All but one individual agreed to allow their file to be used for research. That patient was examined and treated but their file was not analyzed subsequently. Ultimately 1123 patients were seen.

All patients who wanted a consultation and treatment sat with the local Spanish-speaking volunteers, who recorded their basic demographic information. The volunteers asked them, in Spanish, to answer the templated basic health history questions on the standard intake form. These included the chief complaint and secondary complaints, if applicable, together with a pain diagram, as well as previous surgeries, traumas and other red flags. The patients were also screened for any possible current active viral infections that may have needed them to be referred out for medical evaluation immediately (including fevers, skin rashes, and painful or red eyes). Various common comorbidities and health problems, as listed in the intake form, were also specifically screened for. Further questions were asked, including whether they were aware of having had a mosquito borne viral infection in the past such as zika, chikungunya and dengue. All these items were recorded on the templated form written in Spanish that served as the first page of their clinical record and ensured that each patient was asked the same questions.

Each intern then called in a patient and took their height, weight and blood pressure. After reviewing the chart, interns performed a further history on primary and secondary complaints, using one of the local translators. With consent, an exam was performed, under the supervision of the two CMCC clinicians, and notes were recorded in the paper intake form. The intake form was structured in a template format allowing note takers to check off boxes for findings as well as for a variety of CI/diagnoses, and also to write out any additional notes as necessary. Once the clinicians approved of the examination and CI/diagnosis rendered by the intern, consent was obtained for treatment. Treatment was rendered as appropriate, including manual therapy as well as exercises and advice with the help of a translator. When a CI/diagnosis was rendered that required referral, urgent or otherwise, whether related to the presenting complaint or to a condition noticed by the intern/clinician based on the examination or health history, appropriate referrals were arranged immediately. The local medical students, host doctor and nurse, who formed part of our team, were called upon to secure and expedite any referrals made.

Patients were seen for a single visit, given the structure of this mobile clinic. In a very limited number of cases, an additional treatment may have been rendered the following day if necessary and if the next day's location was close by the previous one. In such cases, the patient was instructed to return to the same intern to avoid having to queue up again and refill paperwork.

Study methods

This was a retrospective chart review done on the records of people who attended the 2017 CMCC outreach to the Dominican Republic. Ethics approval for this study was obtained from the Office of Research Administration of CMCC, under Certificate No. 1702X03 and by the Dominican Republic Ethics Council CONABIOS under issued letter number 007-2017. Patient records were maintained in a de-identified format separate from the

signed consent forms. Files were housed in a locked storage area within the campus clinic of CMCC. All but one patient consented to the use of their data.

Data entry from the patient records was performed by a recent chiropractic graduate not involved in the outreach trip. The data entered was then reviewed by one of the outreach clinicians for input accuracy. Data from any clinic attendees who decided to leave prior to being seen by an intern for consultation were excluded from data entry and thus do not form part of the reported population.

The data entered included demographic information, such as age, sex, height and weight (reported as body mass index (BMI)) and occupation. It also included findings such as chief complaint, secondary complaint, comorbidities, review of systems, red flags, CI/diagnoses as listed in the file, treatment rendered, referrals made and previous infectious diseases. The CI/diagnoses related to conditions seen were then classified into mechanical or non-mechanical, for the various regions of the body, covering the spine and extremities. Mechanical low back pain or pain that some refer to as non-specific low back pain is defined as pain not caused by specific pathologies (e.g., fracture, dislocation, tumor, infection or systemic disease).[3,4] This definition was used by this author to apply not only to CI/diagnoses related to the spine but to those of the extremities as well. In this study, radiculopathies with and without back pain were considered non-mechanical. For neck pain, mechanical referred to Grades I and II as classified by Haldeman *et al*.[5] Grade III neck pain was considered non-mechanical due to neurologic involvement. Where other nerve related disorders were seen, such as nerve entrapments or polyneuropathies for example, those were also considered non-mechanical.

The statistical analysis for this study was generated using SAS software v9.4. (Copyright © 2012-2018, SAS Institute Inc., Cary, NC, USA) SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA. The analysis comprised mean and standard deviation (where applicable), for demographic data, and percentages for data collected on conditions seen.

Results

Demographic information related to the patients from this data set is provided in Table 1, reflecting a diverse range of age, sex and BMI characteristics for the population. Patients who attended had a mean age of 57 and included 39 patients under 20 years of age, and 91 patients over the age of 80. Two thirds were female, and the majority of patients were found to be in the overweight or obese categories of the BMI.

The full list of mechanical and non-mechanical conditions, by region of the body, that were templated on the 13-page intake form, can be found in Table 2. Of this

Table 1.
Basic descriptive information of the study sample.

	N	Male	%	Female	%	
Sex (N)	1121	375	33.45	746	66.55	
	N	Range	Minimum	Maximum	Mean	Std deviation
Age (Value)	1121	104.5	1.5	106	56.84	17.69
	N	0 – 19	20 – 39	40 – 59	60 – 79	80 +
Age Distribution (N)	1121	39	144	412	435	91
	N		Minimum	Maximum	Mean	Std deviation
BMI (Value)	1062		8.77	55.25	27.09	5.43
	N		0.0 – 18.5	18.5 – 25.0	25.0 – 30.0	30.0 +
BMI Category (N)	1062		37	353	400	272

N = Number of Values Captured (values below N=1122 reflect missing data points)

Table 2.
Clinical impressions/diagnoses templated and rendered, divided into mechanical and non-mechanical.

Mechanical		**Non-Mechanical**	
Templated potential diagnoses /clinical impressions	**Suspected /rendered**	**Templated potential diagnoses /clinical impressions**	**Suspected /rendered**
Cervical spine		**Cervical spine**	
Mechanical pain (facet and muscle) i.e. grade 1/2 NAD	✓	Spondyloarthropathy	✓
Strain/myofascial pain syndrome	✓	Radiculopathy i.e. Grade 3 NAD	✓
Sprain		CSM (Cervical Spondylotic Myelopathy)/ cord compression	✓
Congenital torticollis		Migraine headache	✓
Cervicogenic headache	✓		
Tension headache	✓		
TMJ dysfunction (including disc/myofascial origin)	✓		
Thoracic spine		**Thoracic spine**	
DDD/DJD	✓	Fracture	✓
Facet/Costovertebral Joint Dysfunction/sprain	✓	Spondyloarthropathy	
Discal Lesion		Radiculopathy	
Strain	✓	Viscerosomatic referral pain from gall bladder	✓
		Shingles	✓
		Kidney infection or stones	✓
Lumbar spine		**Lumbar spine**	
Discogenic non-radicular	✓	Spondyloarthropathy	✓
Myofascial pain syndrome	✓	Radiculopathy/nerve root impingement	✓
Mechanical LBP w/ facet	✓	Neurogenic claudication	✓
Thoracolumbar syndrome	✓		
Sacroiliac Syndrome/dysfunction	✓		
Foot/Ankle/Leg		**Foot/Ankle/Leg**	
Joint dysfunction	✓	Fracture	
Osteoarthritis	✓	Infection	✓
Plantar Fasciitis	✓	Neuropathy	✓
Sprain	✓	DVT/thrombophlebitis	✓
Synovial impingement		Rheumatoid arthritis	✓
Tendinopathy	✓		
Elbow/Wrist/Hand		***Elbow/Wrist/Hand***	
Osteoarthritis	✓	Fracture	✓
DeQuervain's tenosynovitis	✓	Infection	
Benign hypermobility syndrome		Rheumatoid arthritis	✓
Tendinopathy	✓	Carpal tunnel syndrome	✓
Medial / Lateral epicondylitis	✓	Radiculopathy	✓
Trigger finger	✓	Thoracic outlet syndrome	✓
Dupuytrene's contracture	✓	Polyneuropathy	✓
Strain	✓		
Sprain	✓		
TFCC sprain			
Scapholunate instability			

Table 2. – Continued

Clinical impressions/diagnoses templated and rendered, divided into mechanical and non-mechanical.

Mechanical		Non-Mechanical	
Templated potential diagnoses /clinical impressions	**Suspected /rendered**	**Templated potential diagnoses /clinical impressions**	**Suspected /rendered**
Shoulder			
Impingement	✓		
Osteoarthritis	✓		
Instability/SLAP (labral)	✓		
Rotator cuff lesion	✓		
Adhesive capsulitis	✓		
Tendinopathy	✓		
AC Separation	✓		
Subacromial bursitis			
C/Spine referral			
Strain	✓		
Knee		***Knee***	
Internal derangement/meniscus	✓	Infection	
Osteoarthritis	✓	Rheumatoid arthritis	✓
Strain	✓		
Sprain	✓		
Tendinopathy	✓		
Patellofemoral pain syndrome	✓		
Plica irritation			
Hip		***Hip***	
Bursitis	✓	Legg-Calve-Perthes	
FAI	✓		
Tendinopathy	✓		
Labral tear			
Transient hip synovitis			
Slipped capital femoral epiphysis			
Osteoarthritis	✓		
Other *	✓	***Other *****	✓

Other* – includes joint dysfunction not templated and club foot

Other** – includes neurologic (post stroke paralysis/weakness, brain injury, other neurodegenerative diseases like Parkinson's), cerebral palsy, Bell's palsy, tumors, headache of unknown origin, whole body pain, dislocations, deformities, enlarged testicle, primary abdominal pain, leg/foot ulcers, venous disease, infection

LBP- low back pain; TFCC- triangular fibrocartilage complex ; FAI- Femoral Acetabular Impingement; NAD- Neck Pain Associated Disorder; DVT- deep vein thrombosis; SLAP- superior labrum anterior and posterior; DDD- degenerative disc disease ; DJD- degenerative joint disease

detailed list of potential conditions, those marked with a checkmark in Table 2 are those that were suspected or rendered as CI/diagnoses in this patient population. The majority of conditions templated were in fact diagnosed and those without a check mark were those conditions not encountered. There were some conditions seen that were not templated individually (captured as "other"), which may serve to inform similar future studies done by other institutions or CMCC.

Table 3 provides a summary of data related to region of complaint, CI/diagnoses rendered, manual therapy and referrals. Spinal chief complaints, being the majority of the presenting complaints, are further split into cervical, thoracic and lumbar complaints, and the data is categorized between mechanical and non-mechanical conditions. The majority of patients were treated with manual therapy. Approximately 6.4% of patients either required referral for urgent care or further investigation or were sent to a local World Spine Care clinic.[6]

As described in the Outreach Program Clinical Processes section above, patients were screened for various comorbidities and problems with their health, as well as an awareness of a history of certain viral infections, all of which were self-reported. This data is provided in Table

Table 3.
Summary of region of complaint, clinical impression/diagnoses rendered, manual therapy and referrals.

Chief complaint		**Total**	**Spine**	**Extremity**	**Other/whole body**
	N	1120[#]	804	276	40
	%		71.79	24.64	3.57
Chief complaint – spine		**Total**	**C Spine**	**T Spine**	**L Spine**
	N	804	265	122	417
	%		32.96	15.17	51.87
Both chief and secondary complaints combined – spine		**Total**	**Mechanical**	**Non-mechanical**	**Both**
Cervical spine	**N**	325	297	16	12
	%		91.38	4.92	3.69
Thoracic spine	**N**	251	237	8	6
	%		94.42	3.19	2.39
Lumbar spine	**N**	527	481	46	0
	%		91.27	8.73	0
		N	**Yes**	**No**	**%**
Manual therapy rendered		1076*	1034	42	96.10
		N	**Yes**	**No**	**%**
Referral to urgent care		1122	20	1102	1.78
Referral for further investigation		1122	46	1076	4.10
Referral to World Spine Care clinic		1122	6	1116	0.53

N = Number of Values Captured
Other refers to non-MSK related complaints
[#] 2 missing data points
* 46 missing data points

4. In particular, the most commonly reported comorbidities were hypertension, arthritis, stomach problems and diabetes. Furthermore, a majority of patients self-reported that they had previously been infected with chikungunya.

Discussion

According to Sykes[7], there are few published studies which report empirical evidence of the activities and outcomes of short-term medical service trips. Stone[8] reports that articles that write about short term medical service trips are often anecdotal, narrative, or focused solely on the quantity of services offered. Although outreaches have occurred with various chiropractic educational institutions for many years, there has not been a detailed account in the peer reviewed literature as to empirical findings on these short-term outreach trips. Consequently, this study's findings intend to narrow this gap.

This retrospective chart review details the MSK conditions that presented, treatments rendered, and referrals made during CMCC's 2017 outreach trip. In order to be able to report on these findings, a robust templated patient intake form was used throughout the trip. Of the MSK cases that presented, the majority involved the spine and, of those, over 91% were mechanical in nature. Most patients seen on the outreach were treated on location with manual therapy (manipulation/mobilizations and or soft tissue therapy) and, where appropriate, the provision of exercises and advice.

While the empirical evidence collected showed that most presenting conditions were of a mechanical nature, non-mechanical conditions, whether presenting as a complaint or as a concomitant finding, included suspected or known tumors, neurodegenerative diseases, viscerosomatic referrals, spondyloarthropathies, fractures and leg wounds. Some unusual cases were encountered among the patients seen. These included club foot in a 5-year-old

Table 4.
Summary of screened self-reported comorbidities and problems with health.

	N	Yes	No	%
Diabetes/problems with sugar	1121	177	944	15.79
Hypertension	1121	457	664	40.77
Problems with thyroid	1121	70	1051	6.24
History of cancer	1121	10	1111	0.89
Arthritis	1121	316	805	28.19
Osteoporosis	1121	104	1017	9.28
Heart Problems	1121	114	1007	10.17
Asthma	1121	48	1073	4.28
Pulmonary problem	1121	69	1052	6.16
Stomach problems	1121	270	851	24.09
Depression	1121	115	1006	10.26
Dengue	1042	63	979	6.05
Chikungunya	1042	654	388	62.76
Zika	1042	105	937	10.08

N = Number of Values Captured (values below N=1122 reflect missing data points)

child, a suspected diabetic toe ulcer, a suspected venous leg ulcer in accordance with the CEAP classification system that this author has experience using[9,10], a post-fracture pin that was distinctly protruding from the arm of a patient, and a left 3rd metacarpal osteoblastoma sent to surgery at no cost to a twelve-year old patient.

Diabetes and hypertension were two of the most common comorbidities that patients self-reported. Anecdotally, some patients admitted to not taking prescribed medications consistently. The International Diabetes Federation (IDF) highlights the extent to which the poor are affected by diabetes within low and middle-income countries and have less access to diabetes medications such as metformin and insulin.[11] According to Dethlefs *et al*.[12] complications of diabetes and hypertension, such as ischemic heart disease and cerebrovascular disease, together with diabetes account for 57.7% of premature deaths in the DR. The multidisciplinary nature of this outreach meant that those people whose non-MSK conditions such as diabetes and hypertension were of concern, including visible complications, could easily consult with the medical doctor or nurse that was part of the team.

Another self-reported data point in this study population was in relation to previous infection with the chikungunya virus, which is an arthropod-borne alphavirus primarily transmitted by Aedes mosquitoes that are endemic in the Americas.[13] In 2014 there was an outbreak in the Dominican Republic.[14] Chikungunya is known to have a high symptomatic attack rate among infected people, with 50%–97% developing clinical disease with fever and polyarthralgia.[13] Goupil and Mores[15] have reported that the arthralgia that can develop from this virus can be severe and chronic, lasting months to years. Some of the patients that were seen during this outreach reported to us that they believed their current joint pains originated from this prior infection. Future studies could look at the longevity of suffering of those previously infected with the virus.

Although short-term medical trips have been criticized in the literature as providing care that is unsustainable, self-serving, burden imposing, inappropriate, and ineffective[16], this outreach team recognized these issues and sought to help mitigate them, to an extent, by working with local health care resources. This occurred through the involvement of the local medical doctor, nurse and medical students during the trip for immediate care. Their involvement was also used for referrals to the local health care system primarily to facilitate further appropriate medical care.

This study demonstrates the procedures undertaken during this CMCC outreach to the DR providing free chiropractic care to underserved communities, predetermined to be in need by a local medical doctor. It can inform other groups planning such trips with regards to the types of conditions that might be encountered and the benefits of coordination with local medical practitioners. Together with the description of the methods used to capture data, this may serve to assist such groups in planning for their outreaches and potential future studies.

Future studies could additionally plan a follow-up with patients, where possible, to assess how they feel post outreach and to gather information on whether advice and exercise therapy given on the outreach was being followed.

Limitations

A limitation of the study is that a double entry method was not used for the data entry but rather the data input was checked by one of the outreach doctors. This could have led to errors in data entry.

There are many limitations in gathering data such as this. There were many different notetakers who attempted to see a large number of people in a short period of time whilst adhering to standard protocols. This could lead to inaccuracies in data capture. The need for and use of translators also introduces an additional risk of data inaccuracy.

All of the diagnoses rendered were clinical impressions or suspected diagnoses based on a hands-on physical exam performed to the interns' best ability considering the available conditions of the outreach. In addition, simple radiographs that accompanied some patients were sometimes of poor quality, and any reports provided were written in Spanish which also impacted the accuracy of the diagnoses made.

A further limitation is that the study relied on self-reporting of comorbidities and infectious disease history, which may be unreliable since this predominantly socio-economically disadvantaged population may not have had access to accurate diagnostic testing or have even been seen by a medical professional. Intake form volunteers may also not have asked or recorded questions appropriately.

Conclusion

Conditions seen on this 2017 CMCC outreach, which visited multiple communities over 11 days across the northwest region of the DR, included those that were considered mechanical and non-mechanical. Mechanical pain accounted for 95.07% of all cervical, 96.81% of thoracic and 91.27% of lumbar spine diagnoses. Manual therapy was performed in 96.10% of cases. Twenty referrals were made to local urgent care, six to a World Spine Care clinic within the country and 46 for further investigation, including local medical doctors or surgery.

The outreach provided otherwise unattainable chiropractic care in various underserved communities for musculoskeletal complaints and connected patients back into their health care system where necessary and possible.

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Australian chiropractic students' perceptions of education: validation of a questionnaire

Stanley I Innes, BApp Sc (Chiro), M Psych, PhD[1]
Norman Stomski, PhD[1]
Charlotte Leboeuf-Yde, DC, PhD[1,2]
Bruce F Walker, AM, DC, MPH, DrPH[1]

Background: *This study aimed to validate a questionnaire to address an absence of a measure to evaluate Australian chiropractic students' perceptions of the quality of chiropractic programs.*

Method: *Potential relevant questionnaire items were selected from the Australian chiropractic accreditation standards. Chiropractic students rated these items for clarity and relevance, which resulted in a pilot questionnaire of 47 items. Principal components analysis was used to establish the structure of the scales. Finally, intra-class correlation coefficients were used to establish the scales' test-retest reliability.*

Results: *Thirty-four items were omitted resulting in the retention of 13 items that strongly loaded onto five factors. Internal consistency was adequate. The test-*

Ce que pensent des étudiants Australiens en chiropratique des programmes de formation : validation d'un questionnaire

Contexte : *Cette étude visait à valider un questionnaire destiné à combler le manque d'outils pour connaître l'opinion d'étudiants australiens en chiropratique de la qualité des programmes d'études.*

Méthodologie : *Des points, éventuellement pertinents, ont été choisis en fonction des normes australiennes d'agrément en chiropratique. Des étudiants ont évalué leur clarté et leur pertinence; un questionnaire pilote comprenant 47 questions a été établi. Les points principaux ont servi à établir la structure des échelles. Des coefficients de corrélation interclasses ont servi à établir la fiabilité du test-retest des échelles.*

Résultats : *Trente-quatre points ont été rejetés; on en a conservé 13 portant surtout sur cinq facteurs. La cohérence interne était suffisante. La fiabilité du test-*

[1] College of Science, Health, Engineering and Education (SHEE), Murdoch University, Murdoch, Australia
[2] Institute for Regional Health Research, University of Southern Denmark, DK-5000 Odense, Denmark

Corresponding author: Stanley I Innes, College of Science, Health, Engineering and Education (SHEE), Murdoch University, Murdoch, Australia
Tel: +61-8-9360-2841
E-mail: s.innes@murdoch.edu.au

Abbreviations
CCE-A: Council on Chiropractic Education of Australasia
CCE-I: Council on Chiropractic Education International
DREEM: Dundee Ready Education Environment Measure
ICC: Intra-class correlation coefficients
I-CVI: Item- Content Validity Index

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retest reliability ranged from adequate to good for four of the derived factors. The fifth was poor and omitted.

Conclusion: *A valid questionnaire for assessing Australian chiropractic programs has been developed comprising four scales that enquire about: 1) quality of the educational program; 2) provision of student support services; 3) enablement of independent learning; and 4) adequacy of teaching resources.*

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KEY WORDS: Education, Chiropractic, Outcome, Validation, Accreditation

retest allait d'adéquate à bonne pour quatre des facteurs dérivés. Le degré de fiabilité du cinquième était faible et celui-ci a été omis.

Conclusion : *On a élaboré un questionnaire utile servant à évaluer des programmes d'études en chiropratique offerts en Australie. Quatre échelles ont servi à sonder les étudiants sur 1) la qualité des programmes de formation; 2) les services d'aide aux étudiants; 3) l'enseignement individualisé; et 4) la suffisance des ressources pédagogiques offerte.*

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MOTS CLÉS : formation, chiropratique, résultats, validation, agrément

Introduction

Education programs that train health professionals are required to meet standards set by regulatory bodies. The intent is to protect the public and provide high quality health care by ensuring competent training.[1] There has been increasing interest in education environments and their role in professional health care training.[2] Recent research has identified the need for quality measures of the learning environment for medical accreditation and accreditation process.[3-6] This has also been raised as an issue for chiropractic accreditation.[7-11]

It is proposed that the educational environment consists of two main aspects: tangible and intangible factors.[12] Tangible factors encompass objective components, such as the physical infra-structure of classrooms, training facilities, and equipment.[12,13] Intangible factors are subjective and include subtle features such as the "personality" traits of an institution.[12] These intangible factors can be difficult to objectively measure.[14] However, they are manifested in students' everyday experiences and perceptions, which provide an avenue for measurement.[15] Consequently, students are increasingly being recognised as a key source of information for assessing the educational environment particularly for re-accreditation purposes.[16] However, at present there is no gold standard for assessing medical students' perceptions of the learning environment.[6]

Such a gold standard would ideally possess evidence for validity of content, response process, internal structure and relationship to other variables.[6] Further it would be a 'nimble' questionnaire that is efficient to administer and complete, widely applicable and sensitive to change over time.[6]

The most common method for developing items in such questionnaires is to use sources thought to be related to the student experience. For example, one of the most widely used, the Dundee Ready Education Environment Measure (DREEM)[17], was developed based on the Dundee University Medical School records of the curriculum planning committee meetings. The intent was to develop items that would measure the targets of 'Health for All by the Year 2000' i.e., a person's ability to work productively and participate actively in the social life in the community in which they live.[18] Another questionnaire, the Postgraduate Hospital Environment Measure (PHEEM), employed Postgraduate Deans and Educational Supervisors to develop and agree on a list of possible items based on a literature review.[19] Hence, none of these two commonly used assessment tools used as their source of inspiration formal accreditation documentation. By deriving items from such documentation the questionnaire would potentially be 'purpose built' and 'nimble'.

