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Identifying and prioritizing research to inform a research agenda for Canadian chiropractors working in sport – the Canadian sports chiropractic perspective.

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ABSTRACT

Objectives: To identify and prioritize research to inform research agenda development for Canadian chiropractors working in sport.

Methods: Clinicians, researchers and leaders from the Canadian sports chiropractic field were invited to participate in 1) a survey to refine a list of research priorities, 2) a Delphi procedure to determine consensus on these priorities, and 3) a prioritization survey.

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Results: The top three research priorities were 1) effects of interventions on athletic outcomes, 2) research about sports healthcare teams, and 3) clinical research related to spinal manipulative and mobilization therapy. The three highest ranked conditions to research were 1) low back pain, 2) neck pain, and 3) concussion. Collaborations with sports physicians and universities/colleges were rated as important research collaborations to pursue.

Conclusions: These results represent the Canadian sports chiropractic perspective to research priority setting and will be used alongside stakeholder input to set the first research agenda for the Canadian sports chiropractic field.

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KEY WORDS: sports, chiropractic, Delphi study, research priorities

Introduction

Research agendas identify knowledge gaps¹, prioritize future research^{1,2}, and ensures that the research being conducted is clinically relevant². They can guide resource allocation, establish funding priorities, and inform the pursuit of strategic partnerships and collaborations.¹⁻³ With up to 55% of adults^{4,5} and 74% of youth⁶ participating in sports and physical activity in Canada, the importance of contributing to research about sport, physical activity, and their related injuries is an important endeavor for chiropractors as partners in the Canadian healthcare system.

To date, a research agenda for the sports chiropractic field has not been published, limiting the ability of the field to coordinate a research strategy to direct investment, align research efforts, cultivate research capacity, and foster sustainable research programs. A common method to

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provide data to inform a research agenda is to utilize the Delphi procedure, which is a systematic method used to integrate expert opinions to determine consensus. It involves recruiting a panel of experts to participate in an iterative survey process that uses repeated rounds of voting where experts vote on a list of statements (often referred to as ‘seed statements’) and rank their importance.⁷⁻⁹ The results from each voting survey are fed back to the experts in progressive voting rounds to facilitate their subsequent voting with the purpose of determining consensus.⁷⁻⁹ Previous researchers have applied the Delphi procedure to develop research agendas for various professions¹⁰⁻¹³, including chiropractic^{1,3}.

In 2014, Rubinstein *et al.*³ utilized the Delphi procedure to inform the first research agenda for the chiropractic profession in Europe. They reported consensus on 19 research priorities with cost-effectiveness/economic evaluations, identification of subgroups likely to respond to treatment, and initiation and promotion of collaborative research efforts as the highest ranked research priorities. Similarly, in 2017 French *et al.*¹ conducted a modified Delphi study to determine consensus on research priorities for the Canadian chiropractic profession and identified the integration of chiropractic care into multidisciplinary settings, cost-effectiveness of chiropractic care, and effect of chiropractic care on reducing medical services as the top three ranked priorities. While these research agendas facilitate research planning for the chiropractic profession, their Delphi panels had minimal sports chiropractic input, and may not address the specific research needs of these practitioners.

Chiropractors providing care to athletes must do so within the sports context, which is a performance-driven setting.¹⁴⁻¹⁷ Athlete- and sport-specific factors, such as addressing time-loss from sport¹⁴ and coordinating care within an integrated sports healthcare team¹⁸, can affect how

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healthcare providers working in sport approach care delivery^{14,19}. These contextual factors can influence the research requirements of healthcare providers operating in these settings. An interview study exploring the opinions of sports-focused chiropractors about research revealed that they concentrated their discussions about research on topics specific to the sports context, such as the effects of sports chiropractic interventions on athletic performance, injury prevention, and the care of athletes in clinical practice.²⁰ These sports-related research interests were not captured by previous Delphi studies conducted for the chiropractic profession,^{1,3} reinforcing the need to develop a unique research agenda for the Canadian sports chiropractic field.

Developing a research agenda for a field of study requires input from multiple sources.²¹ Research priorities must be identified, consensus on these priorities from research end-users must be reached, stakeholder input should be sought, and an evaluation of the field's research capacity must be conducted.²¹ Our research group has planned and conducted multiple studies^{20,22,23} to provide data on each of these areas to inform the setting of a research agenda and a subsequent implementation plan for the Canadian sports chiropractic field. An exploratory study to provide preliminary data on sports chiropractors' opinions about research was published²⁰, a qualitative study was completed to identify research priorities for consideration for research agenda development²², athlete opinions about research direction for the chiropractic field was explored²³, research capacity evaluations are being conducted, and a stakeholder consultation study is being planned. This present study will build upon our previous work^{20,22} and utilize the Delphi method to provide a key piece of information to inform research priority setting – the Canadian sports chiropractic perspective on the prioritization of research.