Presently there has been a shift in the approach by accrediting agencies to move toward a model of outcomes-based education.[20,21] No longer do accreditation standards prescribe detailed specified curriculum content. Rather, each institution is expected to provide the means

to achieve the desired educational outcomes as well as systems for its assessment. Therefore, it would seem logical to take the regulators' expected student experiences and assess in the target population students themselves as evidence for re-accreditation purposes.

It is evident that there is a need to develop a psychometrically robust and 'nimble' tool for the evaluation of health education programs for accreditation purposes. Such a questionnaire should provide important information to be used to improve the quality of educational outcomes. Therefore, the aim of this study is to produce a valid and reliable questionnaire that captures the students' perceptions of the quality of their professional education, using chiropractic students as an example.

Methods

Human Research Ethics Committee approval was granted by Murdoch University (Project No 2017/ 112).

Development of the preliminary questionnaire

The initial questionnaire items were derived from the CCE-A 2009 and 2017 accreditation and competency standards.[1,22] Both standards were used because the study occurred during a transition period between the 2009 and 2017 standards. This is represented in Figure 1.

The educational standards were downloaded and any criteria that related to students were extracted and copied verbatim. This created an initial item set that was refined by splitting double-barrelled statements into separate statements (See Appendix 1). Some items were then reworded to enhance their clarity or transform statements into questions. For example, the criterion "It is required that programs have a balance between formative and summative assessment", was rephrased as "Do you agree that the chiropractic program has assessment that is balanced between formative and summative assessment?" Finally, items were deleted if they were considered by the research team to be an unrealistic expectation, or largely irrelevant to students' evaluation of the quality of a CP. For example, the item "Do you agree that the chiropractic program has an admission policy that is consistently applied?" implies that students are not only aware of the presence of an admission policy, but also its content and the degree to which it is consistently applied and its subsequent impact on the CP quality.

The initial list consisted of 67 potential items (Appendix 1). After splitting double-barrelled statements into separate statements, it consisted of 71 items. Irrelevant items (18) were removed. This refined this initial item set to 53 questions distributed across the following six domains: Chiropractic Program; Student Experience; Student Assessment and Learning; Staff; Resources; and the Teaching Clinic.

Panels on two occasions used a Content Validity Index

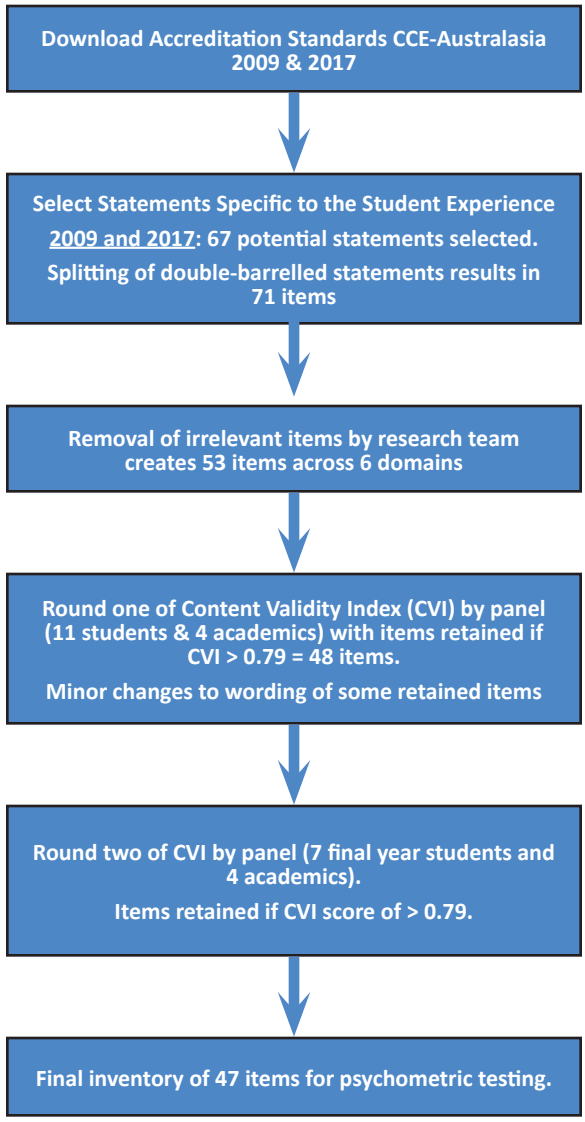

Figure 1.
Flowchart of method used to derive survey items.

(CVI) to assess the content validity of the refined initial item set.[23,24] The composition of these panels accorded with guideline recommendations, which state that CVI panels should comprise six to twelve participants with backgrounds representative of the target population.[23,24] We therefore recruited chiropractic students.

All fifth-year chiropractic students were asked if they would like to join the panels by chiropractic staff who did not have any classroom involvement with them. On the first occasion, the panel consisted of 11 chiropractic students who responded to this invitation. Each panel member assessed each item using four categories: not relevant; needs major revision; needs minor revision; and very relevant. Consistent with guideline recommendations, a value of '*one*' was awarded to either the "needs minor revision" or "very relevant" categories, and '*zero*' was awarded to either the "not relevant" or "needs major revision" categories.[23,24] An Item-Content Validity Index (I-CVI) was calculated for each item by summing the values for each rater and then dividing by the number of raters. Based on previous research, an item was retained if its I-CVI was greater than 0.79.[23,24] Of the 53 questionnaire items reviewed, five recorded an I-CVI below 0.79 and were subsequently deleted.

The student panel also made written recommendations to improve the phrasing of the some of the 48 items that were retained from the initial item set. A smaller focus group comprising five chiropractic students who were involved in the study as part of their undergraduate study was then held to incorporate the feedback to improve the wording of the remaining items.

Next, a panel was convened to evaluate the content of the rephrased 48 items with a CVI, using the same method and criteria as described above. This panel consisted of seven chiropractic students who volunteered to further assist from the original 11-student-panel along with four chiropractic academics. On this occasion, all but one of the items recorded an I-CVI value above 0.79, resulting in a final pilot questionnaire comprising 47 items (Appendix 1).

The final pilot questionnaire was distributed to all fourth and fifth year chiropractic students at Murdoch University on two occasions at a three week interval. This time interval has been shown to reduce the potential for learning, carry-over, and recall effects.[25,26] The rating of each item ranged from 'strongly disagree' (assigned a score of 1), 'disagree' (a score of 2), 'Neither agree nor disagree' (a score of 3), 'Agree' (a score of 4) and finally 'Strongly agree' (a score of 5). The questionnaire was administered twice in order to examine its test-retest reliability.

Data analysis

Factor analysis is a statistical procedure that simplifies data by reducing many individual items into a fewer number of items.[27] In order to establish the structure of the scales in the questionnaire so that they contained the least number of items and explain the most amount of variance we performed a principal components analysis with a varimax rotation. It was determined a priori that the principal components analysis would be undertaken from data obtained from the administration of the questionnaire on the first occasion. It is generally agreed that an item is of appropriate written quality (strength) and should be retained if it shares a value of at least 0.45 or higher with other items in its domain[27]; by not sharing excessive variance (cross-loading) with other domains of greater than 0.32[28]; and the item conceptually fitted with other items on the component[29].

For the validity testing, Cronbach's alpha was used to examine the internal consistency of the scales that were derived from the retained items to determine whether all items within a scale tapped the same construct. A two-way mixed effects, absolute agreement Intra-class correlation coefficients (ICC) model was used to establish the scales' test-retest reliability. Finally, floor and ceiling effects were explored by calculating the proportion of respondents who achieved minimum or maximum total scale scores. Floor or ceiling effects are considered to be present in a sample size of at least 50 people if more than 15% of respondents achieved the lowest or highest possible score, respectively.[26] All data were entered and analysed in SPSS v.24.

Results

For the flow of the study, number of participants and final questionnaire construction, see Figure. 1. In total, on the first administration the pilot questionnaire was completed by 78 students out of 111 (response rate of 70%) and 60 students (54%) on the second administration. In all, 56 students completed the questionnaire at both time points.

Questionnaire's structure

Of the 47 items in the pilot questionnaire, the factor analysis technique omitted 34 items because they were either not correlated "strongly" enough with a factor (low factor loadings) or were significantly related to a number of factors (cross-loadings). This resulted in the retention of 13 items, which strongly loaded onto five factors (Tables 1 and 2) that accounted for 70% of the total variance. These factors were conceptualised as: Factor 1: Program Quality; Factor 2: Student Support; Factor 3: Developing Independence; Factor 4: Learning Resources; and Factor 5: Teaching Clinic Staff Support of Students.

Table 1.
Total variance explained by the five extracted factors

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.17	24.37	24.37
2	1.79	13.78	38.15
3	1.67	12.84	50.99
4	1.23	9.46	60.45
5	1.19	9.12	69.56

Table 2.
Five factor structure of the 13 extracted items.

Rotated Component Matrix[a]	Component				
	1	2	3	4	5
Factor 1: Program Quality					
P2 The CP promotes high quality teaching.	0.72				
P4 The CP seeks to minimize risks to the students while they are learning	0.54				
P5 The CP seeks to continually improve the program	0.66				
P6 The CP content is based on evidence-based practice	0.79				
Factor 2: Student Support					
S1 Students have ways to deal with concerns or complaints		0.63			
S3 The CP provides emotional well-being support services for students		0.88			
S4 Student support services are provided by qualified personnel		0.79			
Factor 3: Developing Independence					
S11 The CP ensures that students are prepared to be responsible for their learning processes				0.86	
S12 The CP ensures that students are prepared to become lifelong learners				0.84	
Factor 4: Learning Resources					
R2 The CP provides adequate access to on-line resources			0.91		
R3 The CP lecture rooms are satisfactory			0.91		
Factor 5: Teaching clinic staff					
TC4 The teaching clinic staff are easy to gain access to					0.85
TC5 The teaching clinic staff support the students					0.81

Extraction Method: Principal component analysis.
Rotation nethod: Varimax with Kaiser Normalization.[a] a. Rotation converged in 6 iterations.

Test-retest reliability

Table 4 displays the ICC values for all scales. Moderate levels of reliability were observed for scales F1 (Program Quality), F2 (Student Support), F3 (Developing Independence), and good reliability was obtained for the F4 (Learning Resources) scale.[30-32] Poor reliability was observed for the F5 (Teaching Clinic Staff) scale, which was consequently deleted, leaving a questionnaire comprising 11 items distributed across four scales. Examining the ICC for the remaining four scales combined together yielded a value of 0.95 (95% CI= 0.93-0.96), which indicated excellent reliability for the overall scale.

Internal consistency

The Cronbach alpha values for each of the four retained scales ranged from 0.62 to 0.83, which indicates that all four scales had adequate levels of internal consistency (See Table 3) [33,34]. The overall scale Cronbach alpha was excellent at 0.95.

Table 3.
Internal consistency and test-retest reliability

Factor	Scale	Cronbach Alpha	Intra-class correlation coefficient (95% CI)
1	Program quality	0.62	0.56 (0.26 – 0.74)
2	Student Support	0.71	0.69 (0.47 – 0.82)
3	Developing Independence	0.73	0.64 (0.38 – 0.79)
4	Learning Resources	0.83	0.79 (0.63 – 0.87)
5	Teaching clinic staff	0.64	0.41 (0.00 – 0.65)
Total Score	Overall	0.95	0.95 (0.93 - 0.96)

Table 4.
Item frequencies of items retained in final questionnaire.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Factor 1: Program Quality					
The CP promotes high quality teaching.	1.3	1.3	14.5	65.8	17.1
The CP seeks to minimize risks to the students while they are learning	2.6	9.2	57.9	30.3	
The CP seeks to continually improve the program	2.6	5.3	21.1	47.4	23.7
The CP content is based on evidence-based practice			5.3	42.1	52.6
Factor 2: Student Support					
Students have ways to deal with concerns or complaints	6.6	2.6	23.7	50.0	17.1
The CP provides emotional well-being support services for students	1.3	10.5	32.9	42.1	13.2
Student support services are provided by qualified personnel		4.0	28.0	48.0	20.0
Factor 3: Developing Independence					
The CP ensures students are prepared to be responsible for their learning processes	1.3	1.3	9.2	56.6	31.6
The CP ensures students are prepared to become lifelong learners		3.9	10.5	55.3	30.3
Factor 4: Learning Resources					
The CP provides adequate access to on-line resources		6.5	10.4	66.2	16.9
The CP lecture rooms are satisfactory		11.7	14.3	53.2	20.8

Table 5.
Descriptive statistics for final scales

	N	Minimum	Maximum	Mean	Std. Deviation
Factor 1: Program Quality	56	9.00	20.00	16.63	2.06
Factor 2: Student Support	55	7.00	15.00	11.15	1.99
Factor 3: Developing Independence	55	4.00	10.00	8.30	1.26
Factor 4: Learning Resources	56	4.00	10.00	7.86	1.54
Valid N (listwise)	54				

Descriptives for the final questionnaire

Table 4 displays the frequencies for all items in the retained four scales. Means and standard deviations for the four retained scales and overall total scale score are presented in Table 5. The proportion of respondents who achieved either the minimum or maximum score did not exceed 15% for any of the retained four scales, which meant that no ceiling or floor effects were observed.[35,36]

Discussion

This is the first study we are aware of that has sought to develop a questionnaire to assess the chiropractic student study experience by using the regulators' own accreditation standards; a questionnaire that could be used by chiropractic schools to monitor students' perceptions of the quality of their course and for accreditation purposes. The final questionnaire demonstrated adequate internal consistency and test-retest reliability.

Our report details the development of a questionnaire that was designed to assess the quality of Australian chiropractic educational programs. It comprises 11 items in four scales that enquire about: 1) quality of the educational program; 2) provision of student support services; 3) enablement of independent learning; and 4) adequacy of teaching resources. In addition, psychometric testing showed that these four scales can be combined to provide an overall summary measure of the students' opinions of the quality of the chiropractic program.

The item reduction techniques employed in this study accord with best practice recommendations for the development of outcome measures.[26] Our interrogation of the questionnaire's structure yielded a parsimonious item set that clearly delineated four discrete constructs. However, deletion of redundant items resulted in an item set that did not assess areas of chiropractic programs such as the appropriateness of student assessments, quality of staff and teaching clinic environment. Many of the redundant items were deleted because of item cross-loading between factors, which indicates a lack of conceptual clarity for the formulation of the redundant items. It may be worthwhile to re-examine the content of the scales to identify item sets that more clearly assess the constructs that encompass student assessments, staff quality and the teaching clinic, given that it might be important to understand students' perceptions of these program areas.

The CCE-A accreditation standards are congruent with the CCE-I and thus with the European and Canadian CCEs. This means that the questionnaire designed in this study may be suitable to assess the quality of chiropractic programs in Europe and Canada. However, before the instrument is used in these settings, its cross-cultural reliability and validity should be established in further validation studies to explore its general applicability. Similar studies could be done in other health care professional areas, using this as an example.

Limitations

Students who participated in the panels provided their ratings of the derived items, and it is possible that this may have been impacted by their past experiences. Also, the sample for this study was recruited from a single Australian university. It is therefore unclear if this study's findings can be generalised to other chiropractic programs in Australia and other CCEI members in Europe and Canada. Further psychometric testing of the instrument developed in this study is therefore warranted in

other chiropractic program settings. In addition to consolidating the instrument's validity and reliability, further psychometric evaluation should incorporate an assessment of the instrument's construct validity and responsiveness.

Directions for further research

The construct validity of our questionnaire should be established by concomitantly administering it with a validated generic measure of students' perspectives about the quality of university education. Such an analysis could be enhanced through incorporating measures of other constructs that have been influenced by students' educational experience. A recent systematic review of the DREEM has suggested these constructs may include quality of life, resilience, preparedness for practice, peer support, and psychological distress.[2]

Studies involving other chiropractic programs in other CCE regions will determine if this questionnaire is more widely applicable. Our internal testing suggested that this may be 'nimble' as the questionnaire takes students, on average, less than four minutes to complete a 'hardcopy'. We have not tested an on-line version yet.

Finally, assessing our questionnaire's responsiveness or sensitivity to change could be challenging. To establish whether our questionnaire is responsive, ideally, it would be necessary to administer the questionnaire in the same student cohort before and after they have been exposed to changes in educational program content. It is unlikely that such an assessment can be practicably undertaken.

Conclusion

The questionnaire presented in this study is the first tool that has been specifically developed to evaluate a health education programs using accreditation standards. It can potentially provide Australian educational stakeholders with information about the quality of an Australian chiropractic program's educational content and student support services, the adequacy of learning resources, and its facilitation of independent learning skills. Such material could importantly inform the direction of quality improvement programs that enhance the learning experience of chiropractic students. Nevertheless, further testing in other settings would be necessary to be certain that the results can be translated to other disciplines, other courses and in other countries.

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Appendix 1.
Original 71 items derived from CCEA accreditation standards.
Weighted Scores are included for items retained for CVI purposes

Do you agree that Murdoch University CP in general...	**Weighted score**
PROGRAM (P)	
P1. The CP has progression requirements and processes that are fair	0.86
P2. The CP has mechanisms to ensure quality and integrity of the programme of study.	0.91
P3. The CP promotes high quality teaching	0.89
P4. The CP promotes research.	0.98
P5. The CP seeks to minimize risks to the students while they learn	0.86
P6. The CP seeks to continually improve the program.	0.93
P7. The CP uses valid and reliable evaluations to improve the program.	0.72
P8. The CP content is based on evidence-based practice	1.00
P9. The CP can change in response to contemporary developments in health professional education	0.89
P10. The CP has a coherent educational philosophy that informs the program of study (design & delivery).	0.91
P11. It is easy to find good information about any aspect of the CP	0.70
P12. The CP is of sufficient scope to make a competent chiropractor (and quality)	0.86
P13. The CP offers a program that is relevant	0.89
P14. The CP is capable of producing good chiropractors	0.86
P15. I am clear about the learning objectives of the course.	0.93
~~P16. Has quality improvement processes that use valid and reliable student and other evaluations, to improve the program.~~	
~~P17. Includes representatives of the chiropractic profession for the design and management of the program.~~	
~~P18. Has mechanisms for responding in the curriculum to contemporary developments in health professional education in an effective manner.~~	
~~P19. The CP has progression requirements and processes that are and transparent~~	
~~P20. The CP promotes learning, scholarship.~~	
STUDENT (S)	
S1. Students have ways to be able to deal with concerns or complaints.	0.82
S2. The CP provides support to meet the learning needs of students.	0.89
S3. The CP provides emotional support services for students	0.89
Items deemed to be irrelevant to student experience and removed by the research team are ~~crossed out/through~~	

Do you agree that Murdoch University CP in general...	**Weighted score**
S4. Students' support services are provided by qualified personnel.	0.95
S5. Students are involved in the decision-making processes of the CP.	0.82
S6. Student feel that the CP promotes equity (and diversity principles).	0.89
S7. The CP has the confidence of new graduates.	0.95
S8. Protection of the public and patients is important in the CP.	0.93
S9. The CP is an enjoyable place to be to learn about chiropractic	0.91
S10. Students achieve the relevant competencies before providing patient care.	0.95
S11. Students are held to high levels of (ethical and) professional conduct.	1.00
S12. The CP ensures that students have the responsibility for their learning processes	1.00
S13. The CP ensures that students are prepared to become lifelong learners	0.95
~~S14. Student impairment screening and management processes are effective.~~	
~~S15. Students have access to effective grievance and appeals processes.~~	
~~S16. Students are informed of and have access to personal support services provided by qualified personnel.~~	
~~S17. Students are represented within the deliberative and decision-making processes for the program.~~	
~~S18. Equity and diversity principles are observed and promoted in the student experience.~~	
ASSESS / LEARNING (A/L)	
AL1. The CP uses different types of assessment Eg., both formative and summative	0.93
AL2. The CP has (consistent and) appropriate assessment to students.	0.91
AL3. The CP has (consistent and) appropriate feedback to students.	0.75
AL4. Student assessment covers important learning outcomes and competencies.	0.98
AL5. The CP has learning outcomes that address the chiropractic competency standards.	0.93
AL6. The CP teaches how to work with other health professionals	0.85
AL7. The CP teaches about cultural awareness	0.95
AL8. The CP develops your research skills.	0.93
AL9. The CP exams are fair	0.91
~~A10. The CP uses multiple validated assessment tools and modes including direct observation in the clinical setting.~~	
~~A11. Student assessment is related to the relevant chiropractic competency standards.~~	
~~A12. The CP has teaching and learning environments that ensure the achievement of the required learning outcomes.~~	
Items deemed to be irrelevant to student experience and removed by the research team are ~~crossed out/through~~	

Do you agree that Murdoch University CP in general...	Weighted score
~~A13. The CP exams are meaningful~~	
~~A14. Has the scope of student assessment covers all learning outcomes and competencies.~~	
STAFF (St)	
St1. The teaching staff clearly communicate the course material	1.00
St2. It is easy to gain access to the teaching staff	1.00
St3. Teaching staff support the students.	0.89
St4. Teaching staff conduct themselves professionally.	0.93
St5. The lecturers are competent	0.98
RESOURCES (R)	
R1. The CP facilities and equipment are accessible, (well maintained, and fit for purpose).	0.82
R2. The CP provides adequate access to on-line resources.	0.80
R3. The CP lecture rooms are satisfactory	0.93
R4. The CP equipment is satisfactory	0.84
~~R5. The CP has the resources to facilitate the achievement of the standards necessary to be a competent chiropractor.~~	
CLINIC (C)	
C1. Student clinic has quality and safety practices.	0.98
C2. The student clinic has the necessary resources and equipment	0.87
C3. The clinic staff clearly communicate the course material	0.91
C4. The clinic has a mix of patients that will adequately prepare students for becoming a chiropractor.	0.89
C5. The clinical staff are easy to gain access to.	0.80
C6. The clinic staff support the students.	1.00
C7. The clinicians are conduct themselves professionally.	0.95
~~C8. Student clinics meet relevant jurisdictional requirements and standards.~~	
~~C9. Students are registered with the relevant regulatory authorities.~~	
Items deemed to be irrelevant to student experience and removed by the research team are ~~crossed out/through~~	

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Inter-rater reliability of the Quebec Task Force classification system for recent-onset Whiplash Associated Disorders

Yaadwinder Shergill, DC[1,2]
Pierre Côté, DC, PhD[3,4]
Heather Shearer, DC, MSc[3,4]
Jessica J. Wong, DC, MPH[3,4]
Maja Stupar, DC, PhD[5]
Anthony Tibbles, DC[6]
J. David Cassidy, DC, PhD[7]

Purpose: *The inter-rater reliability of the Quebec Task Force (QTF) classification system for Whiplash-Associated Disorders (WAD) remains unknown. Our objective was to determine the inter-rater reliability of the WAD classification between an experienced chiropractic clinician and two chiropractic residents.*

Methods: *We conducted an inter-rater reliability study using baseline clinical data from 80 participants*

Fiabilité inter-évaluateur de la classification établie par le Groupe de travail du Québec sur les troubles associés au coup de fouet cervical d'apparition récente

Objectif : *La fiabilité inter-utilisateur du système de classification des troubles associés au coup de fouet cervical (TACF) établi par le Groupe de travail du Québec (GTQ) demeure inconnue. Notre étude visait à établir la fiabilité inter-évaluateur du système de classification des troubles associés au TACF utilisé par un chiropraticien clinicien d'expérience et deux résidents en chiropratique.*

Méthodologie : *On a effectué notre étude à l'aide de données cliniques de départ sur 80 participants à un*

[1] Department of Health Research Methods, Evidence, and Impact – McMaster University
[2] One Elephant Integrative Health Team, Oakville
[3] Faculty of Health Sciences, Ontario Tech University and Institute for Disability and Rehabilitation Research
[4] Dalla Lana School of Public Health, University of Toronto
[5] Department of Graduate Education and Research, Canadian Memorial Chiropractic College
[6] Clinics, Canadian Memorial Chiropractic College
[7] Division of Epidemiology, Dalla Lana School of Public Health, University of Toronto

Corresponding author: Yaadwinder Shergill, McMaster University Medical Centre, 1280 Main St W. Hamilton, Ontario, Canada L8S 4K1.
Tel: 416-708-2102
E-mail: shergiy@mcmaster.ca

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assessed for inclusion in a randomized clinical trial of the conservative management of WAD grades I and II. We reported reliability using Cohen's kappa (k) and 95% confidence intervals (CI).