Methods

This project involved a 1) pre-Delphi survey to refine a list of research priorities identified from a qualitative study²², 2) Delphi procedure to determine consensus on research priorities and 3) prioritization survey of the research priorities that achieved consensus from the Delphi procedure.

Identification of participants

Given the aim of the present study is to provide the Canadian sports chiropractic perspective for research prioritization, purposive sampling was used to identify representative experts from the Canadian sports chiropractic field.^{24,25} Recognizing there are different domains of expertise within a field of study, our purposive sampling aimed to identify clinical, leadership, and research experts within the Canadian sports chiropractic field.²⁵ To assist with this sampling strategy, a study advisory committee was assembled by requesting the Board of Directors of the Royal College of Chiropractic Sports Sciences (Canada) [RCCSS(C)] to nominate four sports chiropractors who they deemed knowledgeable of the Canadian sports chiropractic landscape.

Clinical experts were identified by creating a list of all active fellows of the RCCSS(C) as of June 2020 (116 fellows). Leadership experts were identified by creating a list of all past and present members of the Board of Directors of the RCCSS(C), Board of Directors of the Foundation for the RCCSS(C), and Committee members of the RCCSS(C) (75 individuals). Research experts were identified by conducting literature searches to identify sports-focused research conducted by Canadian chiropractors that was published within the past 20 years. Literature searches of MEDLINE (EBSCO), PubMed, CINAHL, Index to Chiropractic Literature and SportDiscus databases were conducted in consultation with an academic librarian on January 22, 2020 (please

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contact the primary author for detailed search strategies). The results of the literature searches were imported into EndNote, duplicates were removed, and citations were screened by the authorship team by using titles/abstracts and full text when clarification was required. For inclusion, articles must have met the criteria for sports-focused research as defined by the RCCSS(C)²⁶ (see Appendix 1 for the RCCSS(C) sports-focused research definition), been published in a peer reviewed journal, and at least 1 author must be a Canadian chiropractor or a non-chiropractor faculty member of a Canadian chiropractic educational institution as identified by internet author searches performed by the authorship team. This process yielded a list of 87 researchers.

To make sure key individuals from the Canadian sports chiropractic field were not missed, snowball sampling²⁷ was used by asking the study advisory committee to review the lists of clinical, leadership, and research experts gathered from our purposive sampling methods and use their knowledge of the Canadian sports chiropractic field to nominate any experts who they believe may have been missed. Snowball sampling added an additional six names to the clinical experts list.

The sampling strategy resulted in three lists of experts from the Canadian sports chiropractic field (clinical, leadership and research). To rank order these experts, each member of the study advisory committee was asked to independently rate the experts on each list based on their level of expertise within the respective expertise domain (clinical, leadership or research) using an 11-point Likert scale, ranging from 0 = the least experienced to 10 = the most experienced. The mean rating score for each expert on each list was calculated, and the lists were rank ordered based on the mean expert rating score. If any experts were identified on more than one list, they remained on the list of their highest ranking and were removed from lists where they had a lower

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ranking. This process resulted in three rank-ordered lists of Canadian sports chiropractic experts: clinical (n=65), leadership (n=42) and research (n=59).

Delphi panel member recruitment

Presently, there are no criterion standards for sample size determination for Delphi studies. Samples too small run the risk of a lack of stability of responses, and large samples can lead to large dropout rates with successive survey rounds.^{28,29} Recommendations for sample sizes for Delphi studies have ranged from 15-30 participants^{9,28}, with the stability of responses demonstrated with as little as 20 participants for homogeneous samples²⁹. Assuming a 40% response rate for the Delphi procedure, to ensure a reasonable Delphi panel size, the highest ranked 30 experts from each of the clinical, leadership and research rank-ordered lists (90 total experts) were invited to participate in the online Delphi procedure.

Pre-Delphi survey - identification of research priorities

Our previous qualitative study²² that interviewed sports chiropractic researchers and leaders, identified 150 individual research priorities, categorized into three themes: area of research, research actions and research methodology. To further refine this list of research priorities for the Delphi procedure, it was first presented to the study advisory committee who reviewed the list for completeness and were asked to add any research priorities they thought may have been missed or remove priorities due to redundancies. Secondly, all 166 experts identified from our purposive sampling methods were invited to participate in an online pre-Delphi research priorities refinement survey where each participant was asked to rank the importance of each research priority using a

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nine-point Likert scale, anchored from “1” representing the “lowest importance” to “9” as the “greatest importance”. All items ranked 3 or lower by 75% or more of the experts were deemed to reach consensus as an “unimportant” research priority, and “unimportant” items were removed from the list of research priorities that will progress into the Delphi procedure. Additionally, participants were asked at the end of this pre-Delphi survey to suggest any other research priorities that were not mentioned on the survey using an open text field. These text responses were qualitatively analyzed by the authorship team to determine if these suggestions were unique research priorities that should be added to the research priority list for the Delphi procedure.

Delphi procedure

Delphi panel members were invited by email to participate in the online Delphi procedure. Within the email, a brief letter explained the purpose of the Delphi procedure (‘to understand what research priorities are important to help direct future research efforts for Canadian sports chiropractors’) and a link was provided to the online Delphi survey. The first round Delphi questionnaire collected non-identifying demographic data. All Delphi surveys presented participants with questions asking them to rate the importance of individual research priorities categorized into their respective research theme. In general, the questions were worded as follows: “How important is it that we conduct research on (*individual research priority*)?”

Similar to a previous chiropractic Delphi research prioritization study³, participants were asked to rank the importance of each research priority using a nine-point Likert scale anchored by “1” representing the “lowest importance” to “9” as the “greatest importance”³. The use of the nine-point scale to rate the importance of an item was originally outlined by the RAND appropriateness

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method,³⁰ and has been recommended by the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) Working Group.³¹ With an a priori consensus level of 75% for this Delphi procedure, each research priority could reach consensus on whether it is “important” (ranked from seven to nine), of “uncertain importance” (ranked from four to six) or “unimportant” (ranked from one to three) if 75% or more of the experts rate the item within one of these respective ranges. All research priorities that did not reach the 75% consensus threshold were determined to not reach consensus. At the completion of each voting round, items that reached consensus for being “important”, of “uncertain importance” and “unimportant” were removed from the Delphi survey, and the remaining non-consensus items remained on the Delphi survey for subsequent voting.^{3,28} Participants were provided with feedback in the form of summary results of the previous Delphi round prior to completing each subsequent Delphi round questionnaire. Retaining non-consensus items in successive Delphi round questionnaires and presenting them alongside the results from previous rounds can facilitate decision making by allowing participants to re-evaluate the remaining non-consensus items within the context of having knowledge of the group’s prior ratings.²⁸ This process continued until either consensus was achieved on all research priorities or a maximum of three voting rounds were completed. Only the research priorities that reached consensus for being “important” were used to inform the final prioritization survey.

Prioritization survey

All 90 experts of the Delphi panel were invited by email to participate in an online prioritization survey. To create the final prioritization survey, the authorship team met to review the “important”

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research priorities that achieved consensus from the Delphi procedure. Similar research priorities were amalgamated to remove redundancy and were sorted into the categories: 1) area of research, 2) collaborations, and 3) specific conditions. The collaborations category was subcategorized into interprofessional, interorganizational, intraprofessional, sports community, and academic collaborations.

To prioritize these categories, participants were asked to rank each list of research priorities using a forced ranking procedure where participants were asked to rank each research priority from most to least important (with the most important ranking being ranked as #1, with each subsequent numerical ranking representing a sequential decline in importance). For these forced ranking questions, the weighted average ranking score for each research priority was calculated.

Pilot testing of the prioritization survey was conducted by eight members of the investigative team to trial the survey for ease of use. It revealed the category – ‘*area of research*’ – was difficult to rank using a forced ranking procedure due to too many choices (28 priorities). A decision was made, a posteriori, to prioritize this category by asking participants, “Given the current research capabilities of the Canadian sports chiropractic field, select the 10 most important research priorities from this list that the Canadian sports chiropractic field should pursue.” The percentage of participants who selected each research priority as a “10 most important research priority” was calculated, and the highest percentage determined the priority order of this list.

Survey administration

All email invitations to participate in all online surveys for this study were sent by the RCCSS(C). The data collection period for each online survey was for three weeks, with two reminder emails

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being sent each week. SurveyMonkey (Momentive, San Mateo, California, USA) was used for all online survey administration for this study.

Data analysis

All demographic data, research priority ratings, and responses to the area of research question of the prioritization survey were analyzed with descriptive statistics (frequencies, percentages and means) using Excel (Microsoft Corporation, USA). For all forced ranking questions of the prioritization survey, a weighted average ranking score was calculated by SurveyMonkey³² where ranking weights are assigned and multiplied to the response count for each question item and are averaged across the total response counts for the question (Momentive., San Mateo, California, USA).