Results: *The mean duration of WAD symptoms was 7.6 days (s.d.=5.2). In our study, the interrater reliability of the WAD grade classification varied from k=0.04 (95% CI -0.04 to 0.12) to k=0.80 (95% CI 0.67 to 0.94).*

Conclusion: *Inter-rater reliability of the WAD classification varied greatly across raters and may be associated with the experience of the raters and with their understanding of the criteria. Our results suggest that clinicians may benefit from training to standardize how they classify WAD. Furthermore, our results need to be tested in a different sample of patients and with a range of clinicians from different clinical disciplines.*

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KEY WORDS: whiplash-associated disorder, neck pain, classification, Quebec task force, diagnosis

essai clinique, à répartition aléatoire, sur le traitement conservateur du TACF de stades I et II. On a utilisé le coefficient kappa (k) de Cohen et des intervalles de confiance (IC) à 95 % pour évaluer la fiabilité.

Résultats : *La durée moyenne des symptômes du TACF était de 7,6 jours (écart-type :5,2). La fiabilité inter-utilisateur de la classification des TACF a varié de k = 0,04 (IC à 95 % – de 0,04 à 0,12) à k = 0,80 (IC à 95 % de 0,67 à 0,94).*

Conclusion : *La fiabilité inter-utilisateur de la classification des TACF a beaucoup varié d'un évaluateur à l'autre; l'écart pourrait être lié à l'expérience de l'évaluateur et à sa compréhension des critères de classification. Selon les résultats de notre étude, les cliniciens pourraient bénéficier d'une formation servant à normaliser leur méthode de classification des TACF. Nos résultats devraient être confirmés par une autre étude utilisant un autre échantillon de patients et un éventail de cliniciens appartenant à diverses disciplines.*

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MOTS CLÉS : trouble associé au coup de fouet, douleur cervicale, classification, groupe de travail du Québec, diagnostic

Introduction

Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. It is the most common injury following motor vehicle collisions, affecting 83% of individuals injured in traffic collisions.[1] Whiplash is associated with clinical symptoms including neck pain, arm pain and paresthesias, dizziness, and psychological distress.[1] These symptoms are collectively known as whiplash associated disorders (WAD).[2] In North America, WAD is common, with an estimated incidence of 600 per 100,000 people.[3-5] The annual economic burden ranges in the billions of dollars depending on the country. In the United States, the burden of whiplash injuries, including medical care, disability, and sick leave is estimated at $3.9 billion (USD) annually.[3] In 2007, the accident benefits paid by Ontario insurers for WAD was reported to be $4.12 billion in Canadian dollars.[6]

The current evidence suggests that 50% of individuals with WAD recover within three to six months of their injury.[7] Of those who report symptoms at one-year post-collision, 30-40% report mild to moderate levels of pain and 10-20% report moderate to severe pain.[7] In 1995, the Quebec Task Force on Whiplash-Associated Disorders proposed a classification system for grading WAD injuries (Table 1).[8] The system classifies patients using clinical data collected during the history and physical examination (including pain, decreased range of motion, point tenderness, neurological signs and fracture or dislocation).[8]

Although the Quebec Task Force classification is commonly used to guide the management of WAD, its inter-rater reliability remains unknown.[9,10] Little is known about the clinical utility of the QTF classification. To our knowledge, there is only one study that supports using the QTF classification system to predict the prognosis of

Table 1.
Quebec Task Force Whiplash Associated Disorders Classification System[8]

Grades	Clinical Presentation
0	No complaint about the neck No physical sign(s)
1	Neck complaint of pain, stiffness, or tenderness only No physical sign(s)
2	Neck complaint AND Musculoskeletal sign(s)*
3	Neck complaint AND Neurological sign(s)^
4	Neck complaint AND Fracture or dislocation

* Musculoskeletal signs include decreased range of motion and point tenderness.
^ Neurologic signs include decreased or absent deep tendon reflexes, weakness, and sensory deficits

WAD within 24 months of the injury' the study suggest that the prognosis worsens with increasing WAD grade.[11] Our objective was to determine the inter-rater reliability of the Quebec Task Force classification system in patients with WAD I and WAD II by comparing the physical examination ratings of an experienced clinician and the chart review ratings of two chiropractic residents.

Methods

Design and study sample

We conducted a chart-based inter-rater reliability study. Our study sample included participants enrolled in a randomized clinical trial (RCT) investigating the effectiveness of conservative management of patients with acute grade I/II WAD.[12] Individuals were eligible for the RCT if they made an insurance claim with a large Canadian automobile insurer between February, 2008 and April, 2011 and resided or worked in the Greater Toronto Area, Mississauga, Burlington, Cambridge, or Kitchener. Participants enrolled in the RCT met the following inclusion criteria: 1) 18 years or older; 2) diagnosed with Grade I or Grade II WAD by the trial coordinator; 3) made an insurance claim for physical injury within 21 days of the traffic collision; 4) reported neck pain greater than or equal to 3 on a 0-10 Numerical Rating Scale; and 5) were able to communicate in English. Excluded individuals were those with: 1) fracture/dislocation of the spine (Grade IV WAD); 2) head trauma; 3) previous whiplash injury within one year; 4) active systemic disease; 5) previous neck surgery; and 6) previous care from a physiotherapist or chiropractor for neck pain in the three months prior to the collision.[10] The study sample for this reliability study included 80 randomly selected charts from potential participants who consented to participate in the RCT.

Data used for the determination of WAD grade

Clinical data used in our reliability study was collected by the same trial coordinator, a chiropractor with nine years of clinical experience, who assessed potential participants for their eligibility to the RCT. The trial coordinator was trained in the grading of WAD. The trial coordinator used standardized forms to collect baseline data and ensured completeness of data collection. The data used to classify WAD grade included: 1) a pain diagram completed by the participant[13]; 2) clinical information describing post-collision symptoms; 3) cervical spine range of motion; 4) results from cervical spine palpation; 5) results from neurological examinations, and 6) neck pain intensity rated by the participants as well as disability measured on the Whiplash Disability Questionnaire[12].

Classification of WAD grade by raters

Our inter-rater reliability study involved three raters: the trial coordinator who initially graded WAD when assessing potential participants for the RCT and two chiropractors with two to three years of experience who were completing their post-graduate residency in Chiropractic Clinical Sciences. Both residents attended a training session delivered by the trial coordinator where the structure of the clinical chart and extraction tables were reviewed. The Quebec Task Force classification system was provided, and five charts were used to pilot the WAD classification. The residents were not provided any training regarding the application of the Quebec Task Force classification because it was assumed to be well understood by the raters who underwent the same education at the same institution.

The WAD grade assigned by the trial coordinator when assessing study participants was used for this study for reliability. The residents received a randomly ordered series of charts and classified WAD grade independently. They

Table 2.
Patient characteristics

Variable	N	Mean	Standard deviation	Minimum	Maximum
Age (years)	80	43.02	13.77	20.00	81.30
Days since injury	80	7.61	5.19	1.00	24.00
Neck pain intensity in past 24 hours (0-10)	80	5.89	1.97	2.00	10.00
Whiplash-related disability score – WDQ (0-130)	79*	51.90	30.00	4.00	116.00

[a] Composite disability score; WDQ: whiplash disability questionnaire
* Data for WDQ score was missing from the sample

were blinded to the WAD grading reported by the trial coordinator and to each other's ratings. Residents provided a WAD grade for the participants once they reviewed the charts.

Sample size

We estimated the sample size according to the method described by Cantor.[14] Based on a desired power of 0.80, alpha level of 0.05 and a null reliability coefficient set at 0.85, a sample size of 69 charts was necessary. However, due to availability of data and to improve precision of our estimates, we used a sample size of 80 participants.

Data analysis

We computed an unweighted kappa (k) statistic and 95% confidence intervals (CI) for each pair of raters (trial coordinator and residents).[15] We performed all statistical analyses using SAS statistical software (Version 9.1; SAS Institute Inc, Cary, NC).

Ethics

The study was approved by the Ethics Institutional Review Board of the Canadian Memorial Chiropractic College and the University Health Network.

Results

Study sample

The mean age of the sample (n=80) was 43.0 years and 75.0% were women. On average, participants were assessed 7.6 days after the collision (Table 2). The mean intensity of neck pain was 5.9/10 (SD = 2.0) and the mean level of disability measured on the Whiplash Disability Questionnaire was 51.90/130 (SD =30.0). The characteristics of the sample from which the participants were selected for our reliability are presented elsewhere.[16]

Table 3.
Distribution of responses A: Rater 1 and Rater 2; B. Rater 1 and Rater 3; C. Rater 2 and Rater 3.

A. Rater 1 and Rater 2		**Rater 1**		
Rater 2		**WAD I**	**WAD II**	**Total**
WAD I	Frequency	24	6	30
	Percent	30.8	7.7	38.5
WAD II	Frequency	1	47	48
	Percent	1.3	60.3	61.5
Total	Frequency	25	53	78
	Percent	32.0	68	100
B. Rater 1 and Rater 3		**Rater 1**		
Rater 3		**WAD I**	**WAD II**	**Total**
WAD I	Frequency	1	0	1
	Percent	1.3	0	1.3
WAD II	Frequency	24	54	78
	Percent	30.3	68.4	98.7
Total	Frequency	25	54	79
	Percent	31.6	68.3	100
C. Rater 2 and Rater 3		**Rater 3**		
Rater 2		**WAD I**	**WAD II**	**Total**
WAD I	Frequency	1	29	30
	Percent	1.3	37.2	38.5
WAD II	Frequency	0	48	48
	Percent	0	61.5	61.5
Total	Frequency	1	77	78
	Percent	1.3	98.7	100

Inter-rater reliability

Rater 1 (trial coordinator of primary RCT) classified 25 participants (31.2%) with WAD I and 55 (68.8%) with WAD II. Rater 2 (chiropractic resident) classified 30 participants (37.5%) with WAD I, 48 (60.0%) with WAD II, and 2 (2.5%) as WAD III. Rater 3 (chiropractic resident) reported classified 1 participant (1.3%) with WAD I, 78 (97.5%) as WAD II, and 1 (1.3%) with WAD III (see Table 3).

The percentage agreement between Rater 1 and Rater 2 was 89.0% and the inter-rater reliability was k=0.80 (95% CI 0.67-0.94). The percentage agreement between Rater 1 and Rater 3 was 69.0% and the inter-rater reliability was k=0.05 (95% CI -0.05-0.16). Finally, the percentage agreement for Raters 2 and 3 was 63.0% and the inter-rater reliability was k= 0.04 (95% CI -0.04 to 0.12). WAD III results were removed as that diagnosis was not present in the original exam diagnoses.

Discussion

We measured the inter-rater reliability of the WAD classification system in a sample of participants with WAD grade I and II. We compared the WAD grades of an experienced chiropractor who examined the potential clinical trial participants with the grades extracted from clinical files by two chiropractic residents with two to three years of clinical experience. Our analysis showed important differences in the inter-rater reliability. In fact, our results suggest that the reliability of a well-known classification system can vary significantly between clinicians with different levels of experience. Stynes[17] performed a systematic review on classification of patients with low back-related leg pain. Of the 22 classification systems investigated, six systems reported reliability with scores ranging from not acceptable to great reliability. Varying levels of experience were cited as a possible reason for the low reliability. It is possible that individuals with greater experience are better at classifying due to more exposure to the classification systems.

The low inter-rater reliability in our study may be attributable to several factors. First, raters likely had a different understanding of the WAD classification system due to varying clinical experiences. Specifically, one rater classified 97.5% of participants as suffering from WAD grade II while the other two raters classified 68.8% and 60% of participants as WAD II. A published systematic review assessing the reliability and validity of clinical prediction rules to screen for neck pain reported that inter-rater reliability may be impacted by raters' backgrounds, experience and training.[18] Second, two raters (chiropractic residents) did not assess the participants in person; they relied on the chart's clinical data to classify WAD, whereas the other rater (trial coordinator) assessed the patients clinically. It is likely that in-person assessments provide information that is not adequately captured by clinical charts and/or WAD classification system such as facial grimaces and may be used when classifying. The WAD classification system is dependent exclusively on clinical signs. Third, the criteria for WAD II [i.e., neck complaint and musculoskeletal sign(s) (decreased range of motion and point tenderness)] may be interpreted with ambiguity. Upon further review one rater required the presence of both "decreased range of motion" and "point tenderness" to classify WAD II, whereas the other rater required only one of the musculoskeletal signs to be present for WAD II. The original classification by Spitzer et al. (1995) does not specify how to operationalize the criteria. A modification to the WAD classification system has been suggested by Hartling *et al*.[11] to distinguish between Grade II cases with normal or limited ranges of motion. Previous research supports poorer recovery in patients with both decreased range of motion and point tenderness.[19]

Strengths and limitations

Our study had strengths. First, WAD was graded independently by each rater. Second, the order of rating by each rater for the 80 participant charts was randomized. Third, we used a large sample size to improve the accuracy of data analyses. However, our study has some limitations. The raters may be limited by their years of clinical experience and the patient populations within their private practices. There was also a small number of raters involved in this study. The second and third raters were restricted to written assessment notes to render their diagnosis. Although all relevant clinical information to make the appropriate diagnosis were reported in the patient records, it is possible that non-verbal behaviors had an indirect impact on clinician ratings. This is a component of the physical examination that may aid in diagnosing the WAD grade had the raters observed the physical interaction.[20] Inter-rater reliability may have been improved had the initial clinician-participant interaction been video

recorded. Lastly, it is possible that the low reliability estimates computed in our study may have been due to the low cell counts used for the kappa calculations.[21] To our knowledge, this is the first study assessing the inter-rater reliability of Quebec Task Force WAD classification. It is possible that the original WAD classification may be used reliably by clinicians. Future research on the inter-rater reliability of the classification system should ensure that clinicians are well-trained in the use of the classification to ensure consistent use of the WAD classification. Future studies could also rely on clinicians with similar levels of experience, however these results may not be generalizable to all clinicians because their expertise and training varies. Our results need to be tested in a different sample of patients and with a range of clinicians from different clinical disciplines. Additionally, future studies are needed to investigate the validity and prognostic value of the WAD classification. Finally, as the WAD classification system is already widely adopted, educational measures are needed to target current students, practitioners, and researchers.

Conclusions

The inter-rater reliability of the WAD classification varied greatly between raters. The inconsistency may be associated with raters' experience and understanding of the WAD criteria. Our results suggest that clinicians may benefit from training with clear operational definitions to improve the reliability of the Quebec Task Force classification of WAD. Further, this study highlights the need for clarity in clinical criteria to ensure consistent use of the classification system.

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Neuromuscular exercises on pain intensity, functional disability, proprioception, and balance of military personnel with chronic low back pain

Ehsan Alvani, MSc[1]
Hossein Shirvani, PhD[1]
Alireza Shamsoddini, PhD[1]

Background: *Due to their occupational status, military personnel are a high-risk group for low back pain (LBP).*

Purpose: *The aim of this study was to investigate the effect of neuromuscular exercises on the severity of pain, functional disability, proprioception, and balance in military personnel with LBP.*

Methods: *Military personnel with LBP were randomly assigned into two groups: intervention (n=15) and control (n=15). The intervention group performed 60 minutes of neuromuscular exercises three times per week for eight weeks while the control group continued their routine physical activities.*

Results: *The mean post-intervention pain intensity, disability, and proprioception error significantly*

Des exercices neuromusculaires pour réduire l'intensité de la douleur, diminuer l'incapacité fonctionnelle et améliorer la proprioception et l'équilibre chez les militaires aux prises avec la lombalgie chronique

Contexte : *En raison de leur profession, les militaires sont très exposés à la lombalgie.*

Objectif : *Cette étude consistait à examiner l'effet des exercices neuromusculaires sur l'intensité de la douleur, l'incapacité fonctionnelle, la proprioception et l'équilibre chez les militaires aux prises avec la lombalgie.*

Méthodes : *Des militaires souffrant de lombalgie ont été répartis au hasard en deux groupes : le groupe sous traitement (n=15) et le groupe témoin (n=15). Les sujets du groupe sous traitement ont fait 60 minutes d'exercices neuromusculaires trois fois par semaine pendant huit semaines, alors que le groupe témoin a poursuivi ses activités physiques de manière habituelle.*

Résultat : *L'intensité moyenne de la douleur, l'invalidité et le déficit proprioceptif ont significativement diminué*

[1] Department of Exercise Physiology Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

Corresponding author: Alireza Shamsoddini, Exercise Physiology Research Center, Life Style Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran
Tel: + 9821 87554402
Fax: +9821 88600030
E-mail: alirezaot@bmsu.ac.ir

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decreased in the intervention group. Whereas their mean post-interventions static and dynamic balance scores significantly increased.

Conclusions: *The results indicate eight weeks of neuromuscular exercise decreased pain intensity and improved functional ability, static and dynamic balance, and proprioception among military staff suffering chronic low back pain.*

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KEY WORDS: chronic low back pain, military personnel, proprioception, pain intensity, functional disability, balance

dans le groupe sous traitement, alors que les cotes moyennes attribuées à l'équilibre statique et dynamique post-intervention ont augmenté de façon appréciable.

Conclusions : *Les résultats montrent que les exercices neuromusculaires pratiqués pendant huit semaines ont permis de réduire l'intensité de la douleur et d'améliorer la capacité fonctionnelle, l'équilibre statique et dynamique et la proprioception chez des militaires aux prises avec la lombalgie chronique.*

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MOTS CLÉS : lombalgie chronique, personnel militaire, proprioception, intensité de la douleur, incapacité fonctionnelle, équilibre

Introduction

Low back pain (LBP) is one of the most common and costly musculoskeletal problems in modern society[1], which affects almost everyone at least once over their lifetime[2]. Considering that the cause of low back pain is multifactorial, investigating physical, psychological and social factors is essential for better management of this condition.[3] LBP occurs in all age groups from children to the elderly[4,5], and it is the leading cause of disability and work absenteeism worldwide[6]. This has led to substantial expenses for the general public as a whole.[7]

Chronic LBP is associated with histomorphologic and structural changes in the paraspinal muscles.[8] In addition, chronic LBP is linked to subsequent musculoskeletal system deficiencies, such as decreased range of motion, changes in lumbar proprioception and muscle density.[9] Chronic LBP may have different etiologies with several neuromuscular factors including muscular imbalance, poor postural control, the decreased proprioception accuracy, and sacroiliac joint dysfunction.[10]

LBP is furthermore a common and high-risk problem among the military personnel due to their active work environment. Musculoskeletal injuries are the main cause of disability among military personnel.[11] Notably, around 20% of musculoskeletal disorder diagnoses resulting in disability among military personnel are back related.[12]

Most LBP patients develop chronic pain and disability, both of which can cause personal and economic burdens.[13] Meanwhile, pain is known to be one of the first manifestations of LBP pathology and can lead to restricted activity in patients. In this regard, there is a disagreement on explaining the mechanism of how pain causes disability. Findings suggest there is a close association between pain perception and disability.[14] Yang *et al*.[15] suggest pain in chronic LBP patients causes impaired movement control, and fear of pain recurrence at different times causes increased disability as well as restricted activity. In a different study, patients had decreased movement control and performance when changing postures, and they experienced diminished movement control and functions in other dimensions of their lives.[16] Moreover, movement control is an essential need for the body to perform and function normally.[17]

Smidt *et al*.[18] report treatments that enhance flexibility and increase abdominal and extensor back muscle power are beneficial for both acute and chronic LBP. They furthermore found performing kinesiotherapy with the above-mentioned goals is often incorporated into programs for the patients with LBP. "Kinesiotherapy comprises of different types of therapeutic exercises such as stretching and strengthening (isotonic, isokinetic, and isometric)."[19] Neuromuscular exercises are also important in improving the coordination, power, range of motion, and proprioception in these patients with chronic LBP. These exercises affect sensory receptors of the joints, which send information related to the body's position during

movement.[20] In this regard, neuromuscular exercises can improve back muscle control, flexibility, and power.[21] The general aim of neuromuscular exercises is reversing the disorders resulting from pain as well as enhancing the muscular strength and endurance required in activities.[22] We hypothesized that a neuromuscular exercise intervention would reduce pain intensity and disability in military personnel as compared to those receiving only general exercise. Therefore, the main aim of this study was to investigate the effect of neuromuscular exercises on the severity of pain, functional disability, proprioception, and balance of military staff with chronic LBP.

Methods

The present study was a randomized controlled trial with a pre- and post-test design consisting of intervention and control groups. Prior to initiating the research and any intervention, the Baqiyatallah University of Medical Sciences ethics committee approved the study (IR.BMSU.AC.IR.REC. 01398.0142). This study was also registered (IRCT20190427043384N1) with the Iranian Registry of Clinical Trials (IRCT).

In the current study, we investigated the effect of neuromuscular exercises on pain intensity, functional disability, proprioception, and balance of military personnel with chronic non-specific LBP. Non-specific low back pain is defined as low back pain not attributable to a recognizable, known specific pathology (e.g., infection, tumor, osteoporosis, lumbar spine fracture, structural deformity, inflammatory disorder, radicular syndrome, or cauda equina syndrome).[23]

The study population consisted of military men aged 20- to 50-years old suffering from chronic non-specific LBP who were referred to hospital clinics in Tehran, Iran. Patients were randomly assigned into one of two treatment groups at a 1:1 ratio as follows: intervention group (n = 15) or control group (n = 15). The randomization was performed by an individual who was not involved in other procedural aspects of the study. Randomization was achieved by drawing a number from 1 to 30 prepared in advance and placed in sealed opaque envelopes in a box. All outcomes were assessed pre- and post-intervention by a blinded assessor. Due to their military experience, subjects were sufficiently trained and experienced to perform the objective tests. Other inclusion criteria for this study were: 1) a history of LBP for more than three months; 2) evidence of chronic LBP confirmed by a physical medicine and rehabilitation specialist; 3) the absence of any specific pathology in the vertebral column such as disc herniation, fracture, vertebral column surgery, or infection; 4) a score at least three on the visual analog scale (VAS) pain test; 5) the abilities to sit, stand, and walk without auxiliary devices and to perform normal daily activities. The exclusion criteria were no consent by the subject, damage to the lumbar region during the treatment period, a diagnosis of any systemic arthropathy, asthma, cancer, diabetes, and/or having a psychological disease.

As shown in Figure 1, 45 individuals were identified as meeting the inclusion criteria. Out of these subjects, 30 patients were randomly assigned into two groups: a group that underwent a neuromuscular exercise intervention (n=15) and a control group (n=15). Sample size

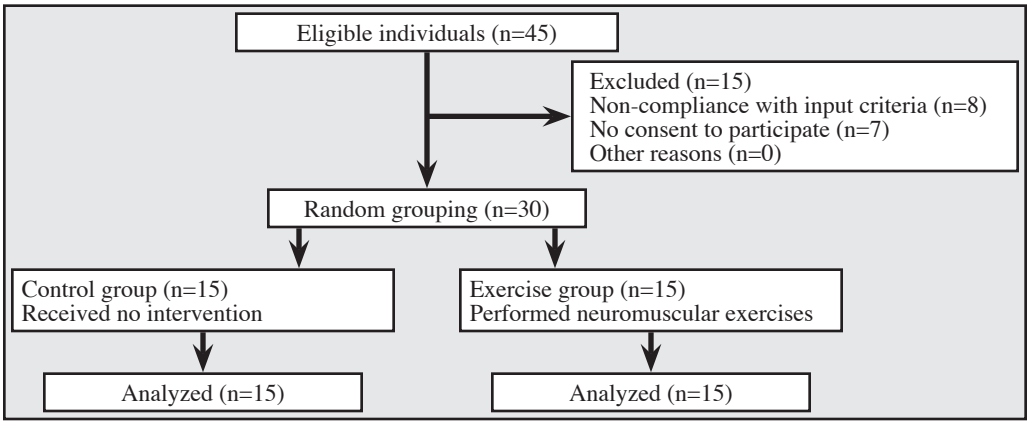


Figure 1. *Research process flowchart*

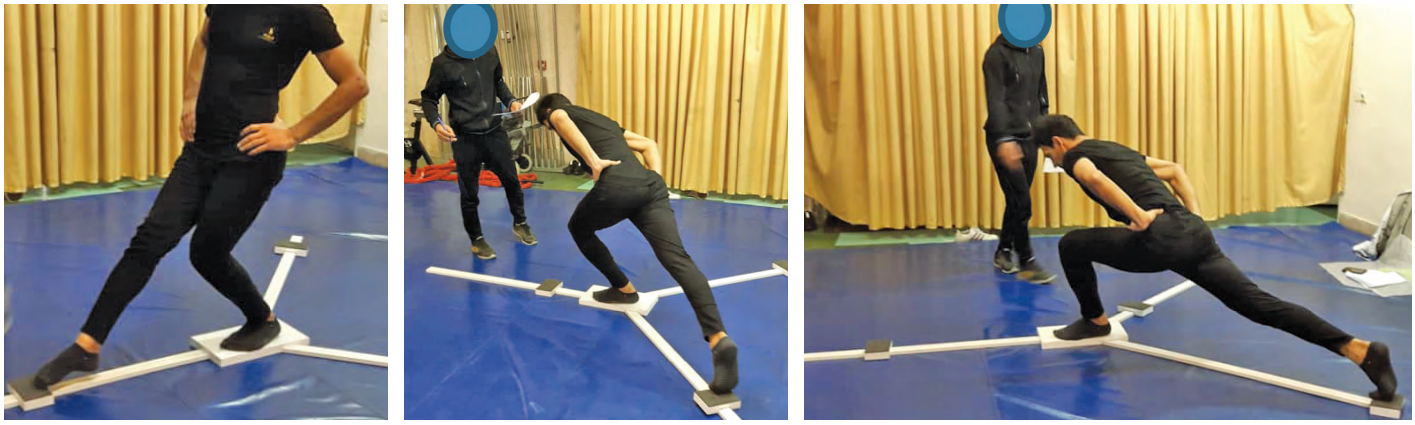


Figure 2.
The Y balance test (YBT) across different directions

calculations using G-Power software as in previous studies[24,25] resulted in 30 patients (15 patients per group). Considering the 20% attrition rate, an effect size of 0.25, a statistical power of 95%, and an alpha of 0.05 (two-tailed test), a total sample size of 30 was required (15 patients per group). A written informed consent form was received from all the subjects. After all subjects were informed of their right to leave the study at any time, their anthropometric characteristics, including their height, weight, age, and duration of LBP, were recorded. After completing the quality of life questionnaire, the severity of pain test (VAS), the Oswestry (functional disability) questionnaire, proprioception test, as well as static (stork balance) and dynamic balance (Y balance) tests [YBT]) were conducted. All evaluations were performed by testers who were blind to participant group allocation. This study was completed within eight weeks, and no intervention nor outcome measure was continued after its completion.

During the research period, both groups performed their daily routine physical and exercise activities. The intervention group also performed the neuromuscular exercises according to the research protocol for three sessions per week for eight weeks with each session lasting for 60 minutes. During the intervention, the control group performed their routine sports and physical activities and did not receive any additional training. At the end of the intervention, all variables of the research were measured again and recorded.

Visual analog scale (VAS) for pain measurement

The VAS, a widely used psychometric response scale tool, was employed to measure subjects' pain severity. Subjects were asked to indicate the severity of their pain along the VAS, which is a horizontal line with 11 points along it. The beginning shows no pain (marked with a zero and an image of a smiling face), and its endpoint (marked with a 10 and a face in pain and discomfort) represents very severe pain. Its reliability and validity have been excellent, and its internal consistency has been shown as ICC=0.91.[26] The validity of the VAS scale is based on Cronbach alpha that has been reported to be 0.95.[27]

Functional disability

In the present study, the Oswestry questionnaire was used to assess the degree of disability in subjects with chronic LBP. This questionnaire includes 10 six-option items. These 10 items examine the performance of the individuals in their daily activities. Each item ranks the degree of disability in performance from zero (desired function with no feeling of pain) up to five (disability in performing the activity due to severe pain).

The Oswestry disability index is equal to sum of the scores of these 10 items multiplied by 2, the value of which ranges from 0 to 100. A score of zero indicates the person is able to perform daily activities with no pain. A 0-20 score indicates mild or minimal disability, 21-40 indicates moderate disability, 41-60 indicates severe disability, and 61-80 indicates crippling disability. Scores 81

and higher indicate the person is bed-bound or exaggerating symptoms.[28] The validity of Oswestry questionnaire has been confirmed based on Cronbach alpha of 75%, and its reliability has been reported with a correlation coefficient of 0.92 using the test-retest method.[29]

Dynamic balance assessment

The YBT was used to assess dynamic balance. Previous studies have proven YBT is reliable and valid as a dynamic test for balance.[30,31] The YBT device used for this study (Qamat Pouyan Company, Iran) measured anterior, anteroposterior, and posterior directions of movement (Figure 2).

The current study's subjects were instructed to stand on their support foot on the YBT device's center box. Each participant was instructed to maintain balance on their supporting (right) leg while performing the test using their non-supporting (left) leg. To perform the test, subjects pushed the indicator box forward as far as possible along the anterior, anteroposterior, and posterior planes with their left feet. Afterward, they repeated the same procedure with their left leg as the support leg. The test was repeated three times in each direction with both feet. Subsequently, after three times of repeating the test in each direction, a short rest (10-15 seconds) was given to the subjects to prevent fatigue.[32] In order to minimize the learning effects, each subject practiced this test in all the three directions six times with 15 seconds rest intervals.

After five minutes of rest, the final assessment was performed. Results were discarded and the subject asked to repeat the test if their support leg moved or they lost balance and placed their nonsupport foot on the ground. The length of leg was measured from anterior superior iliac spine (ASIS) up to the medial malleolus. To obtain the total balance score of the three directions average (i.e., anterior, anteroposterior, and posterior), the following formula was used:

$$CS = A+PL+PM/\ 3x\ \text{leg length}\ x100$$

where *CS* = composite score, *A* = anterior, *PL* = posterolateral, and *PM* = posteromedial.

Stork balance test

The stork balance test was used to assess subjects' static balance.[33] Subjects were asked to stand on one (support) leg without shoes while lifting the foot of the opposite (nonsupport) leg toward the inner part of the support leg's knee and then to place the hands on the hips (Figure 3).

Figure 3.
The stork balance test

Subjects were instructed to keep their eyes open and focus on the wall directly in front of them. They then stood on the ball of their foot of the support leg and tried to preserve their balance. The test would conclude when an error in balance (e.g., the heel touched the ground, the foot on the ground moved, the hands were moved off of the hips, or the foot of bent leg was moved off of the support leg) was observed. When starting the measurement using a chronometer (Professional model, Iran), the time of standing on one leg until the loss of this status was recorded up to the closest hundredth of a second. Each subject performed the stork balance test three times, and their best performance was recorded.[34] The test-retest reliability coefficient of this test is reported to be 0.87.[35]

Proprioception measurement method

In this study, proprioception was measured by a goniometer (MSD, Belgium) with international standard of measurement (STFR). In this regard, the procedure of the pelvic lumbar proprioception measurement was introduced by Newcomer et al. with reliability and validity of 91% and 87%, respectively.[36]

In our study, to reduce proprioception feedback from the lower limb and pelvis, prevent the pelvis from receding during bending, and separate the trunk and pelvic movements, the lower limbs were immobilized in the areas of the shin, knee, and hip with a special frame provided by the researcher. Subsequently, markers were attached to the external upper surface of the arm, iliac crest, and the greater trochanter of femur. Next, subjects were positioned in a

Figure 4.
The proprioception test

relaxed standing posture without wearing shoes or socks. The legs were open to the width of the shoulders. Subjects then crossed their arms and placed their hands in front of their shoulders, so they would not use the contact between their palms and anterior surface of the hips during bending as a guide to achieve the target angle. In this regard, the position of a subject's neck was maintained in its normal position. Researchers instructed the subjects to close their eyes to eliminate visual afferents.

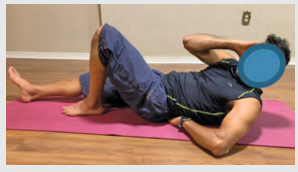
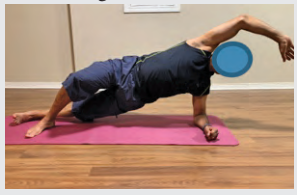
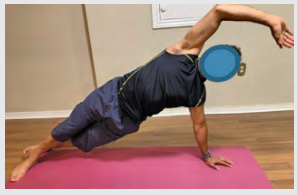
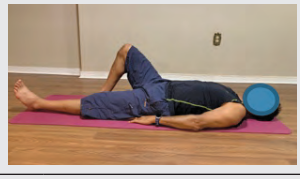
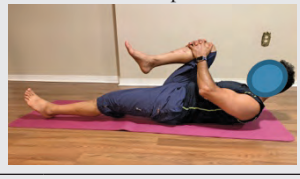
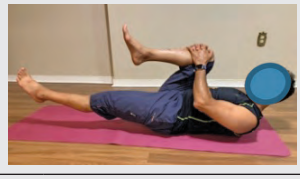
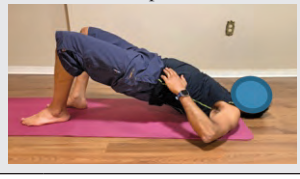
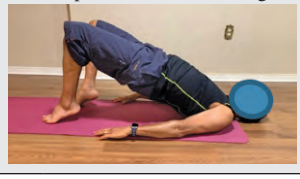
Next, the center of the goniometer was placed on the iliac crest, where one of the arms of the goniometer was aligned to the greater trochanter, while the other arm was adjusted to a 30° angle. The subjects were asked to bend with uniform speed and relatively slowly up to a 30° angle with closed eyes (Figure 4). They were then asked to remember this position with a five-second pause (at this stage, termination of the movement was notified to the subjects using an auditory stimulus). Then, subjects were instructed to return slowly to their initial standing position, and they began the next movement after a five second pause. After three repetitions (for learning), at the test stage, subjects should have reproduced the 30° angle in the bent position with no auditory stimulus. The test was repeated three times, and subjects' errors were recorded based on degree. The error value in each movement was the deviation between the above-mentioned angles from the target angle. In addition, the mean error value in the regeneration of posture in the three replications was recorded as the posture regeneration error.[37]

Exercise protocol

In this study, a neuromuscular exercise intervention was created for military personnel with chronic LBP. Each exercise session was performed in three stages as follows:

1. Warm up for 10 min with stretching exercises and light walking in the gym area.
2. Perform specific exercises that enhance the stability of vertebral column, improve the stamina of the abdominal muscles, improve balance and control posture, increase back muscle strength, and increase the lumbar and pelvic range of motion in terms of the protocol of the study for 45 min (Table 1).
3. Stretch and perform other cooling down movements for 5 min.

Table 1. *Neuromuscular exercise protocol*

	Exercise Type	Level 1	Level 2	Level 3
Week 1	McGill curl up (modified curl up): subjects lay supine with one knee in flexion and the other leg completely straight with the hands under the lumbar lordosis. Curl-ups were performed without pressing the lumbar spine down. • 6–8 repetitions on each side	Curl the torso upward with elbows on the floor 	Curl the torso upward with elbows off the floor 	Curl the torso upward and point one elbow towards the opposite knee while keeping the hip joint flexed 
Week 2	Bird dog stretch: subjects performed four-point kneeling by pressing the hands and shins towards the floor to stabilize the shoulder region and neutralize the lumbar vertebrae. The stretch was performed by extending one hand straightforward and the opposite leg straight backward; the test was repeated on each side. • 6–8 repetitions on each side	Stretch one leg out on the floor 	Lift the leg to the same level as the trunk 	Stretch one leg and the opposite arm completely 
Week 3	Side bridge or mermaid side bridge with bent knees: subjects laid on one side with their legs straight and then pressed their forearm onto the floor to lift their bodies so that only the forearm and foot touched the floor (side bridge), or they laid on one side with their legs bent at the knee and pressed their forearm onto the floor to lift their bodies so that only the forearm and knee and lower leg touched the floor (mermaid side bridge with bent knees). • 6–8 repetitions on each side	Lift the pelvis up 	Extend the arm and lift the lower leg off the floor 	Extend the arm and lift both legs off the floor 
Week 4	Single leg stretching • 8–10 repetitions on each side	From a supine crook lying position, stretch one leg on the floor and then draw it back while maintaining a neutral spine 	From a supine crook lying position, pull the head and shoulders off the mat and draw one leg to the chest while stretching the other leg straight on the floor; switch the legs and maintain a neutral spine 	From a supine crook lying position, stretch one leg on the floor and then draw it back while maintaining neutral spine 
Week 5	Shoulder bridge	From a supine crook lying position, lift the pelvis up while maintaining a neutral spine • 6–8 repetitions 	Perform a Level 1 shoulder bridge, then lift one heel from the floor with no pelvis rotation • 5 repetitions with both legs 	From a supine crook lying position, lift up the pelvis and maintain a neutral spine • 6–8 repetitions with both legs 

	Exercise Type	Level 1	Level 2	Level 3
Week 6	"Tai chi Warrior" stance	1) Lean forward on the left leg while bending the left knee to 90° while straightening the right leg to the rear and keeping the hands on the hips; 2) stand straight on the left leg while raising the right foot and bending the right knee 90°; 3) repeat on the other side	1) Lean forward on the left leg while bending the left knee to 90° while straightening the right leg to the rear and the right arm to the front and resting the left hand on the hip; 2) stand on the left leg while raising the right foot and bending the right knee to 90° and bring the right hand to the right hip; 3) repeat on the other side	Lean forward on the left leg while bending the left knee to 90° while straightening the right leg to the rear and the right arm to the front (the left hand rests on the hip); 2) stand on the left leg while raising the right foot and bending the right knee to 90° and bring the right hand to the right hip and straighten the left arm to the front; 3) repeat on the other side
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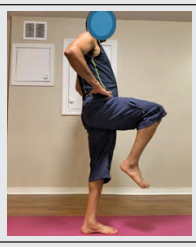
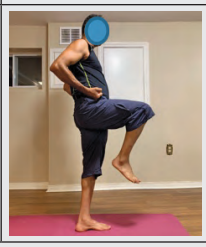
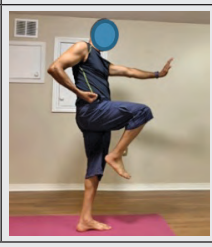
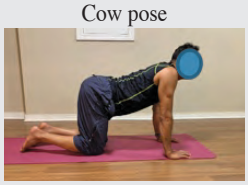
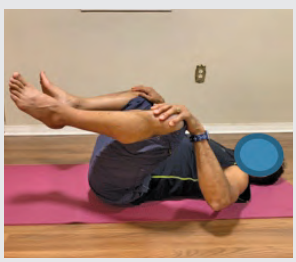
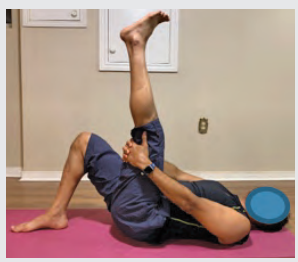
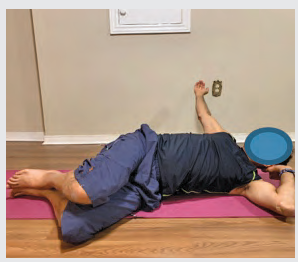
		2 	2 	2 
Weeks 7 & 8	"Cat – cow – downward facing dog" yoga poses • Intended to achieve a normal range of motion in the thoracic region and in the hips and ankles) • 6 repetitions	Hip circumduction • Intended to emphasize flexion and abduction with the help of the hands while maintaining a neutral spine • After 5 repetitions, change the direction and repeat	Hamstrings stretch • Flex and point the ankle 8 times while maintaining a neutral spine • Change legs and repeat	Starting position • 1) Lay on the side with hips and knees flexed; 2) extend the upper arm upwards while maintaining a neutral spine; 3) rotate the thoracic spine backwards without moving the pelvis. • 6 repetitions
	Cat pose  Cow pose  Downward facing dog pose 			

Table 2.
Subject characteristics

Group	Mean±SD of BMI (kg)	Mean±SD of weight (kg)	Mean±SD of height (cm)	Mean±SD of age (years old)	Number
Control	25.48±3.90	78.60±10.99	175.87±5.78	30.67±7.84	15
Experimental	28.12±4.04	87.73±13.61	176.60±6.57	40.60±6.03	15
BMI: body mass index, kg: kilogram, cm: centimeter					

To achieve the normal range of motion in each exercise, the subjects received instruction on how to contract the trunk muscles to maintain a neutral vertebral column posture.[38,39,40,41]

Statistical analysis

Data normality was confirmed by the Shapiro-Wilk test. In addition, descriptive statistics were used to calculate the central tendency and distribution indices. Levene's test was also used to determine the homogeneity of variance in each group. A Two-way ANOVA test was used for inferential analysis of the obtained data. A Two-way ANOVA test was used to determine the post-intervention outcome measure scores in the intervention and control groups. Each dependent variable was analyzed with Two-way ANOVA test with group (intervention/control) as the between-subjects factor, and time (pre/post) as the within-subjects factor. All statistical analyzes were performed using SPSS (version 25).

Results

The mean and standard deviation of the personal characteristics of the control and intervention subjects, which included their age, height, weight, and BMI, are shown in Table 2. In the pre-test, the groups had no significant difference with each other in any of the demographic variables ($p>0.05$) (Table 2).

There were no statistically significant main effects for group or time for any of the dependent variables (all $p > .05$). However, there were significant interaction effects for pain intensity ($p < .001$), level of disability ($p = .044$), static balance ($p = .017$), dynamic balance ($p = .015$), and proprioception ($p = .021$).

Minimal clinically significant difference (MCID) pain scores[42] intensity and level of disability scores (Oswestry) were set at 2 and 6 respectively. The mean post-intervention pain intensity and level of disability scores significantly decreased in the intervention group compared to control by 2.1 and 7 points, respectively. On the other hand, the mean post-intervention static and dynamic balance scores increased in the intervention group by 1.6 and 5.6 points, respectively, which indicates improvement in static and dynamic balance in this group. Furthermore, there was a significant decrease in proprioception error in the intervention group post-intervention (Tables 3 and 4).