Ethics approval

This study received approval by the Canadian Memorial Chiropractic College (CMCC) Research Ethics Board (#1908B01, approval date 11/27/2019) prior to commencement. Each online survey from this project included a project information letter and informed consent form, and participants provided their informed consent to participate in each online survey by selecting the “accept” response at the end of the online informed consent form.

Results

Participation

The response rates for the online surveys for this study are listed in Figure 1. The pre-Delphi survey response rate was 42%. Three Delphi rounds were required, and the response rates for the three Delphi rounds and the prioritization survey were 60%, 62%, 56% and 61%, respectively.

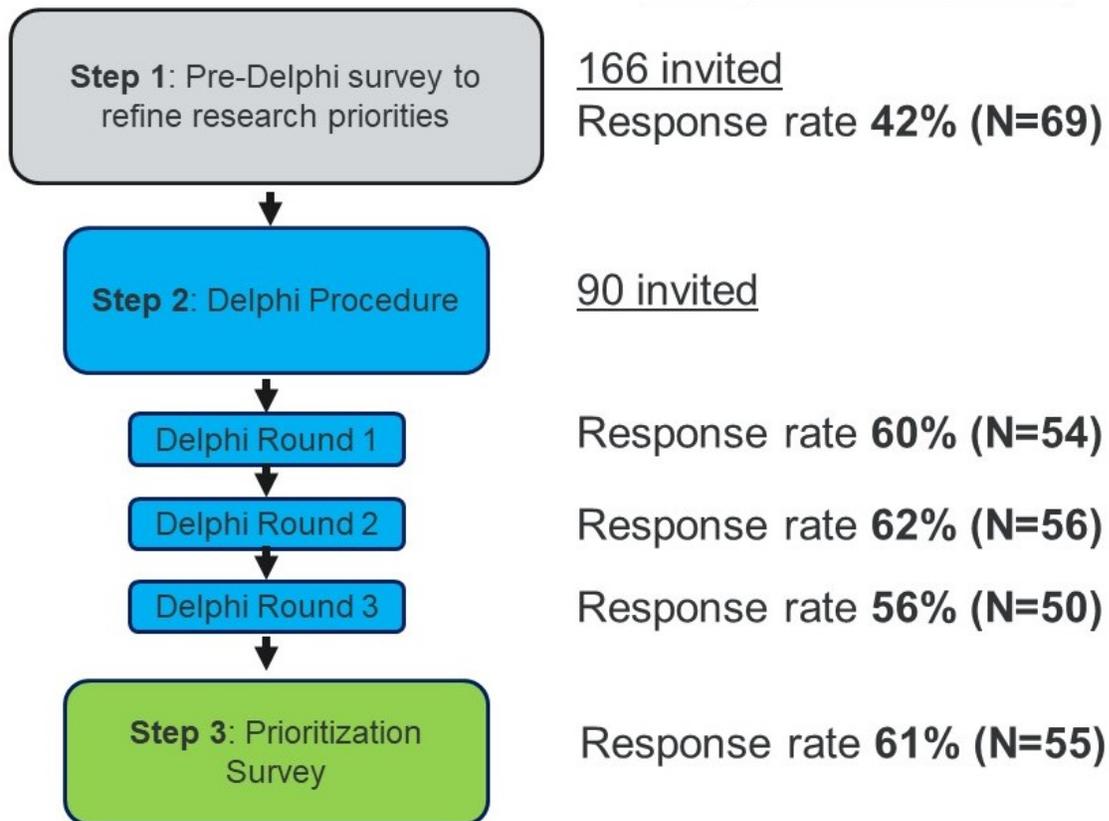


Figure 1. *Response rates for surveys*

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Pre-Delphi survey - identification of research priorities

After reviewing the list of 150 research priorities identified from our previous qualitative study,²² the study advisory committee added 11 unique research priorities and recommended the removal of seven due to redundancy. Additionally, the authorship team removed 17 research priorities related to research methods, as it was decided that research methods are determined by the specific research questions under investigation and did not constitute a specific research topic for this consensus study. As a result, 137 research priorities were included in the pre-Delphi survey to refine research priorities. The results of this survey revealed that no research priority achieved consensus for being “unimportant”, so no research priorities were removed from the list. Nine research priorities were suggested by the pre-Delphi survey participants and upon consensus of the authorship team, two were deemed unique and were added to the list. A total of 139 research priorities were entered into the Delphi procedure.