Table 3.
Pre- and post-intervention outcome measure (Mean+SD) mean and standard deviation for control and experimental groups

Time		Pre-intervention	Post-intervention
Group	Variable	Mean+SD	Mean+SD
Control group	Pain intensity	3.93±1.75	5.13±1.29
	Level of disability	13.87±9.15	17.20±11.92
	Static balance	8.40±6.31	6.93±4.54
	Dynamic balance	93.85±5.16	92.94±7.79
	Proprioception	2.22±0.64	2.54±0.47
Experimental group	Pain intensity	5.73±1.63	3.67±1.96
	Level of disability	16.80±8.34	9.87±8.68
	Static balance	6.06±2.62	7.73±3.42
	Dynamic balance	92.15±10.63	97.84±10.56
	Proprioception	2.34±0.68	1.92±0.58

Table 4.
Two-way ANOVA test of the post-intervention outcome measure scores in the experimental versus control groups

Variable	Time	Group	time * group	Effect Size
Pain intensity	.320	.701	.001*	.203
Level of disability	.472	.380	.044*	.71
Static balance	.931	.507	.017*	.32
Dynamic balance	.299	.484	.015*	.36
Proprioception	.740	.110	.021*	.92
* = significant difference ($p<0.05$).				

Discussion

The aim of the present study was to investigate the effect of neuromuscular exercises on the intensity of pain, functional disability, balance, and proprioception of male military personnel with chronic LBP. In this regard, the results indicate that eight weeks of neuromuscular exercises could result in diminished pain severity in the intervention group. In other words, neuromuscular exercises might lead to a significant reduction in the severity of pain among the military personnel with chronic LBP.

Notably, the results of this study are in agreement with Suni *et al*.'s[38] findings who examined the effect of neuromuscular exercises and counseling on decreasing the absence of young soldiers with LBP. They found exercise and education had preventive effects on improving the LBP region control in military environments. They also tested the effectiveness of neuromuscular exercises and counseling on back pain among the healthcare personnel with nonspecific chronic LBP and observed exercising one time per week for six months along with five sessions of counseling on back care after work in a real life environment reduced the severity of LBP pain as well as the fear of pain due to the interventions; however, their intervention model was not economical. Suni et al. also explored the effect of neuromuscular exercises and counseling on back pain among the female nurse personnel with nonspecific chronic LBP in which their intervention resulted in improved ability to work and quality of life.[40] It appeared the exercises used by Suni et al. were effective at mitigating pain and pain-associated improvement.[39]

The results of the present study also show eight weeks of neuromuscular exercises had a significant effect on the level of disability in the intervention group compared to the control group. Accordingly, this may indicate that neuromuscular exercises led to the increased functional ability of military personnel with chronic LBP. Similarly, Taulaniemi *et al*. investigated the effect of neuromuscular exercises on reducing the severity of LBP as well as improving the physical functioning in nursing tasks among female healthcare staff.[41] They found neuromuscular exercises were effective at reducing pain and improving back movement control, abdominal power, and physical performance of nursing tasks.[41] Bauer *et al*.[21] investigated the effectiveness of doing neuromuscular exercises for six months on back motion. They found neuromuscular exercises improved back movement in the short term, which might have also demonstrated neuromuscular functioning integrity. In addition, they revealed that designing an optimal neuromuscular exercise program that would achieve long-term improvement in movement variability would require further research.

Garcia et al. examined 148 patients with nonspecific chronic LBP and then compared the effects of the McKenzie method and a back health educational program.[43] They found both interventions led to a diminished level of disability in these patients. Nevertheless, they reported exercise therapy using the McKenzie method was more effective as compared to the back health educational program. In this regard, Shamsi *et al*.[44] compared the effects of central stability exercises and traditional trunk exercises on patients with chronic LBP using pelvic lumbar stability functioning tests. Statistical analysis of the results showed significant progress in stability test scores as well as a reduction of disability and pain in the central stability of the exercise group.

Some studies have shown increased pain causes an increase in the range of variations as well as the impaired balance in the patients with LBP.[45,46] In such patients, the delay in the contraction of trunk muscles, and especially deep muscles, as well as the altered adaptation between the trunk muscles status during pain causes impaired stability and balance. Accordingly, rehabilitation programs are essential to improve the balance of these individuals. Carpes *et al*.[46] and Rhee *et al*.[47] dealt with examining the effect of dry-land stability exercises on the balance of the patients with LBP. As a result, both studies concluded these exercises lead to the increased balance and stability in these patients. The duration of exercises and the type of exercises in these studies were different from the present study. In Carpes *et al*.'s[46] study, 20 subjects underwent dry-land strength exercises for 20 sessions, which resulted in improved balance in these patients. Rhee *et al*.[47] also had 20 subjects undergo dryland core stability training programs five times per week for four weeks. In that study, subjects' balance was assessed using the center of pressure displacement index and showed significant improvement.

Neuromuscular exercises can improve the ability of the nervous system to generate a fast and desired muscle stimulus pattern that enhance dynamic joint stability, reduce forces exerted to the joint, and improve movement patterns.[48] Maintaining balance depends on a person's

sensory information and is affected by coordination, joint range of motion, and strength.[49] In this regard, planned and proper neuromuscular exercises are important in improving the neuromuscular coordination based on a wide range of strengths, ranges of motion, and proprioception function.[50]

Moreover, Waldén *et al*.[51] and Banderchet *et al*.[52] dealt with the effect of neuromuscular exercises on knee proprioception. Recent research has suggested an index like proprioception is associated with LBP, and LBP patients have a weaker proprioception compared to healthy individuals.[53] Several studies have also shown proprioception is trainable, and rehabilitation programs that mostly train proprioception can improve functional movements.[49-52] Accordingly, balance exercises, which are known as a subset of neuromuscular exercises, have been proposed to improve the proprioception disorders.[54] Neuromuscular exercises are typically practiced in the weight-bearing functional situations, which emphasize quality of movement in the truck and lower limbs. Another possible mechanism of these changes can be found in the effectiveness of neuromuscular exercises on the proprioception receptors. The information obtained from these receptors can help in the precise and delicate implementation of movements as well as in the provision of active stability thereby supporting balance.[55] For rehabilitation of the movement patterns and prevention of the long-term motor disorders, an overload pattern of neuromuscular exercises is used for physiological stimulation of sensory feedback changes, and thus, for improving the proprioception and neuromuscular control mechanisms.[56] The primary emphasis of neuromuscular exercises is not on changing strength; rather, it focuses on improving dynamic balance and proprioception receptors, which are defined as the awareness of the posture, movement, and changes in the balance as well as understanding the position, weight, and resistance of objects in regards to the body. The focus of this type of exercise is on the proper posture and position of the body for improved dynamic muscular balance during functional activities.[57] Therefore, improved muscular balance can control abnormal transfer of the joint during these activities. Neuromuscular exercises also tend to improve posture control and implementation of functions by challenging limbs in functional positions.[58] Consequently, the exercises used in the present study focused on improving the strength, stamina, balance, posture control, and enhanced range of pelvic lumbar muscular motion, which also stabilize the core's muscles.

Limitations

The limitations in this study include a low sample size, spatial constraints, the lack of female subjects, and the lack of long-term follow up testing. Furthermore, according to the Iranian laws governing military environments, it was impossible to have female researchers measure female subjects. Lack of access to advanced laboratory equipment, time constraints and lack of financial support were the other limitations of this study. Iranian cultural constraints and the unavailability of military personnel due to their jobs and insufficient support could have also affected this study's results negatively.

Conclusion

The results of the present study indicate performing neuromuscular exercises for eight weeks led to diminished severity of pain, increased functional ability, as well as improved static and dynamic balance and ameliorated proprioception among male military personnel with LBP. Preventive measures in military personnel should focus on mitigating back injury; therefore, the heavy burden of musculoskeletal diseases among the military personnel could be diminished. As such, the results of this study suggest that performing neuromuscular exercises can be effective in mitigating LBP. Considering the positive and considerable effect of the neuromuscular exercises performed in this study, the low-cost of the implementation of the exercises into existing programs and their simplicity, these exercises can be considered ideal for military personnel.

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Agreement of primary outcomes in chiropractic-related clinical trials registered in clinicaltrials.gov with corresponding publication

Robert M. Coté, DC, MS, DACBR[1]
Stephen M. Perle, DC, MS[1]
Derek S. Martin, DC[1]

Introduction: *Previous analysis of registered clinical trials has found a number of protocols result in changes in the registered primary outcome measures. This investigation determined if reported primary outcomes in chiropractic-related clinical trials registered in clinicaltrials.gov match their published results. Additionally, we assessed secondary outcomes, publication status and whether raw data were posted to the registry.*

Methods: *Clinicaltrials.gov was searched for chiropractic-related trials and having a completed status. If the study was published, outcome measures were compared between the clinicaltrials.gov entry and the published paper to assess for consistency.*

Results: *Within clinicaltrials.gov 171 chiropractic-related protocols were identified with 102 of those*

Concordance entre les résultats primaires d'essais cliniques sur la chiropratique enregistrés dans clinicaltrials.gov et ceux parus dans les publications

Introduction : *En examinant des essais cliniques enregistrés, on s'est rendu compte qu'un certain nombre de protocoles faisaient varier les résultats principaux. On a mené une étude pour savoir si les résultats primaires d'essais cliniques sur la chiropratique enregistrés sur clinicaltrials.gov correspondaient à ceux publiés. On a aussi examiné les résultats secondaires, l'état de publication et cherché à savoir si les données brutes étaient publiées dans le registre.*

Méthodologie : *Dans la base de données Clinicaltrials.gov, on a repéré des essais cliniques sur la chiropratique qui étaient terminés. Lorsque l'essai clinique avait été publié, on a comparé les résultats au moment de son enregistrement sur clinicaltrials.gov à ceux parus dans des publications pour savoir s'ils concordaient.*

Résultats : *Sur le site clinicaltrials.gov, on a trouvé 171 études sur la chiropratique, dont 102 avaient été*

[1] College of Health Sciences, School of Chiropractic, University of Bridgeport

Corresponding author: Robert M. Coté, College of Health Sciences, School of Chiropractic, University of Bridgeport, Bridgeport, CT
Tel: 1-716-908-1793
E-mail: rcote@bridgeport.edu

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published (59.6% publication rate). Ninety-two of the published papers (90.2%) had agreement between their primary outcome and the entry on clinicaltrials.gov and 82 (80.4%) agreed with the secondary outcomes.

Conclusion: *A modest rate of agreement between clinicaltrails.gov entries and the published papers was found. While chiropractic-related clinical trials are fewer compared to medical trials, chiropractic-related research has a substantially better rate of primary and secondary outcome concordance with registered protocols.*

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KEY WORDS: chiropractic, bias, clinical trial registry, research report, status of the profession

publiés (taux de publication :59,6 %). Pour quatre-vingt-douze publications (90,2 %), on a observé une concordance entre les résultats primaires au moment de l'enregistrement sur clinicaltrials.gov et 82 (80,4 %) et les résultats secondaires.

Conclusion : *On a observé un taux modeste de concordance entre les données à l'enregistrement sur clinicaltrails.gov et les données publiées. Les essais cliniques sur la chiropratique sont moins nombreux que des essais cliniques de médicaments. Mais le taux de concordance entre les résultats primaires et les résultats secondaires était considérablement plus élevé lorsque les protocoles de recherches sur la chiropratique sont enregistrés.*

(JCCA. 2021;65(2):207-211)

MOTS CLÉS : chiropratique, biais, registre d'essais cliniques, rapport de recherche, état de la profession

Introduction

Clinical trial registries are an important tool in evidence-based medicine to monitor selective reporting of outcome measures, publication bias, and duplication of trials. In addition, they establish records of non-published trials for clinicians and researchers who are interested in investigating similar hypotheses. Trial registration is required in the United States via the Food and Drug Administration Modernization Act[1] and the Food and Drug Administration Amendments Act[2]. Biomedical journals that subscribe to publication standards of the International Committee of Medical Journal Editors (ICMJE)[3] require that clinical trials are registered. Finally, the World Health Organization[4] also requires trial registration.

In an analysis of registered clinical trials in medical research, Fleminger and Goldacre[5] have found that a disappointing number of study protocols resulted in publications which change the registered *a priori* primary outcome (34.1% of registered trials). Likewise, there is a disappointing rate of unpublished trials. Huić, Marušić, and Marušić[6] evaluated randomized control trial (RCT) completeness and agreement between clinicaltrials.gov and ICMJE publications which found comparable findings (38.8% of registered trials had changes to the "Primary outcome" field) to Fleminger and Goldacre[5]. Similar research on changing primary outcome measures has not been published on chiropractic-related studies, that we are aware of. A recent study by Wells and Lawrence[7] evaluating bias in chiropractic and spinal manipulation research reported a "skew in favor of the intervention" (64.6%) of completed entries on clinicaltrials.gov. In addition, they noted that only 17.7% of completed entries on clinicaltrials.gov had results posted.

The primary purpose of this investigation was to determine if reported primary outcomes in chiropractic-related clinical trials registered in clinicaltrials.gov match their published results. Secondarily, other outcome measures and publication status are assessed.

Methods

Clinicaltrials.gov was searched for chiropractic-related trials. We identified a chiropractic-related trial exclusively by using the search terms "chiropractic", "chiropractor". As we were determining the concordance of registered trial to published manuscript, we also searched for completed status, as incomplete studies would not have been published, except as protocol papers. Publication status was determined by searching PubMed (pubmed.gov), In-

dex to Chiropractic Literature (chiroindex.org), and Google Scholar (scholar.google.com) through 29 May 2020. Search terms for these included the official trial name, the entry name on clinicaltrials.gov, the National Clinical Trial (NCT) identifier, or searching for the principal investigator (as an author [au] search). If the study was published, the paper was acquired and outcome measures were compared between the clinicaltrials.gov entry and the published paper to assess for consistency in methods/tools used and time-frame of collection which was determined by two investigators independently. If disagreements among investigators could not be resolved through consensus discussion, a third investigator was consulted.

Results

Within clinicaltrials.gov 171 chiropractic-related protocols were identified. Of these protocols, 160 novel entries were found with the search term "chiropractic" and 11 novel entries were found with "chiropractor". Twenty-five had results posted on clinicaltrials.gov and 102 were published. Twenty-nine of those entries produced multiple papers consisting of pilot studies, feasibility studies, protocol papers, clinical trials, mixed-methods trials, and poster presentations. Table 1 shows by year, the number of protocols on Clinicaltrials.gov that were registered and published. The vast majority of published studies, 93, were found by searching PubMed. The remaining nine studies were found using Index to Chiropractic Literature or Google Scholar.

Of the 102 studies published, 92 (90.2%) had agreement between their primary outcome and the listed entry on clinicaltrials.gov and 82 (80.4%) agreed with the secondary outcomes. Most published papers had matching outcome language compared to the clinicaltrial.gov entry counterpart and were counted as in agreement. For those that disagreed in primary outcome measures, four were due to improper entry of information on the clinicatrials.gov website; these included: no outcome measures reported, entering the outcome measure in the introduction information and not the Primary Outcome Measure field, and putting study design material in the Primary Outcome Measure field. The remaining six entries that were in disagreement had either changed primary outcome measurement tools, changed the timeframe of assessment, or omitted their stated outcome measures as per the clinicaltrials.gov entry.

Table 1.
Numbers of registered and published Chiropractic ClinicalTrials.gov Entries

Year	Number of protocols registered year	Number of studies published per year
2001	3	0
2002	1	1
2003	2	0
2004	1	1
2005	8	1
2006	20	0
2007	22	2
2008	17	6
2009	13	7
2010	10	13
2011	7	4
2012	13	7
2013	12	6
2014	10	12
2015	9	12
2016	8	12
2017	5	7
2018	6	9
2019	4	1
2020	0	1
Totals	**171**	**102**

Completed trials on clinicaltrials.gov had a 59.6% (102/171) publication rate and a 14.6% (25/171) rate of displaying their results on the website. Eighty-four of those published were from 2016 and earlier and the remaining eighteen were after 2017.

Discussion

A modest rate of primary outcome agreement (90.2%) between clinicaltrails.gov entries and the published papers (59.6% publication rate) were found. This compares favorably to what Fleminger and Goldacre[5] and Huić, Marušić, and Marušić[6] reported, that 38.8% and 64.5% of RCTs in medical literature had discrepant primary and

secondary outcomes, respectively. Ramagopalan *et al*.[8] reported that 31.7% of registered interventional studies between 1999 and 2012 on clinicaltrials.gov had changed their primary outcome measure between the initial entry and obtaining a completed status. In a revision to the previous study, Ramagopalan *et al*.[9] looked at completed interventional studies between 1999 and 2014 that had results published on clinicaltrials.gov and reported that 92.5% of those studies changed their primary outcome measure between initial entry and obtaining a completed status. While these two papers do not assess agreement between the clincaltrials.gov entry and a published paper, it does demonstrate a large proportion of them were not consistent with their initial goal. The authors of those papers attributed this to industry funding and reporting of statistically significant outcomes. Fleminger and Goldacre[5] reported a 44.4% publication rate of trials registered in clinicaltrials.gov and the European Union Clinical Trials Register.

Compared to what we found in the literature, chiropractic-related human subjects studies show a better primary outcome agreement and publication rate. Why chiropractic research has a better agreement and publication rate than the biomedical research community is not explained in the data. We believe that this may be due to two factors. A significant research effort in the chiropractic profession is relatively recent[10-13] and thus likely to have learned from advances made in the overall biomedical research community. For a so-called marginal profession[14] there is an imperative to do better than the overall community. Additionally, there is not as large an amount of research funding provided to the chiropractic profession, as compared to the wider medical community (i.e., from pharmaceutical or medical equipment companies). Because of this, there is not as much financial pressure to produce statistically significant outcomes.

Wells and Lawrence[7] found bias in chiropractic-related publications and spoke to a need for more investigators to add results to clinical trial registries. Our study found more "chiropractic" studies than Wells and Lawrence[7] when searching the same database (160 vs. 65). Wells and Lawrence searched for the terms "chiropractic" (data collection ended in Aug 18) and "spinal manipulation" (data collection ended in May 19), while we searched for "chiropractic" and "chiropractor". Additionally, they searched for all registered protocols, not just completed entries. The data collection time periods and different search methods may account for the differences in entities found.

Unfortunately, only 14.6% (25/171) studies had included results on clinicaltrials.gov. One purpose of clinicaltrials.gov is to have a database of results from clinical trials that have and have not been published, so without posted results from these protocols, the information they obtained is lost. This leads to more publication bias and loss of clinical information. It is important to note, 13 of the unpublished entries on clinicaltrials.gov were recent (within the last three years) and may be still seeking publication at the time of this investigation.

A limitation of our study could relate to the search terms used. While using "chiropractic" or "chiropractor" should include the majority of chiropractic-related clinical trials, having more inclusive search terms, such as "spinal manipulation" may have yielded more results.

Conclusion

While chiropractic-related clinical trials are fewer in number compared to medical trials, chiropractic-related research has a substantially better rate of primary and secondary outcome concordance with registered protocols and a better publication rate. A possible explanation for this is that funding for chiropractic studies is comparatively sparse and authors of these studies are ambitious to report findings, whether positive or negative. They likely do this in an attempt to reduce bias and provide evidence on treatment effectiveness or ineffectiveness.

To date, we found one previous study[7] that has evaluated chiropractic's publication rate and no chiropractic studies assessing outcome agreement in a clinical trial registry. As other authors[5-9] involved in medical research have reported, completion status and errors in registry information is common in healthcare research; it is encouraging that we found moderately good agreement in outcome measures with registered protocols. To further build upon the knowledge base of manual health care, chiropractic investigators need to continue to complete studies, upload results to clinical trial registries, and seek publication regardless of the study findings. In general, it is important to publish negative results so as not to introduce positive bias into meta-analyses. Both positive and negative findings are important when evaluating treatments and determining the best care for patients. Additionally, the NCT

identifier should be included in published papers to better link with the clinical trial registry.

With regards to our investigation and future investigations; future studies should strive to include all chiropractic-related search terms to ensure proper and full representation of chiropractic clinical research.

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Brief action planning to facilitate the management of acute low back pain with radiculopathy and yellow flags: a case report

Joel Weisberg, DC[1]
Gaelan Connell, DC, MRSc[2,3]
Leslie Verville, BHSc, MHSc[2,3]
Carol Cancelliere, DC, PhD[2,3]

Introduction: *Brief action planning (BAP) is a collaborative tool to support patients' self-management goal setting and action planning. BAP facilitates patient self-reflection, and provides opportunity to establish goals of their own priority.*

Case presentation: *A 55 year-old female with recent-onset low back pain with L5 nerve root distribution, described severe pain in the low back and sharp pain and tingle-sensations down to her right foot. Pain worsened with sitting, coughing, and bending. She was diagnosed with lumbar and other intervertebral disc disorder with radiculopathy (ICD 10: M51.1).*

Treatment: *Initial treatment included reassurance,*

Un bref plan d'action visant à faciliter la prise en charge de la lombalgie aiguë avec radiculopathie et avertisseurs jaunes : rapport de cas

Introduction : *L'outil collaboratif Brief action planning (BAP) sert à aider les patients à se fixer des objectifs et à prévoir leurs interventions. Il favorise l'autoréflexion du patient tout en lui permettant d'établir des objectifs selon l'ordre de priorité qu'il établit lui-même.*

Présentation du cas : *Une femme de 55 ans souffrant d'une lombalgie d'apparition récente, accompagnée d'une douleur selon la distribution de la racine nerveuse L5, se plaignait d'une douleur lombaire intense, d'une douleur aiguë et de picotements jusqu'au pied droit. La douleur s'aggravait en s'assoyant, en toussant et en se penchant. On lui a diagnostiqué un trouble du disque intervertébral lombaire avec radiculopathie (CIM 10 : M51.1).*

Traitement : *On a commencé par réconforter la*

[1] Downsview Chiropractic, Toronto, Ontario, Canada
[2] Faculty of Health Sciences, Ontario Tech University, Oshawa, Ontario, Canada
[3] Institute for Disability and Rehabilitation Research, Ontario Tech University and Canadian Memorial Chiropractic College, Toronto, Ontario, Canada

Corresponding author: Joel Weisberg, 552 Sheppard Avenue West, Toronto Ontario, M3H 2R9
Telephone: 416-635-1818
E-mail: info@downsviewchiropractic.com

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education, promotion of movement, and manual therapies. Symptoms worsened at the eighth visit (five weeks) where she also demonstrated pain-catastrophizing behaviours and an over-reliance on passive treatment strategies (i.e., psychosocial factors or yellow flags). BAP was introduced into her treatment plan to set achievable goals for her care.