Delphi procedure

The demographic characteristics of the Delphi panel collected from the round one Delphi survey is presented in Table 1. The mean age of the panel and years in clinical practice were 47.3 and 20.3 years, respectively. While participation was reported from seven provinces of Canada, the majority of participants were located in Ontario (74%), with 49 (91%) receiving their chiropractic training from the Canadian Memorial Chiropractic College. As for research training, 17 advanced research degrees (Masters and PhD) and 56 chiropractic fellowships were reported. Current and past involvement in research was reported by 21 (39%) and 26 (48%) participants, respectively. Only seven (13%) had never been involved in research. As for involvement in academia, 20 (37%)

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academic positions and 2 (4%) management positions at an educational institution were reported. Of the participants, 20 (37%) leadership positions in a chiropractic association/organization were reported.

Table 1. *Delphi panel participant demographic characteristics (n=54), reported as n (%) unless otherwise stated^a*

Age (mean, SD)	47.3, 12.2
Years since graduating from chiropractic college (mean, SD)	20.5, 12.2
Years in clinical practice (mean, SD)	20.3, 11.9
Province of primary duties	
Ontario	40 (74%)
British Columbia	5 (9%)
Alberta	4 (7%)
Nova Scotia	2 (4%)
Manitoba	1 (2%)
Newfoundland and Labrador	1 (2%)
Quebec	1 (2%)
New Brunswick	0 (0%)
Prince Edward Island	0 (0%)
Saskatchewan	0 (0%)
Northwest Territories, Nunavut, Yukon	0 (0%)
Academic degree	

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Bachelor's Degree	41 (76%)
Master's Degree	14 (26%)
PhD	3 (6%)
Doctor of Chiropractic	49 (91%)
Fellow of the College of Chiropractic Sciences	4 (7%)
Fellow of the College of Chiropractic Orthopedists	1 (2%)
Fellow of the Chiropractic College of Radiologists	0 (0%)
Fellow of the Canadian Chiropractic College of Physical and Occupational Rehabilitation	5 (9%)
Fellow of the Royal College of Chiropractic Sports Sciences	46 (85%)
Other	6 (11%)
Institution where received chiropractic degree	
Canadian Memorial Chiropractic College	49 (91%)
Université du Québec à Trois-Rivières	1 (2%)
Other: (New York Chiropractic College, Parker College of Chiropractic West, University of Western States)	4 (7%)
Holds an academic position	
Teaching Assistant	1 (2%)
Instructor	3 (6%)
Assistant Professor	7 (13%)
Associate Professor	2 (4%)
Full Professor	5 (9%)

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Other: guest lecturer, adjunct professor	4 (7%)
Holds a management position at an educational institution Education Director Residency coordinator	2 (4%) 1 (2%) 1 (2%)
Holds a leadership position in a chiropractic association/organization Board member of a chiropractic association(s)/organization(s) Committee member of a chiropractic association(s)/organization(s) Other: Journal editor-in-chief	20 (37%) 10 (19%) 13 (28%) 1 (2%)
Involvement in research Currently involved in research Previously involved in research Never been involved in research	21 (39%) 26 (48%) 7 (13%)

^a Due to rounding, may not add to 100%

In rounds one, two and three of the Delphi procedure 62, 22 and 4 research priorities (88 total) achieved consensus for being “important”, respectively. No research priority achieved consensus for being “unimportant” or of “uncertain importance” in any of the Delphi rounds. Tables 2, 3, and 4 list the research priorities that reached consensus for being “important” in the first, second and third Delphi rounds, respectively. The top 6 research priorities that reached consensus for being “important” in the first round were priorities related to pursuing collaborations for research.

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Table 2. Round 1 Delphi results - research priorities achieving consensus for being "Important".

Research priorities achieving consensus for being "Important"	Participants that ranked in the "Important" rating range
Interprofessional collaboration: sports physicians	100.0%
Interinstitutional collaboration: university/colleges	100.0%
Collaboration: funding agencies (eg. RCCSS(C), FICS, NIH, etc.)	98.1%
Interorganization collaboration: Canadian Academy of Sport & Exercise Medicine	96.3%
Sports collaborations: Sports organizations, federations & associations (eg. National Sports Organizations)	96.3%
Sports collaborations: specialized sports training & development centres (eg. Canadian sports institutes, Olympic training centres)	96.3%
Intervention & clinical efficacy research: exercise & rehabilitation	96.3%
Effects of intervention on specific outcomes: recovery	96.3%
Prognosis research: injury prevention	96.3%
Integration of sports chiropractic into health care teams	96.3%
Intraprofessional collaboration: chiropractic sports residents	94.4%
Interinstitutional collaboration: chiropractic educational institutions	94.4%
Effects of intervention on specific outcomes: performance	94.4%
Effects of intervention on specific outcomes: return to play/sport	94.4%
Create practice- and field-based research networks	94.4%

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Intervention & clinical efficacy research: multi-modal interventions (assessing the efficacy of combining more than 1 intervention)	90.7%
Profiling an intervention: intervention timing & dosage	90.7%
Elite athletes	90.7%
Basic science & mechanism research related to rehabilitation	88.9%
Interprofessional collaboration: orthopaedic surgeons	88.9%
Intervention & clinical efficacy research: comparative effectiveness studies	88.9%
Develop guidelines and evidence-based care pathways	88.9%
Basic science & mechanism research, fields of study - biomechanics of injury	87.0%
Intraprofessional collaboration: Canadian Chiropractic Research Foundation Research Chairs (CCRF Research Chairs)	87.0%
Utilization of sports healthcare services	87.0%
Female athletes	87.0%
Basic science & mechanism research, fields of study - sports biomechanics	85.2%
Interprofessional collaboration: biomechanists	85.2%
Intervention & clinical efficacy research: functional treatment approach (eg. kinetic chain treatment)	85.2%
Prognosis research: risk factors	85.2%
Tendinopathy	85.2%

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Interorganization collaboration: American College of Sports Medicine	83.3%
Diagnosis research: functional assessment/examination	83.3%
Intervention & clinical efficacy research: manipulative therapy - extremity	83.3%
Intervention & clinical efficacy research: mobilization therapy - extremity	83.3%
Masters level athletes	83.3%
Contributing to the broader sports medicine research effort	83.3%
Extremity research (in general)	83.3%
Soft tissue injuries & myofascial pain	83.3%
Interprofessional collaboration: multidisciplinary sports clinics in the community	81.5%
Interorganization collaboration: Sports Physiotherapy Canada	81.5%
Intraprofessional collaboration: chiropractic associations/organizations (eg. Canadian Chiropractic Association, Ontario Chiropractic Association, etc.)	81.5%
Develop consensus and position statements	81.5%
Competency of sports chiropractors	81.5%
Utilization of sports chiropractic	81.5%
Intraprofessional collaboration: various sports chiropractic associations/organizations (eg. International Sports Chiropractic	79.6%

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Federation (FICS), American Chiropractic Board of Sports Physicians (ACBSP), etc.)	
Intervention & clinical efficacy research: soft tissue therapies	79.6%
Profiling an intervention: intervention safety	79.6%
Interprofessional dynamics in sports healthcare	79.6%
Athletes with a disability	79.6%
Rotator cuff	79.6%
Basic science & mechanism research related to soft tissue therapy	77.8%
Interprofessional collaboration: physicians (as a group in general)	77.8%
Interprofessional collaboration: physiotherapists	77.8%
Diagnosis research: diagnostic studies evaluating sports chiropractors as diagnosticians	77.8%
Intervention & clinical efficacy research: manipulative therapy - spinal	77.8%
Research about sports healthcare teams	77.8%
Research on specific sports (e.g. soccer, baseball, basketball, etc.)	77.8%
Basic science & mechanism research related to spinal manipulative therapy	75.9%
Sports collaborations: non-profit organizations involved in sport (eg. Athletes Can, Own the Podium)	75.9%
Pediatric athletes	75.9%
Concussion	75.9%
Total	62

Table 3. Round 2 Delphi results - research priorities achieving consensus for being "Important"

Research priorities achieving consensus for being "Important"	Participants that ranked in the "Important" rating range
Low back pain	89.3%
Sports chiropractors as diagnosticians	85.7%
Neck pain	83.9%
Interorganization collaboration: Canadian Physiotherapy Association	82.1%
Mobilization therapy - spinal	82.1%
Athletic field services (eg. Multi-sport games, team care & travel with athletes, pre-participation examinations, emergency care, field care)	82.1%
Basic science & mechanism research related to extremity	
manipulative therapy	80.4%
Injury incidence & prevalence	80.4%
Cost-effectiveness research	78.6%
Interorganization collaboration: Canadian Society of Exercise	
Physiologists	76.8%
Sports teams & clubs	76.8%
Neuropathies	76.8%
Thoracic spine pain	76.8%