Outcome: *Decreased pain and disability were reported after incorporating BAP into care. Reduced pain-catastrophizing and reduced over-dependence on passive strategies were also demonstrated. Clinical gains were sustained at the 10-week follow-up assessment.*

Key clinical message: *We describe the utilization of brief action planning as a technique for improving adherence to evidence-based clinical practice guideline recommendations in a patient with acute low back pain and radiculopathy, and late-onset psychosocial factors.*

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KEY WORDS: chiropractic, low back pain, rehabilitation, radiculopathy, self-management, risk factors, health behaviour, guideline adherence, case report, brief action plan.

patiente, l'informer, favoriser le mouvement et à administrer des thérapies manuelles. Ses symptômes se sont aggravés à partir de la huitième consultation (au bout de cinq semaines). Elle a commencé à dramatiser sa douleur et à trop compter sur des stratégies de traitement passives (c'est-à-dire intervention sur les facteurs de risque psychosociaux (qu'on appelle aussi « drapeaux jaunes »)). On a utilisé le BAP pour qu'elle puisse se fixer des objectifs thérapeutiques réalisables.

Résultat : *On a observé une diminution de la douleur et de l'incapacité après le début de l'utilisation du BAP. On a aussi noté une réduction de la dramatisation de la douleur et de la dépendance excessive envers les stratégies passives. La patiente a continué à faire des gains jusqu'à l'examen de suivi, à la 10e semaine.*

Message clinique clé : *Nous définissons l'outil BAP comme une technique servant à favoriser l'observance des directives et des recommandations fondées sur des preuves chez un patient souffrant de lombalgie aiguë accompagnée d'une radiculopathie et de facteurs psychosociaux tardifs.*

(JCCA. 2021;65(2):212-218)

MOTS CLÉS : chiropratique, lombalgie, rééducation, radiculopathie, autogestion, facteurs de risque, comportement de santé, respect des directives, rapport de cas, outil collaboratif Brief action plan

Introduction

Back pain is a common source of disability; more than 80% of people experience at least one episode of back pain during their lifetime.[1-4] First-line treatment of low back pain (LBP) with or without radiculopathy includes education on the expected course of recovery, reassurance, advice regarding effective self-management strategies, and support for continued activity.[5-7] Self-management strategies, and the promotion of physical activity in particular, are recommended to help reduce individual and societal burdens associated with back pain, including delayed recovery/chronicity, reduced function and participation in activities (e.g., work, school, community life, leisure activities), and increased costs associated with healthcare utilization and long-term disability.[8,9] Patients who are supported to actively self-manage other chronic illnesses report fewer symptoms, an improved quality of life, and lower healthcare utilization.[10] Yet, there is incongruence between the care patients *should* receive, and the care they *do* receive in the management of LBP and other disorders.[9,11,12] In addition, patient adherence to self-management recommendations is often suboptimal.[13,14]

Patient-centered care that coincides with a patient's self-management goals, preferences, and values is expected to improve their self-efficacy, adherence to recommendations, and lead to improve health-related outcomes.[15] Strategies such as active listening and empathy may be of value to active planning partnerships, as these strategies have been shown to foster the rapport between patient and practitioner.[16,17] Action planning partnerships

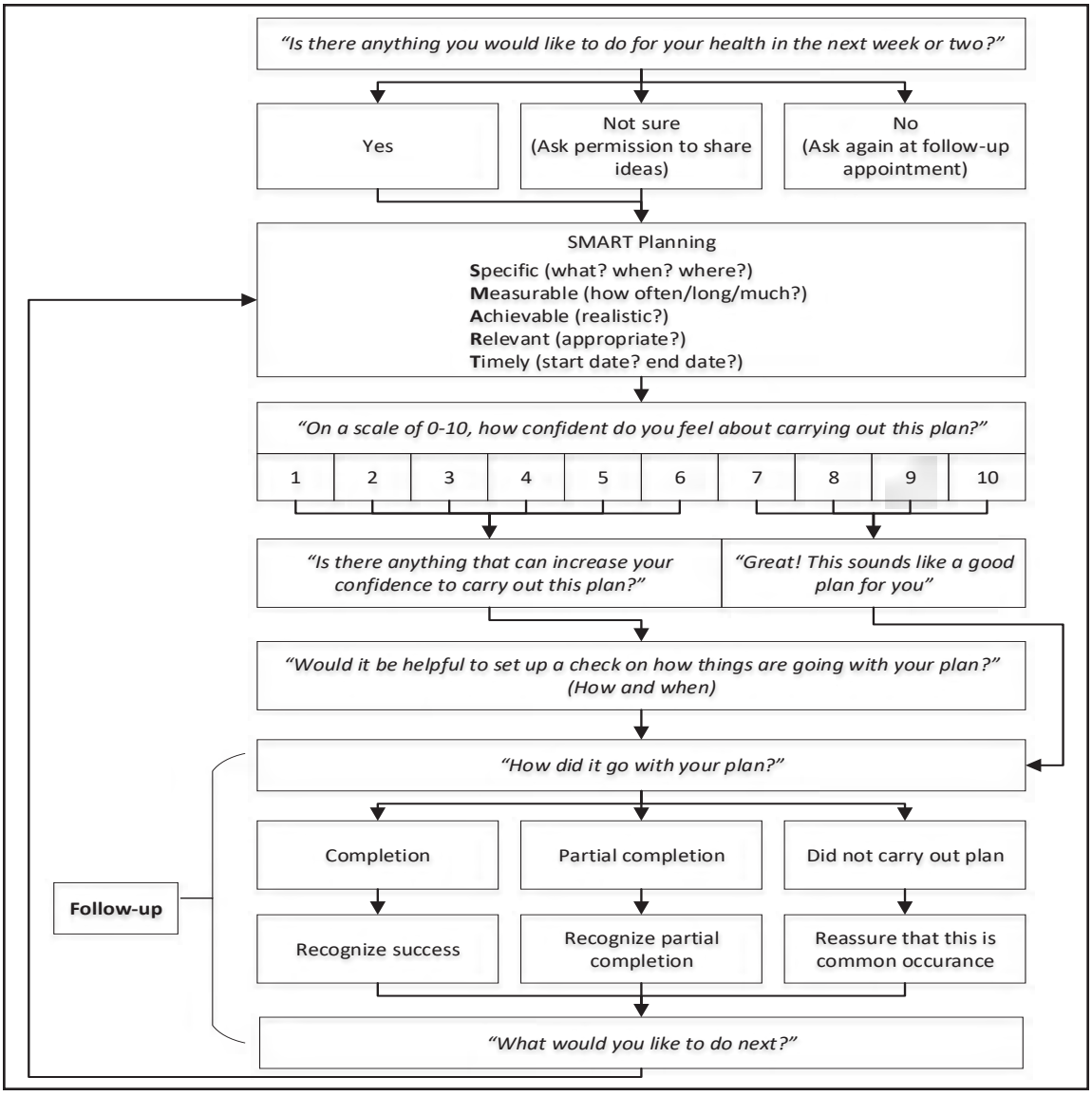

Figure 1.

Brief Action Planning flowchart. Adapted from Gutnick D, Reims K, Davis C, Gainforth H, Jay M, S. C. Brief Action Planning to Facilitate Behaviour Change and Support Patient Self-Management. JCOM. 2014; 21(1): 17-29.

between a patient and practitioner have been used to improve self-efficacy in chronic-illness management and disease prevention, and hold promise for the same in musculoskeletal health.[10,16,18-20] Brief action planning (BAP) is a collaborative tool to support a patient's self-management goal setting and action planning.

BAP is a tool that can be used to facilitate patient centered care by utilizing a stepwise process where practitioners work collaboratively with patients to ensure goals and action plans are both meaningful and realistic for the patient.[10,18,21] BAP supports principles of patient-centered care such as those outlined by the Picker Institute: access to care, respect for patient preferences, physical comfort, information and education, emotional support and alleviation of fear or anxiety, involvement of family, coordination of care, and continuity/transition of care.[22]

In a progression of three questions during the planning process, BAP respects patient preferences and considers environmental needs while promoting access to care.[10,18] With the opportunity to facilitate the patient's own decision-making processes if needed, BAP allows for practitioner provided clinically-relevant information.[10,18] The second in the sequence of three questions aims to assess the patient's confidence in their capacity to adhere to their newly identified plan, thereby offering emotional support.[10,18,23] By working collaboratively to increase confidence if needed, BAP allows for the principles of involvement of family and coordination of ancillary support. The third element of BAP establishes a follow-up regarding the implemented plan and iteratively establishes the plan progression to promote self-efficacy and self-management.[10,24]

Patients experiencing additional barriers to recovery such as yellow flags may benefit from BAP. Yellow flags are psychosocial factors indicative of longer term chronicity and poor outcomes.[5,6,25,26] BAP facilitates the patient's self-reflection, and provides patients with an opportunity to establish a goal of their own priority.[18,23] Patients may not be able to identify a relevant goal on their own, so making suggestions, with the patient's permission, may facilitate the patient's own decision-making processes.

Through this case report, we describe the utilization of BAP in conjunction with evidence-based clinical practice guideline recommendations for a patient experiencing recent-onset LBP with radiculopathy who subsequently developed psychosocial barriers to recovery (i.e., yellow-flags).

BAP in action

A schematic representation of the steps to implement BAP into clinical practice is provided in Figure 1.

BAP goals are time-bound by asking the patient "Is there anything you would like to do for your health in the next week or two?" Their goal may be further refined into a plan by using the common objective approach: SMART (specific, measurable, achievable, realistic, and timely). The choice of activity to change, or not to change, is the patient's alone.

The provider then aims to assess the patient's confidence in their capacity to adhere to their newly identified plan by asking: "On a scale of zero to ten, how confident do you feel about carrying out this plan?".[10] A confidence level below 7/10 implies low self-efficacy, and may be a poor prognostic factor of the patient's adherence to their plan.[10] Nonetheless, affirming their reported confidence of any level keeps the locus of control with the patient. In cases where low patient self-efficacy is identified, the practitioner can then work in partnership with the patient to support an increase in their self-efficacy, if necessary, by asking: Is there anything that can increase your confidence to carry out this plan? The patient may be challenged by problem-solving this on their own, in which case the practitioner may again make suggestions, with the patient's permission, to facilitate the process.

In chronic-illness management and disease prevention, patients may be more likely to follow through with a plan if they report back their progress.[10,24] Setting a follow-up with the patient establishes accountability and aims to further their self-efficacy by asking: "Would it be helpful to set up a check on how things are going with your plan?" Utilization of objective-based SMART planning may be of value again, when collaboratively establishing a follow-up opportunity. When setting a time-bound follow-up opportunity, consider that there is some indication that checking in earlier in the process is important.[10]

Upon follow-up, reassurance of patient successes, or even their partial successes, is important.[10] A patient may discount their partial success by focusing on the elements of their action plan that were poorly adhered to. Reframing the conversation to instances where there was adherence to the plan attempts to increase their confidence and thus their self-efficacy for the next iteration of BAP. Even if the patient reports no adherence to the action plan, the clinician has the opportunity to reframe by asking "What would you like to do for your health next?" and repeating the BAP process.

Case presentation

A 55-year-old female presented with recent-onset LBP with related leg pain. Recent-onset, or acute pain is defined as pain or symptoms that restrict daily activities and present for zero-to- three months duration.[6] The mechanism of injury was undisclosed.

A problem-focused history and examination was conducted. She reported taking prescription medication for hypertension (drug class and dosing not specified). She was self-employed and she described her lifestyle as sed-

entary. Her symptoms began two weeks prior to presentation and were described as a sharp pain in the low back and both buttocks with a sharp pain and tingle-sensation down her right leg and foot. She described a conventional L5 nerve root distribution. She denied changes to her bowel/bladder function or saddle sensation. Her complaint worsened with sitting, coughing, or bending forward. She used heat, self-massage and over-the-counter medication to manage her pain. Her presenting complaint was preceded one month earlier by a less painful episode that had been treated predominantly with passive therapies and minimal self-management advice. She reported poor satisfaction with the results, citing amelioration of that complaint for one week's duration.

Passive single straight leg raise exacerbated her complaint bilaterally. Lumbar forward flexion and lateral flexion were moderately painful. Sensory testing of the right L5 nerve root distribution revealed hypoesthesia. Lower extremity reflex and motor assessments were unremarkable. Verbal numeric pain rating scale was 8/10 where 10 "is the worst imaginable pain" and 0 is "no pain at all". Her Oswestry Disability Index score was 18/50 (moderate disability). She was diagnosed with lumbar and other intervertebral disc disorder with radiculopathy at intake (ICD 10: M51.1).[27]

Initial behavior-based first-line treatments included empathetic reassurance regarding the expected course of recovery, education promoting self-management including active care and hurt-vs-harm, and advice promoting well-tolerated movement, both generally, and utilizing structured exercises. The patient attended a total of 11 clinical visits over a period of 12 weeks and was managed according to evidence-based recommendations. This time-bound plan included active-care components and manual therapies (spinal manipulative therapy (SMT) and soft tissue therapy (STT)), congruent with clinical practice guidelines.[5,6] Her initial response to care was favorable, with her numeric pain rating scale decreasing to 5/10 within the first week over three clinical visits.

On her eighth visit for care, five weeks after initial presentation, the patient stated "I can't continue like this", demonstrating some pain-catastrophizing in response to an exacerbation of her numeric pain rating scale to 7/10. Prior to this exacerbation she reported that she was "*being lazy and not doing exercises*" and "*haven't had the time to do exercises*", and that she had decreased her adherence to remaining active. These reports demonstrated an increasing over-reliance on manual therapy as a passive coping strategy (yellow flag). Accordingly, the presence of these yellow flags likely contributed to her poor pain reduction outcomes and protracted rehabilitation progress.

In response, a partnered approach to revising her self-management behaviours was undertaken. She was asked the first BAP question: "Is there anything you would like to do for your health in the next week or two?" She identified "*I would like to get up more frequently to take standing breaks*." She was then asked; "On a scale of zero to ten, how confident do you feel about carrying out this plan?"[10] The patient rated her confidence 5/10 on a numeric rating scale, implying inadequate self-efficacy. She was then asked: "Is there anything that can increase your confidence to carry out this plan?" Her response included setting a reminder on her phone to take standing breaks when working in 45-minute intervals. The action plan was now specific (set a reminder on my phone), measurable (get up every 45 minutes when working), time bound (in the next two weeks), and in her own appraisal more achievable and realistic.

The patient reported successful implementation of her action plan at her next visit. The numeric rating scale score for her leg-dominant pain improved to 2/10.

Follow-up and outcomes

BAP was iteratively used at each subsequent visit to reconfirm, or progress upon, patient-relevant goals and action plans that were congruent with evidence-based clinical practice guidelines. At each subsequent visit, successful implementation, or partial implementation, of the action plans was met with reassurance from the practitioner.

Decreased pain-catastrophizing and gains in self-efficacy were apparent during these subsequent patient visits: *"[I] see the difference. [I am] more confident now because I can tie it [active self-management] to how I feel"*. Decreased over-reliance on passive coping strategies also became apparent: "*I want to keep being active"*. She presented for a total of three visits over six weeks subsequent to the inclusion of BAP in her care. Gains in clinical outcomes and patient self-efficacy were reported through to the last of her treatment sessions.

A follow-up examination was conducted 16 weeks after initial presentation (10 weeks after the incorporation of BAP). Passive single straight leg raise assessment im-

proved to unremarkable. Lower extremity sensory testing improved to unremarkable. Lower extremity motor and reflex testing remained unremarkable. The reductions in pain and disability were sustained; her numeric pain rating scale improved to 0/10 and her Oswestry Low Back Disability Index score improved to 8/50 (minimal disability).

Discussion

The purpose of this case report was to illustrate how BAP was successfully used to facilitate increased patient self-efficacy and improved patient adherence to evidence-based self-management strategies, congruent with clinical practice guideline recommendations, for the management of acute LBP with radiculopathy in the presence of yellow flags. Self-efficacy and adherence to evidence-based self-management strategies improved after the incorporation of BAP in the patient's care plan. The patient-reported improved function and reduced pain at follow-up assessment at 10 weeks. No adverse events were identified.

In patients with spinal pain, self-management strategies are used to decrease pain, improve function and address psychological distress.[5-8] The use of strategies that facilitate collaborative decision-making and problem-solving should be considered.[10,23,28-30] In the context of musculoskeletal care, strategies should align with the biopsychosocial model of health.[15,26] Patient goal-setting may have positive effects on patient self-efficacy, patient adherence to self-management strategies and healthful lifestyle behaviours, which may ultimately improve pain and functional outcomes.[23,31]

Limitations

Our case is hypothesis-generating and provides insight as to how BAP may be used in a clinical setting. We did not use validated outcome measures to assess the level of patient activation, self-confidence or self-efficacy pre- and post-treatment; these were measured anecdotally. This limitation may have contributed to an over-interpretation of our findings.[32] In addition, we did not systematically assess adverse events; these were collected anecdotally. Finally, implementing a psychosocial assessment, such as the STarTBack tool[33], at the outset of care might have provided insight into the presence of yellow flags earlier in the care enabling the provider to intervene with the fundamentals of BAP before the patient's symptoms worsened.

Future research

Additional follow-up is needed to assess whether self-efficacy and adherence to evidence-based self-management strategies are sustained beyond the timeframe observed in this report. Future analytic studies may assess whether BAP is an effective strategy for promoting self-management, congruent with evidence based clinical practice guidelines, for people with LBP with radiculopathy. Future work in this field should incorporate validated outcome measures including, but not limited to, the Patient Activation Measure (PAM)[34], the Patient Assessment of Chronic Illness Care (PACIC) survey questionnaire[35], and the Patient-Specific Functional Scale (PSFS)[36]. The application of patient-centered communication and counselling techniques such as BAP may be helpful in response to the increasing adoption of telehealth. Future studies may assess the transferability of BAP techniques to telehealth case management.

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The research enterprise at Canadian Memorial Chiropractic College

Brian S. Budgell, PhD[1]
Mark Fillery, MHSc[1]

Objectives: *A bibliometric survey was conducted, using network and textual analysis tools, to assess the current state of the research enterprise at Canadian Memorial Chiropractic College and to augment planning processes.*

Methods: *Searches were conducted via several databases to identify publications attributable to the institution. Bibliometric data were summarized and post-processed using the programme VosViewer and analysis tools provided in the Web of Science.*

Results: *Canadian Memorial Chiropractic College is a productive source of peer-reviewed publications supported by a diverse suite of funding agencies and collaborating institutions, and published across a broad range of journals.*

Conclusions: *As a private, single-purpose educational institution, awarding a qualification only in chiropractic, Canadian Memorial Chiropractic College probably performs well in its class of institution in terms of research productivity. However, assessment is*

L'effort de recherche du Canadian Memorial Chiropractic College

Objectifs : *On a mené une enquête bibliométrique à l'aide d'outils d'analyse de réseau et d'analyse textuelle, pour évaluer l'effort de recherche actuel du Canadian Memorial Chiropractic College et améliorer les processus de planification.*

Méthodes : *On a interrogé plusieurs bases de données pour trouver des articles publiés par le College. Les données bibliométriques ont été résumées et post-traitées à l'aide du programme VosViewer et des outils d'analyse fournis dans le Web of Science.*

Résultats : *Le Canadian Memorial Chiropractic College est une source abondante de parutions évaluées par des pairs, soutenues par un ensemble diversifié d'organismes de financement et d'établissements collaborateurs, et publiées dans un large éventail de revues.*

Conclusions : *À titre d'établissement d'enseignement privé à vocation unique, qui ne délivre qu'une seule attestation de compétence en chiropratique, le Canadian Memorial Chiropractic College fait probablement bonne figure dans sa catégorie d'établissements pour ce qui est de la productivité en recherche. Toutefois, l'évaluation est limitée par certaines incohérences entre les données*

[1] Division of Research and Innovation, Canadian Memorial Chiropractic College

Corresponding author: Brian Budgell, Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, Ontario M2H 3J1
Tel: 1 416 482-2340 ext 151
E-mail: bbudgell@cmcc.ca

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constrained by inconsistencies on the part of authors, journals and databases in archiving data.

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archivées par les auteurs, les revues et les bases de données.

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MOTS CLÉS : chiropratique, recherche

Introduction

On the occasion of the 75th anniversary of the founding of Canadian Memorial Chiropractic College (CMCC), members of the research faculty felt it useful to review the research enterprise of the institution with reference to the institution's current research agenda. In 2016, Canadian Memorial Chiropractic College had revised its research agenda and identified five core research streams: i) Health and Wellness; ii) Biological Basis of Musculoskeletal Injury and Manual Therapies; iii) Clinical and Health Services Research; iv) Education in Healthcare; v) Knowledge Translation and Health Policy.[1]

At the time that the researchers met to formulate the proposed research themes, no comprehensive quantitative information was presented concerning the current research capacity or output of the institution. In fact, while it appears that Canadian chiropractors value chiropractic research[2], and CMCC-affiliated chiropractors have taken a leadership role in promoting chiropractic research in Canada (see [3]), the peer-reviewed literature on the Canadian chiropractic research enterprise is all but non-existent (but see [4,5]). Thus, each researcher brought with them their personal perceptions of the place and trajectory of CMCC within the broader enterprise of research of relevance to chiropractic. It has previously been argued that an essential step in developing a research agenda for chiropractic in Canada would be to take stock of current resources.[6] The above-referenced study by Stuber *et al*.[5] of Canadian chiropractic research had painted a picture of modest research capacity, but used anonymized surveys such that it was not possible to parse out data specific to CMCC. With regard to the research streams identified by CMCC researchers as priorities, there was some congruence with recommendations of a previous Canadian research agenda workshop which had advocated for a focus on spinal pain, but which made no mention of health services research, nor research concerning knowledge translation and health policy.[6] In summary, the process of developing research agendas for chiropractic in Canada, and at CMCC in particular, has not adhered to any standard, and has been of unproven value in identifying and serving the needs of stakeholders. Under these circumstances, while celebrating the substantial research output of the institution, it seems appropriate to support enthusiasm with objective measures, and to augment the current planning processes with the best available information.

Therefore, the current study served to collate objective, quantitative information on the research capacity of Canadian Memorial Chiropractic College and its current scholarly output, and to determine congruence with the needs of the five research streams identified by the researchers. No hypotheses were tested.

Methods

Extending the aforementioned Canada-wide study of research conducted between 2012 and 2017[4], records of research publications for the years 2012 to 2020, inclusive, were obtained from the Office of Research Administration at CMCC. Prior to 2012, in-house records of publications were not archived systematically. Additionally, literature searches were conducted in January 2021 through Web of Science (WoS), PubMed and the Index to Chiropractic Literature (ICL) to identify all primary data peer reviewed articles attributed to Canadian Memorial Chiropractic College from December 31, 2020 back to first citations in WoS and PubMed, and back to January 2001 in ICL.

In more detail, a WoS search was conducted on January 17, 2021 using the search string ZP=M2H3J1 OR ZP=M2H 3J1 or OO=Can* Mem* Chir* Coll*, Timespan=All years. Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI. Similarly, a search of PubMed was conducted on January 21, 2021 using the search string: ("Canadian Memorial Chiropractic College"[Affiliation]) AND ("1900/01/01"[Date - Pub-

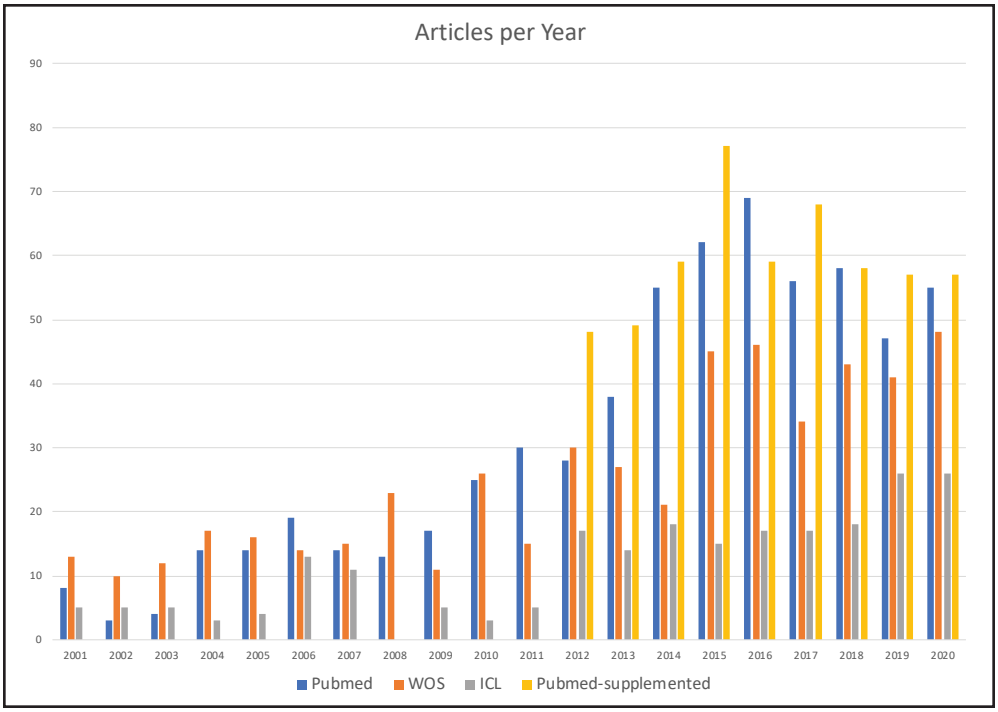

Figure 1.
Total number of publications per year by database

lication] : "2020/12/31"[Date - Publication]). ICL did not permit searching by affiliation, and so all fields were searched for either Canadian Memorial Chiropractic College OR CMCC. The results of all searches were combined, duplicates were eliminated, as were editorials, commentaries and letters to the editor to produce a database referred to hereinafter as PubMed-supplemented. From each article in this database, journal name, funding agencies, collaborating institutions and co-authors were also recorded and correlated. Despite the smaller number of citations in WoS, the utilities in this resource were also used for certain analyses as set out below.

Thus, from the PubMed-supplemented database, numbers of publications per year and publications per journal were calculated. Numbers of acknowledgements of funding agencies were also calculated.

Citations per article for the years 2001 to 2020 were obtained from WoS for the 100 most highly cited articles out of 508 publications listed in total for this period. For the 20 most cited articles, numbers of citations were correlated with the corresponding authors. PubMed and ICL did not provide tracking of citations by affiliated institution.

In order to map the interactions of CMCC affiliated authors, WoS full records for CMCC-attributed papers were entered directly into the network mapping software, VosViewer V1.6.16.[7] Co-authorships were mapped for all authors with a minimum of three publications, an arbitrary threshold to reduce cluttering on co-authorship maps.

In order to derive leading research themes, two approaches were taken. In the first instance, titles and abstracts from WoS were analyzed with VosViewer to visualize linkages in keywords which occurred more than five times in the entire corpus. For this analysis, VosViewer automatically eliminates navigational terms such as 'purpose' and 'methods', plus function words including articles ('the', 'a', 'an') and prepositions ('in', 'on', etc.). Additionally, the theme function in WoS was used to automatically assign thematic areas to articles.

Results

The search of PubMed from inception to 2020 yielded 643 articles, whereas the search of WoS for the same period yielded 625 articles, while the ICL search identified 237 articles. Number of publications per year for the WOS and PubMed searches are plotted in Figure 1, as

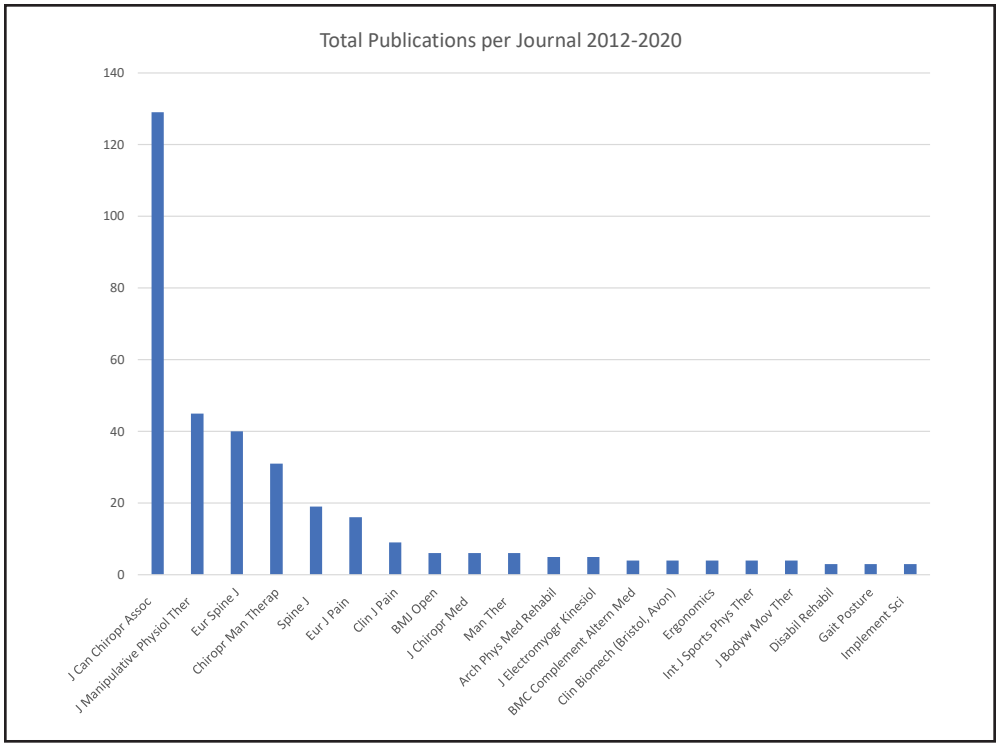

Figure 2.
Total number of publications per journal for the period 2012 to 2020 per PubMed-supplemented

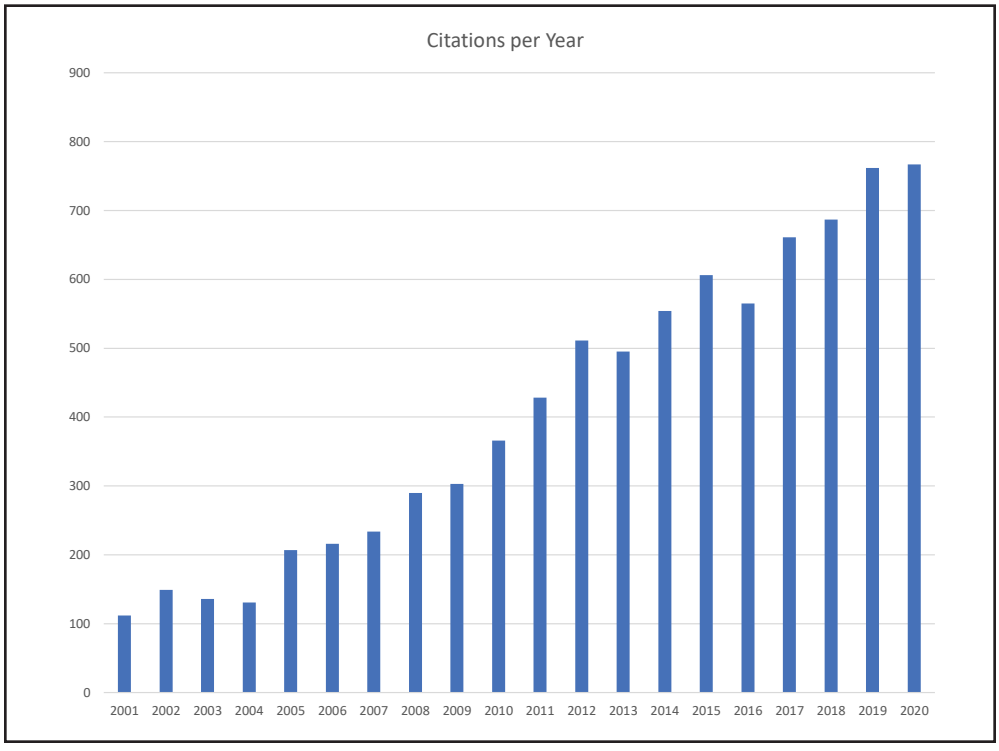

Figure 3.
Citations per year per WoS for top 100 cited articles

are the numbers of publications for 2012 to 2020 per ICL and PubMed-supplemented. Primary data publications, systematic reviews and meta-analyses were identified by reviewing each citation individually to eliminate editorials, commentaries and letters to the editor.

For the 99 journals associated with the 456 CMCC-affiliated articles published from 2012 to 2020 (per PubMed[+]), 52 carried only a single publication. The *Journal of the Canadian Chiropractic Association* was, by far, the most popular venue of publication, with 129 articles, i.e. 28% of the total for this period (Figure 2).

The numbers of citations per year for the 100 most cited CMCC articles according to WoS (PubMed and ICL do not provide this function) are shown in Figure 3. This WoS utility did not distinguish between publication type, but we note that in the period of 2001-2020 there were only six editorials, eight letters to the editor and eight commentaries attributed to CMCC. Hence, far and away the majority of citations would be associated with primary data articles, systematic reviews and meta-analyses.

With regard to funding agencies, both PubMed-supplemented and WoS records indicated that the CIHR was the agency most frequently cited despite the different time ranges for these databases (Figure 4). Of the 432 acknowledgements in PubMed-supplemented articles from 2012 to 2020, 292 agencies were cited only once. It is worth noting that the corresponding authors for the most cited article and three others of the 20 most cited articles have since retired from CMCC.

Discerning collaborating institutions was problematic as different authors would cite the same institution in different ways or would acknowledge departments or programs rather than the institutions which housed them. Nonetheless, the most commonly acknowledged collaborating institutions according to WoS and PubMed-supplemented were the University of Toronto, McMaster University, the Institute of Work and Health (Ontario), the University of Alberta and Ontario Tech University (formerly UOIT).

With regard to collaborations, VosViewer was used

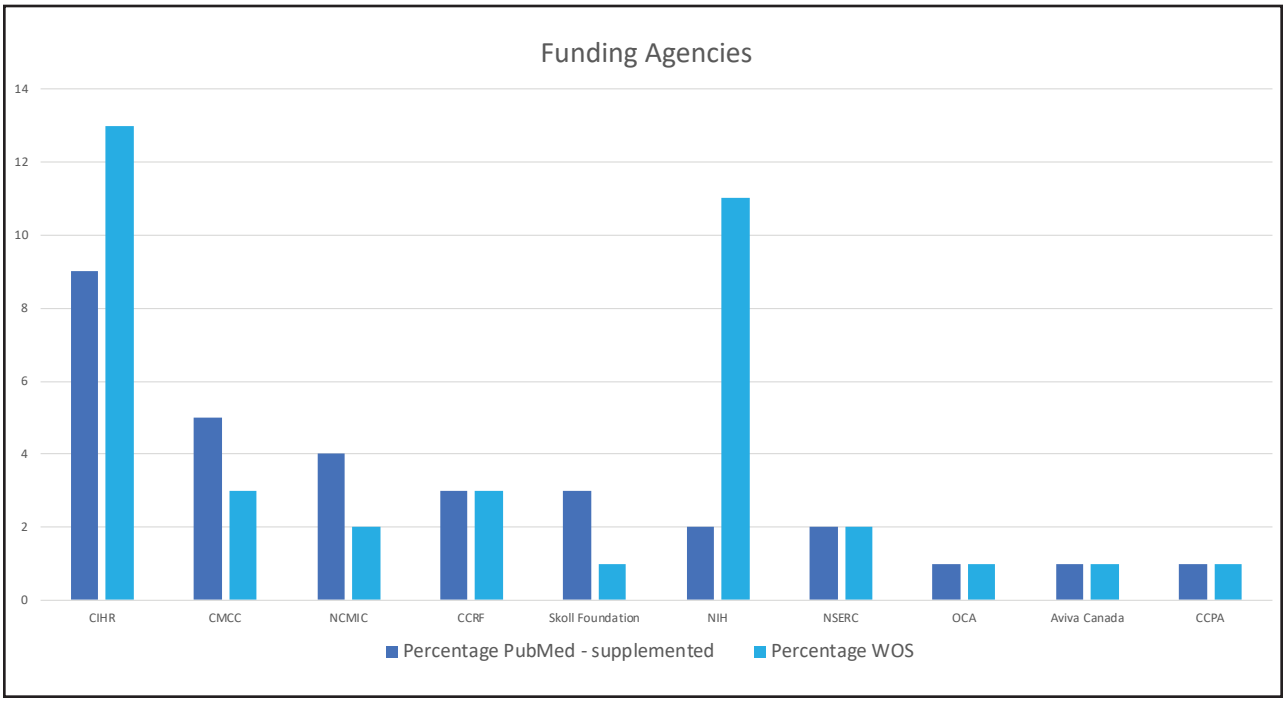

Figure 4.
Funding institutions as percentage of acknowledgements in PubMed-supplemented (from 2012 to 2020) and WoS (over all time).

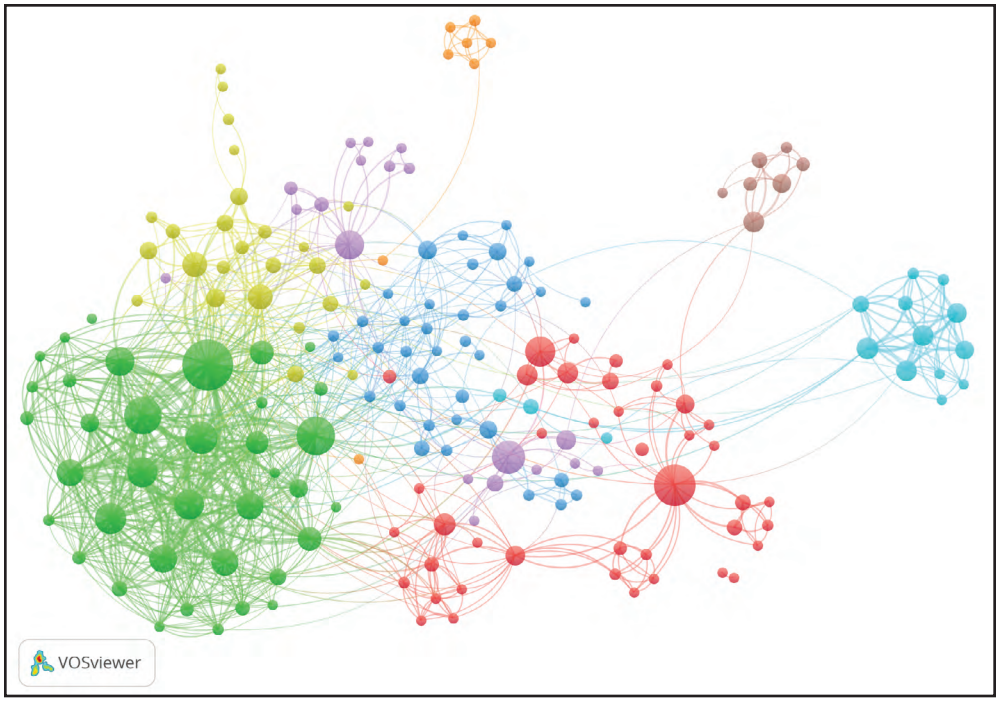

Figure 5.
Collaborative networks of anonymized authors per VosViewer based on WoS output over all time.

to generate co-author networks for WoS output (over all time), with authors anonymized (Figure 5). Node size is scaled according to number of publications in WoS and proximity of nodes is scaled according to frequency of collaboration. An internal algorithm was used to identify colourised clusters, i.e. groups of authors who more frequently collaborated with each other.

With regard to research themes, WoS used an internal algorithm to assign each article to one or more general research fields as shown in Table 1 below. The sum of assigned themes is greater than 100% because some articles were assigned to more than one theme.

As a companion strategy, titles and abstracts of articles retrieved from WoS were analyzed using the text analysis function in VosViewer, counting each instance of any word that occurred more than five times in the entire corpus. For the sake of legibility, of the 528 words which achieved this threshold, 317 (60%) with the highest relevance, i.e. over-representation compared to general English, were mapped as in Figure 6. Node size is scaled to frequency of occurrence in the corpus, node-to-node proximity is scaled according to number of co-occurrences.

Table 1.
Research fields assigned to publications retrieved through WoS.

Web of Science Categories	records	% of 625
Rehabilitation	297	47.52
Health care sciences services	217	34.72
Integrative complementary medicine	215	34.4
Orthopaedics	121	19.36
Clinical neurology	95	15.2
Sport sciences	53	8.48
Neurosciences	33	5.28
Rheumatology	32	5.12
Medicine general internal	29	4.64
Public environmental occupational health	19	3.04
Anesthesiology	18	2.88
Cell biology	16	2.56
Biochemistry molecular biology	13	2.08
Engineering biomedical	13	2.08
Physiology	13	2.08
Biology	12	1.92
Education scientific disciplines	9	1.44
Health policy services	9	1.44
Anatomy morphology	7	1.12
Ergonomics	7	1.12
Multidisciplinary sciences	7	1.12
Social issues	7	1.12
Engineering industrial	5	0.8
Psychology applied	5	0.8
Medicine research experimental	4	0.64

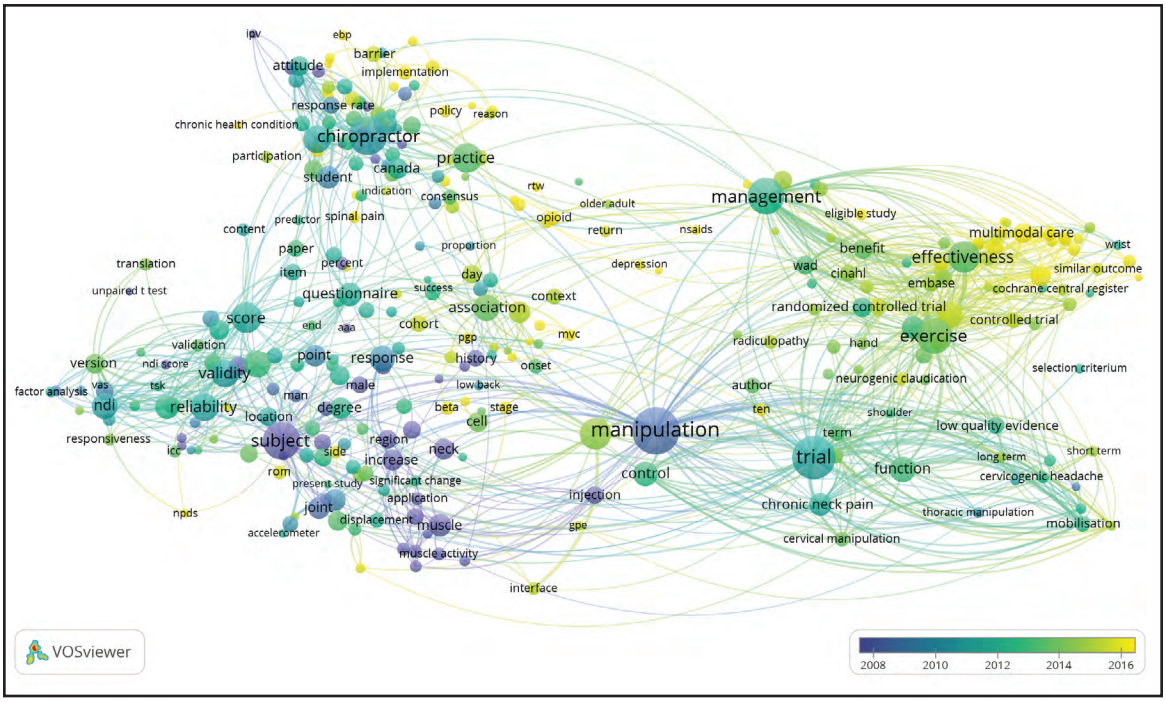

Figure 6.
Co-occurrence of keywords in titles and abstracts of articles retrieved through WoS over all time.

Discussion

The work conducted for this paper takes a new approach to creating a chiropractic research agenda: one where the institution becomes the primary locum for data collection, instead of the individual researcher. The literature supports looking beyond the researcher as a unit, and focusing instead on the environment in which they operate. Bland *et al*.[8] found that individual factors such as age, gender and department type were not significant predictors of this type of research productivity. Rather, once an institution recruited individuals with a passion for research, the departmental environment best predicted how well researchers would fare through: non-monetary recognition of research, emphasis by leadership of institutional research mission, and productivity in grantsmanship. Looking more broadly at research environments also allowed us to incorporate larger and more complex information than individual researchers can provide. Since most institutions report internally on researcher activity, and co-authors must report an affiliation in order for manuscripts to appear in journals, it is believed that this approach will yield better data with which to construct an overview of research activity.

Stuber *et al*.[5] identified two areas which were necessary for the creation of a research agenda for chiropractic: public consultation and an accounting of available research resources. Inventorying of researcher activity at our institution was intended to complement focus on the latter area, as we believe that it must first be understood where researchers are already active before consulting with patients and other stakeholders concerning future research aims.