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Interprofessional collaboration: Exercise physiologists	75.0%
Diagnosis research (such as diagnostic accuracy studies, or specific tests or diagnostic approaches)	75.0%
Clinical prediction rules	75.0%
Injury surveillance	75.0%
Understanding the sports chiropractic patient	75.0%
Physical activity research (eg. exercise is medicine)	75.0%
Ankle sprains	75.0%
Labral injuries of the hip	75.0%
Patellofemoral pain syndrome	75.0%
Total	22

Table 4. *Round 3 Delphi results - research priorities achieving consensus for being "Important"*

Research priorities achieving consensus for being "Important"	Participants that ranked in the "Important" rating range
Knowledge translation research in the sports setting	80.0%
Research supporting the strategic planning for the sports chiropractic field	78.0%
Hamstring strains	78.0%
Sprains & strains (in general)	84.0%
Total	4

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Prioritization survey

Upon reviewing the 88 research priorities achieving consensus for being “important” in the Delphi procedure, three research priorities were not included in the prioritization survey as they were deemed to be related to research methodology and not research topics. After amalgamating similar research priorities to remove redundancies, the prioritization survey was comprised of 28 research priorities for area of research, 21 for collaborations, and 13 for specific conditions.

The prioritization results of the area of research category are listed in Table 5. The top three areas of research were “effects of interventions on athletic outcomes (e.g. athletic recovery, return to play/sport and athletic performance)”, “research about sports healthcare teams (e.g. interprofessional dynamics in sports healthcare teams, integration of chiropractic in sports healthcare teams)” and “clinical research: spinal manipulative and mobilization therapy”.

Table 5. *Prioritized list of areas of research*

Prioritized list of areas of research	Participants who selected the research priority as a "top 10" (N=55)
Effects of interventions on athletic outcomes (e.g. athletic recovery, return to play/sport and athletic performance)	63.6%

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Research about sports healthcare teams (e.g. interprofessional dynamics in sports healthcare teams, integration of chiropractic in sports healthcare teams)	54.6%
Clinical research: spinal manipulative and mobilization therapy	50.9%
Utilization of sports healthcare services (e.g. utilization of sports chiropractic)	50.9%
Research conducted on specific conditions (e.g. concussion, tendinopathy, hamstring strains, ankle sprain, neck pain, low back pain)	50.9%
Develop guidelines and evidence-based care pathways	49.1%
Clinical research: multi-modal interventions (assessing the efficacy of combining more than 1 intervention)	45.5%
Clinical research: extremity manipulative and mobilization therapy	45.5%
Injury prevention and risk factors	45.5%
Clinical research: exercise & rehabilitation	43.6%
Clinical research: functional treatment approach (eg. kinetic chain treatment)	41.8%
Clinical research: soft tissue therapies	40.0%
Diagnosis research: functional assessment	38.2%
Profiling an intervention: intervention timing, dosage and safety	38.2%
Special athletic populations (elite, female, masters, pediatric, athletes with disabilities)	38.2%

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Competency of sports chiropractors	36.4%
Physical activity research (e.g. exercise is medicine)	32.7%
Injury surveillance, incidence and prevalence	27.3%
Clinical research: comparative effectiveness studies	27.3%
Athletic field services (e.g. multi-sport games, team care & travel with athletes, pre-participation examinations, emergency care, field care)	27.3%
Knowledge translation research in the sports setting	25.5%
Understanding the sports chiropractic patient	25.5%
Developing clinical prediction rules	21.8%
Cost-effectiveness research in sports healthcare	20.0%
Basic science research: biomechanics (e.g. biomechanics of Injury and sports biomechanics)	18.2%
Basic science research: manipulative therapy (SMT, EMT)	14.6%
Basic science research: soft tissue therapy	12.7%
Basic science research: rehabilitation	5.0%

The prioritization results for collaborations are listed in Table 6. The highest ranked interprofessional and interorganizational collaborations to pursue were with “sports physicians” and the “Canadian Academy of Sport & Exercise Medicine”, respectively. The highest ranked intraprofessional collaboration was with “sports chiropractic associations/organizations”. “Sports organizations, federations & associations (eg. national sports organizations)” was the highest ranked sports community collaboration, and “universities and colleges” was identified as the

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highest ranked academic collaboration. For the prioritization of specific conditions that reached consensus in the Delphi procedure (Table 7), the top five ranked specific conditions were “low back pain”, “neck pain”, “concussion”, “soft tissue injuries & myofascial pain”, and “thoracic spine pain”.