The survey by Stuber *et al*.[5] garnered a 7% response rate, and revealed 530 publications over five years, but included editorials and commentaries in their corpus. Our institutional level search more completely captured data through affiliation, and additionally allowed for the capture of metadata (e.g., whether research is funded, and by whom), which could then be collated with other data on file. While we recognize Stuber *et al*.'s assertion that there is a hierarchy in types of research, we continue to include case studies in our accounting as we recognize the generative contribution that case studies can make to clinical research.

For CMCC, the publications data show growth which

ramped up quickly around 2012 (Figure 1). The peak in publications data in 2015 coincided with the culmination of the Ontario Protocol for Traffic Injury Management (OPTIMa) Collaboration. The sudden growth in publications, including those produced by OPTIMa, is rooted in the formation of the Ontario Tech University-CMCC Centre for Disability Prevention (CDPR) in 2012. The CDPR, which draws personnel and resources from both institutions, produces systematic reviews as its main publication output. The publications associated with OPTIMa number at least 28 to date, with 13 of those first appearing in print (either in full, or e-publication format) in 2015. However, if all publications with the CDPR affiliation are extracted from the dataset on CMCC publications, it is clear that productivity continued to climb in other areas of the institution until about 2016. Since then, if the outlier year 2015 is overlooked, growth in publications in all areas has steadied out to roughly 56 publications per year until 2020.

We diversified our analysis to look at indicators other than number of publications. Publication venue analysis has proved useful in internal evaluations at CMCC, since it aids in the determination of the audience researchers are reaching. We believe it is important to a research enterprise that the work it produces be viewed by the scientific community to invite criticism, and to foster growth in specialized areas of inquiry. CMCC has therefore tracked where its researchers publish manuscripts. Many different publishing venues have been utilized, each with the different areas of specialty in which CMCC researchers engage, such as biomechanical research, or basic sciences research on mechanisms of pain and injury, or health policy research. Thus, there has been a growth over time in publication venues where CMCC research appears. Indeed, CMCC's Vision and Mission speak to creating leaders in spinal health, and to deliver world class chiropractic research.[9] Nonetheless, it is also important to target journals, such as the Journal of the Canadian Chiropractic Association, where CMCC's stakeholders form a great part of the readership. Therefore, it should be welcomed that a great number of CMCC publications appear in the JCCA, and, at the same time, researchers continue to expand their work to other journals, especially as CMCC recruits the next generation of researchers, who must grow in their own research specializations.

On a final note for publications data, funder acknowledgments and citations data were analyzed to determine the impact, and the potential for impact, that the institution's researchers have on their areas of study.

The number of times CMCC-affiliated works are cited is also an indicator of how often the research produced by the institution is read, and then used to create other works. Note that our projections come from WoS, and are therefore more conservative estimates, since only about 63% of the publications we found from 2012-2020 are listed on that platform. The data provided in Figure 3 are for the top 100 cited articles only, and must therefore not be interpreted as cumulative. Nonetheless, there appears to be a continuous upward trend suggesting continuing growth of impact within the research community.

Researchers will almost certainly attest to the level of commitment that it takes to write an application for funding, whether for small, medium, or larger grants. Additionally, the competitive nature of requests for proposals necessarily includes critique by members of a discipline with a history of securing funding. Grantsmanship success, especially in a Canadian setting for a privately funded institution, is laudable, when considering the restrictive eligibility criteria and fierce competition for federal government grants, and the small pool of funding opportunities specific to the chiropractic profession. The standards for reporting whether a work has been funded vary by journal, as well as funder obligations. Therefore, our results may underreport research funding. It is stipulated in all funding contracts for Tri-Agency grants that the funding agent must be named in resulting publications. Therefore, it was expected that the Canadian Institutes of Health Research (CIHR) would be the most cited funding agency in publications with CMCC affiliations. Administrative records at CMCC show that from 2006-2020, 17% of grant applications logged were for funding from the federal government, with a success rate of 32%. Of note, one third (32%) of the applications logged were collaborative, where another institution was named as the sponsor. As a consequence, it is likely that the success rate is positively skewed, and that other collaborative applications were not captured.

With regard to the nature of collaborations involving CMCC-affiliated authors, it appears that, in comparison to Canada-wide communities of chiropractic-affiliated authors[4], there is a greater cohesiveness. Researchers who more frequently collaborate within a particular

group nonetheless commonly collaborate outside of their preferred group (Figure 5). They do not, to reluctantly use a hackneyed metaphor, 'occupy silos.' The factors behind this phenomenon remain to be explored, but might include the social environment of the institution, access to complementary researchers and resources, or perhaps a generalist rather than specialist bent to some researchers.

With regard to the thematic analysis of CMCC-associated research (Table 1, Figure 6), there would appear to be a bias towards the study of clinical and professional issues, and towards musculoskeletal, neural and immunological influences on health and disease. These foci are congruent with the CMCC core research streams of i) Biological Basis of Manual Therapies, ii) Clinical and Health Services Research and v) Knowledge Translation and Health Policy. The CMCC core research streams of iii) Education in Healthcare and iv) Health and Wellness appear to be underrepresented in actual research activity to date.

This paper did not attempt an analysis of the productivity of individual researchers, but rather was intended as an overview of the research enterprise of the entire institution. However, and recognizing the importance of personal characteristics in personal productivity, it is clear that institutional and leadership characteristics strongly influence the behaviour of individual researchers.[8,10] In this regard, a recent unpublished self-study facilitated by an external researcher/administrator found a high degree of satisfaction among faculty with physical resources and brokered opportunities, but a low level of satisfaction with the fostering of a research culture, intra-institutional communications and research leadership.

Limitations

The greatest amount of data used in this study was derived from electronic databases, each of which has its own strengths and weakness. ICL has a clear focus on chiropractic research, but is relatively under-resourced. PubMed and WoS are both well-resourced, but until fairly recently have not indexed many peer-reviewed chiropractic journals, which, themselves are a recent phenomenon. PubMed probably has the broader scope, but provides limited post-processing of bibliometric data, while WoS involves a more 'curated' suite of journals, but nonetheless provides informative analyses. Hence, the approach of this study of attempting to triangulate the true nature of the CMCC research enterprise through multiple lenses.

Additional challenges involved inconsistencies in the recording or formatting of information by authors, journals and databases. Hence, for example, authors would find multiple ways to record their own names, multiple ways to identify the same affiliation, and multiple ways to identify funders. Journals and databases were inconsistent concerning which bibliometric information they recorded, and which information was searchable/retrievable.

Beyond these technical challenges, the terms *research productivity* and *research excellence* have been the subject of continuous and methodical debate across the globe for half a century, especially since they have been used by institutions as instruments of educational reform in the past 20 years.[11] In 2005, Bland *et al*.[8] synthesized decades of literature in an attempt to identify characteristics associated with faculty research productivity, but the definition for productivity inevitably came back to publications as the main output. The Bland *et al*. study data are now 20 years old, and relied on the perceptions of those surveyed to draw conclusions about what defined research productivity. Investigators have continued to diversify the search for predictive factors of research productivity using publications as currency.[11] However, the use of a small set of metrics on output to quantify success draws criticism about how this practice may in fact be damaging to the traditional values of research, and detrimental to activities that are necessary for its enrichment.[12] Therefore, our use of publication activity as a proxy for research productivity must include a disclaimer that we recognize this approach is flawed. Further discussion and research on ways to measure research productivity must be created and must speak to the creation of a culture where engagement in activities that promote the values of good research is merited. Agate *et al*.[12] propose that this can be done through measuring the use of citations in syllabi, and placing greater emphasis on recognizing peer review.

Notwithstanding these limitations, the authors hope that the current and relatively novel use of social network analysis and textual analysis of research activity advance our shared understanding of the chiropractic research enterprise.

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Scalenus muscle and the C5 root of the brachial plexus: bilateral anatomical variation and its clinical significance.

Gagandeep Kaur Aheer, BSc, MSc, PhD[1]
Joey Villella, HBSc (Kin)[2]

Objective: *To describe an anatomical variant wherein, bilaterally, the C5 ventral root passes anterior to the anterior scalene muscle.*

Clinical Implications: *This and other variants in the anatomy of brachial plexus may complicate diagnosis of thoracic outlet syndrome, by producing unconventional signs and symptoms. Additionally, the passage of C5 ventral root anterior to the anterior scalene muscle, as in this case, may render the nerve root more susceptible to injury, including injury during manual therapy directed to this region.*

(JCCA. 2021;65(2):229-233)

KEY WORDS: thoracic outlet syndrome, anatomical variant, C5 ventral root, cadaver

Scalène antérieur et racine nerveuse C5 du plexus brachial : variation anatomique bilatérale et sa signification en clinique

Objectif : *Décrire une variante anatomique selon laquelle, bilatéralement, la racine ventrale de C5 passe en avant du scalène antérieur.*

Incidence clinique : *Cette variante et d'autres dans l'anatomie du plexus brachial peuvent compliquer le diagnostic du syndrome du défilé thoracique, parce qu'elles produisent des signes et des symptômes inhabituels. Par ailleurs, le passage de la racine ventrale de C5 en avant du scalène antérieur, comme c'est le cas ici, peut rendre la racine nerveuse plus exposée aux blessures, notamment pendant des manipulations dans cette région.*

(JCCA. 2021;65(2):229-233)

MOTS CLÉS : syndrome du défilé thoracique, variante anatomique, racine ventrale de la C5, cadavre

[1] Department of Anatomy, Canadian Memorial Chiropractic College
[2] Undergraduate Program, Canadian Memorial Chiropractic College

Corresponding author: Gagandeep Kaur Aheer, Department of Anatomy, Canadian Memorial Chiropractic College, 6100 Leslie Street, Toronto, ON M2H 3J1
Tel: 647-863-1300
E-mail: gaheer@cmcc.ca

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Introduction

Thoracic outlet syndrome is not a rare presentation and may be seen as a concomitant of whiplash associated disorders and athletic injuries.[1-3] The practitioner therefore needs to be able to recognize this syndrome for what it is, and institute appropriate care. These responsibilities would be made lighter if the relevant anatomy were immutable. However, the physical diagnosis of thoracic outlet syndrome is not trivial[4] and various anatomical variants, including cervical ribs and unusual muscle attachments, mean both the underlying mechanisms and the clinical constellation may be quite variable (for examples, see [5-7]). Hence, for example, what are essentially neurological manifestations may masquerade as cardiovascular complaints[8,9], complicating diagnosis and leading to the implementation of inappropriate treatment. Therefore, anatomical variations of the brachial plexus are of significant interest to clinicians[10].

The brachial plexus is formed by the union of the ventral rami of the C5-C8 and T1 nerves. The C5 and C6 rami join at the lateral border of scalenus medius as the superior trunk (ST), the C8 and T1 rami join behind scalenus anterior as the inferior trunk, and the C7 ramus becomes the middle trunk. After exiting the intervertebral foramen, these ventral rami usually pass through the interscalene triangle, bounded anteriorly by the anterior scalenus muscle (ASM), posteriorly by the middle scalenus muscle (MSM), and below by the first rib.[11] The ASM arises from the transverse process of the C3 to C6 vertebrae, and it inserts into the scalene tubercle of the first rib, between the grooves for subclavian artery (SA) and subclavian vein (SV). The MSM arises from the transverse process of the C2 to C7 vertebrae, and it attaches to the first rib posterior to the attachment of ASM.[12]

There are few studies which evaluate the relations between the roots of the brachial plexus and the scalenus

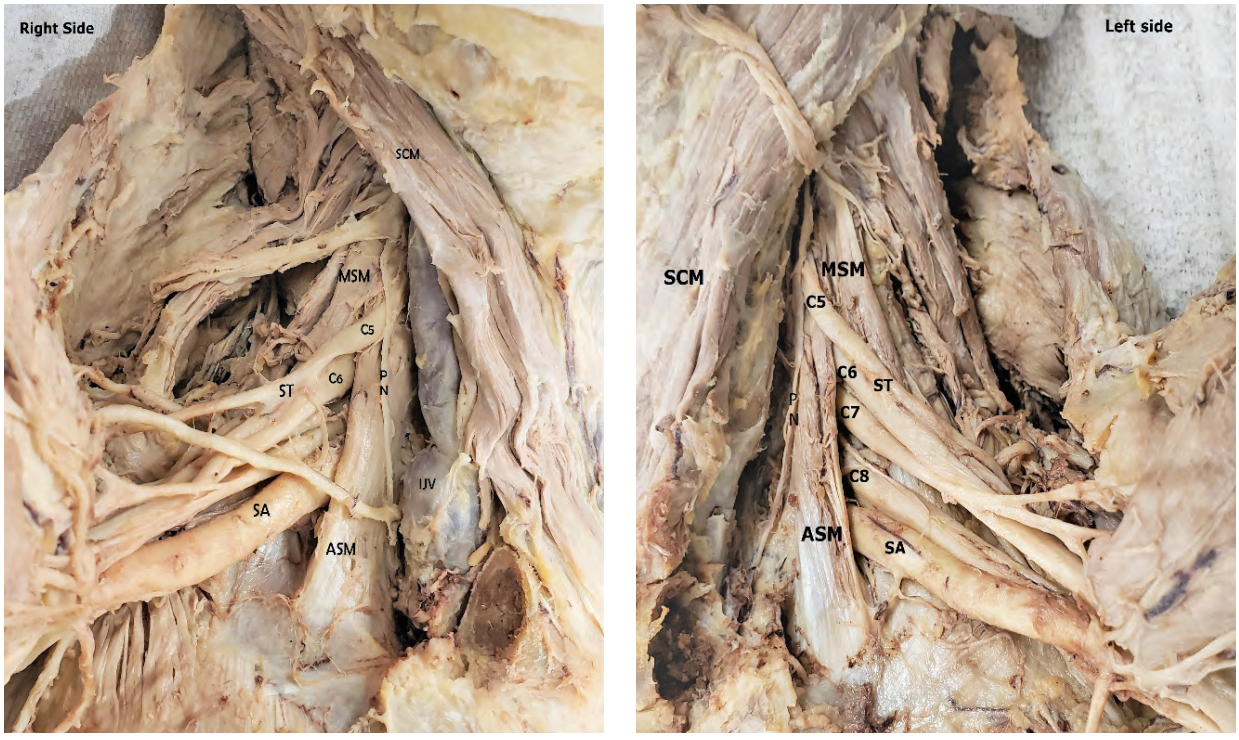

Figure 1.

Bilateral variation of the C5 root of the brachial plexus; Anterior right side and Anterior left side; ASM – anterior scalene muscle; MSM – middle scalene muscle; PN – phrenic nerve; ST – superior trunk; C5 – ventral ramus of the fifth cervical nerve; C6 – ventral ramus of the sixth cervical nerve; C7 – ventral ramus of the seventh cervical nerve; C8 – ventral ramus of the eight cervical nerve; SA – subclavian artery; IJV – internal jugular vein.

muscles. Knowledge of the relations between the roots of the brachial plexus and the scalenus muscles is clinically significant for anesthetists, surgeons, radiologists, and manual therapists, as these variations are a constant challenge, for example during surgical investigation.[13] This study introduces an additional complication to which clinicians should be alert in formulating their diagnosis – a variant passage of the C5 spinal nerve anterior to the anterior scalenus muscle. This variation would likely modify the presentation of thoracic outlet syndrome; for example by sparing the C5 nerve root from compression in the interscalene triangle, and hence sparing, for example, deltoid muscle strength, At the same time, however such superficial passage might render the C5 nerve root vulnerable to forces applied during manual therapies to the neck and so could account for some adverse response to treatment as detailed below.

Case report

During a routine educational dissection for the first-year chiropractic students, we came across a variation in the brachial plexus in a female cadaver. The neck was dissected to expose the posterior triangle. A midline incision was made, followed by lateral reflection of the skin, superficial fascia and the platysma muscle, exposing the sternocleidomastoid muscle. The omohyoid muscle was reflected and the clavicle was disarticulated at the sternoclavicular joint, exposing the scalene muscles, as well as the supraclavicular and infraclavicular parts of the brachial plexus. Prevertebral fasciae and the carotid sheath were cleared from the surface of the anterior and middle scalene muscles, as well as from the root and trunk of the brachial plexus. In our case, bilaterally, the C5 nerve root passed anterior to the anterior scalene muscle (ASM) and inferior to the phrenic nerve, deep to the sternocleidomastoid muscle (Figure 1). After its descent over the anterior scalene muscle, C5 joined C6 on the lateral border of the ASM to form the Superior Trunk. The subclavian artery (SA) and the middle and inferior trunks of the brachial plexus (BP) passed through the interscalene triangle on both sides, with the subclavian vein passing anterior to the ASM. Further dissection of the neck and the axilla proved the branches of the BP trunks and the vascular anatomy to be normal.

Discussion

The current study sheds further light on anatomical variations presenting in the brachial plexus region and cause us to consider potential clinical implications. The presence of anatomical variation is often used to explain the etiology of symptoms that might not otherwise be obvious. Our report of the variant position of the C5 ventral root anterior to the anterior scalene muscle demonstrates yet another brachial plexus variation. C5 and C6 roots forming the superior trunk of the brachial plexus normally run between the anterior and middle scalene muscles, and so they are somewhat protected from superficial trauma.

Variations of the BP and scalene muscles are embryologically determined. The interaction of the neural primordium with the scalene muscles and blood vessels is considered the key factor in the anatomical variations of the neck and the axilla. The development of the BP may orchestrate the cited variation in its relation to the ASM, owing to its formation prior to scalene muscle development.[12]

The C5 root has been described in the literature as piercing the anterior scalene, or more rarely, passing anterior to the muscle. According to a study by Harry *et al*.[10] on 51 cadavers, in 3% of cases the C5 root was located anterior to ASM unilaterally, but never bilaterally. Leonhard *et al*.[13] assessed the brachial plexus variations in 95 cadavers and only found this unilateral variation in two cadavers. Natsis *et al*.[14] who studied 93 cadavers, observed the C5 root passing anterior to ASM and C6 piercing the muscle in one individual. However, Gutton *et al*.[15] observed this unilateral variation in 8%, Kessler and Gray[16] in 6.5%, and Loukas *et al*.[17] in 1% of cadavers. Bilateral occurrence of this variant has not been previously reported.

This superficial location of the C5 ventral root could result in significant neurological deficits, if the nerve were damaged. The superficial position of the superior trunk, and the reduction in protective overlying musculature could render it more vulnerable to injury rather than prolonged compression. Individuals with this variation would be more likely to present with neurogenic symptoms following temporary pressure on the anterior and lateral neck, for example, from carrying a heavy backpack or purse.[18] Others have reported 'pack palsy' defined as impairment of the superior trunk or suprascapular nerve, a proximal branch of superior trunk, due to pressure on the shoulder girdle, and this complaint is commonly seen

in military personnel and hikers.[19] The anterior scalenus muscle produces rotation of the cervical spine to the same side and maximum stretching of the anterior scalene muscles occurs with rotation to the opposite side. Therefore, the variant course of C5, as seen in our case, could be a possible source of neuropathic pain or neuritis with neck musculature strain or hyper-abduction injuries.

From a medical perspective, there are also implications for variation in the position of roots of the brachial plexus relative to the anterior scalenus muscle when performing an interscalene brachial plexus block. In cases where the roots are located outside of the interscalene groove, which is the injection site for this block, the block may not adequately anesthetize the upper limb.[20] However, variation in position of the root and trunk in relation to the scalene muscle can be easily identified on ultrasound imaging. Ultrasound guided visualization of the root can be employed, and if variations are identified, the interscalene approach can be utilized with anesthetic injected into adjacent areas in addition to the interscalene groove, ensuring that these variant nerves are blocked and adequate anesthesia is obtained.[21]

Awareness of anatomical variation in the cervico-brachial region is of increasing importance in the chiropractic profession. The etiology of compressive syndromes in this region (such as TOS) typically involves a combination of flexed head posture, anteriorly rounded shoulders and protracted scapulae.[22] Owing to the life-style trends of the 21st century, there is a growing burden of TOS in full-time students as well as in occupations that require repetitive overhead reaching. A cascade of neuromuscular events can develop secondary to faulty posture, ergonomics, trauma, or even muscular hypertrophy.[23]

When evaluating patients with TOS, the clinician will complete a standard evaluation procedure that consists of a history, and physical and regional assessment of the thoracic outlet and shoulder girdle.[24] The patient interview will aim to discuss the mechanism of injury and a well-rounded health history is required in order to devise a working diagnosis. To confirm or rule out clinical suspicions, the chiropractor will then conduct an orthopedic assessment with an attempt to reproduce the chief complaint through a series of provocative tests. With prior knowledge of neurovascular variants and confirmatory advanced imaging studies, the clinician may, in addition to routine procedures, attempt to provoke or amplify the patient's symptoms by applying pressure to the anterior margin of the ASM. Subsequently, the clinician may consider this anatomical variant in the diagnostic process and adjust the treatment plan accordingly.

The foundation of chiropractic management for many compressive syndromes is to adopt a holistic approach in re-establishing proper function, giving focus to neurological innervation by offloading impingements.[25] In practice, the challenge to manual therapy is to facilitate this decompression without further irritating the relevant neurovascular supply.[23] For patients presenting with a suspected cervico-brachial compression syndrome, treatment options might include myofascial release therapy of scalene musculature, first rib adjustments and cervical joint mobilization or manipulation. In reference to the current case study, the bilateral superficial location of the C5 ventral roots could result in significant unexpected neurological deficits following otherwise conventional manual therapy, such as trigger point therapy or stripping massage applied to the ASM. As a result, clinical manifestations of varying severity may refer as C5 nerve root dermatomal and myotomal patterns. The patient may experience ipsilateral numbness and tingling in the lateral arm following manual pressure to the anterolateral neck.[22] However, due to individual differences, it is not possible to forecast the exact implications in all cases.

Conclusion

Clinicians should be aware that variants, as described in this paper, exist and have clinical implications. Awareness of relevant neurovascular anatomy allows chiropractors to derive more specific differential diagnoses and develop appropriate treatment plans. Without careful consideration, certain treatment modalities would be ineffective, or even exacerbate symptoms in some patients. The mere presence of anatomical variation does not imply that symptoms will become manifest. However, the etiology of compressive syndromes in the cervico-brachial junction typically involves a combination of predisposing risk factors including faulty posture and congenital anatomical variants. These individual differences can often explain symptoms that might not otherwise be obvious. Therefore, the most reliable way to correlate structure and function of the thoracic outlet is through a good medical history, physical examination and periodic reassessments.

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