Table 6. *Ranked list of collaborations that reached consensus for being "important"*

(N=55)

Collaboration	Ranking score
Interprofessional	
Sports physicians	5.71
Orthopaedic surgeons	3.58
Physiotherapists	3.38
Physicians (as a group in general)	3.29
Biomechanists	2.53
Exercise physiologists	2.51
Interorganizational	
Canadian Academy of Sport & Exercise Medicine	4.58
Sports Physiotherapy Canada	3.36
American College of Sports Medicine	2.69
Canadian Physiotherapy Association	2.20
Canadian Society of Exercise Physiologists	2.16
Intraprofessional	

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Sports chiropractic associations/organizations	2.85
Chiropractic sports sciences residents	2.85
Canadian Chiropractic Research Foundation research chairs	2.45
Chiropractic associations/organizations (eg. Canadian Chiropractic Association, etc.)	1.84
Sports community	
Sports organizations, federations & associations (eg. national sports organizations, etc.)	3.24
Specialized sports training & development centres (eg. Canadian Sports Institutes, etc.)	3.04
Non-profit organizations involved in sport (eg. Athletes Can, Own the Podium)	1.93
Sports teams & clubs	1.80
Academic	
Universities & colleges	1.69
Chiropractic educational institutions	1.31

Table 7. *Ranked list of specific conditions that reached consensus for being “important” (n=55)*

Specific condition	Ranking score
Low back pain	9.60
Neck pain	9.25

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Concussion	9.07
Soft tissue injuries & myofascial pain	8.75
Thoracic spine pain	7.31
Tendinopathy	7.29
Research on specific sports (e.g. soccer, baseball, basketball, etc.)	6.84
Rotator cuff	6.35
Neuropathies	6.02
Hamstring strains	5.42
Patellofemoral pain syndrome	5.40
Labral injuries of the hip	5.38
Ankle sprains	4.33

Discussion

To our knowledge, this is the first study to investigate consensus on research priorities for the Canadian sports chiropractic field. The top five priority-ranked areas of research were 1) effects of interventions on athletic outcomes (e.g. athletic recovery, return to play/sport and athletic performance), 2) research about sports healthcare teams (e.g. interprofessional dynamics in sports healthcare teams, integration of chiropractic in sports healthcare teams), 3) clinical research: spinal manipulative and mobilization therapy, 4) utilization of sports healthcare services (e.g. utilization of sports chiropractic), and 5) research conducted on specific conditions. The highest ranked specific conditions were 1) low back pain, 2) neck pain, 3) concussion, 4) soft tissue injuries &

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myofascial pain, and 5) thoracic spine pain. Research collaborations were an important topic in this study, as 23 of the 88 research priorities achieving consensus for being “important” were related to pursuing research collaborations, with 100% of the Delphi panel rating collaborations with sports physicians and universities/colleges, as “important” research priorities.

When comparing our results to previous chiropractic Delphi studies^{1,3} that prioritized research, we found our Delphi panel prioritized areas of research that were unique to the sports-context, such as the effects of interventions on athletic outcomes (e.g. athletic recovery, return to play/sport and athletic performance), research about sports healthcare teams (e.g. interprofessional dynamics in sports healthcare teams, integration of chiropractic in sports healthcare teams), and the utilization of sports healthcare services (e.g. utilization of sports chiropractic). These research priorities were not identified in previous chiropractic research priority Delphi studies.^{1,3} Our results provide evidence that chiropractors working in sport have context-specific research requirements that necessitate a discipline-specific research agenda to direct research initiatives to improve care delivery and inform strategies for interprofessional collaboration.

While we identified research priorities unique to the sports chiropractic field, we did find overlapping research priorities with those from general chiropractic practice.^{1,3} The Delphi study by Rubinstein *et al.*³ identified “initiation and promotion of collaborative research efforts” as one of their top research priorities, which is consistent with our study where participants prioritized research collaborations, as evidenced by the 23 collaboration research priorities reaching consensus for being “important”. Similarly, French *et al.*¹ identified “integration of chiropractic care into multi-disciplinary settings” as the highest prioritized research item. In the present study, the research priority “research about sports healthcare teams (e.g. interprofessional dynamics in

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sports healthcare teams, integration of chiropractic in sports healthcare teams)” can be viewed as a specific application of the research priority identified by French *et al.*,¹ but applied to the sport context. It is not surprising that chiropractors working in sport share common research priorities with general chiropractors, as some areas of research (such as spinal manipulation research) has applicability for the entire profession, including its sub-disciplines. It is important to recognize areas of overlapping priorities in general and sports-focused chiropractic research, as collaborative research efforts can improve investigative capacity within these priority areas.

To our knowledge, the only other sports healthcare profession that published their research prioritization efforts is the athletic training profession in the United States of America, by Eberman *et al.*² These authors used a combination of focus group sessions, content-expert review, and a web-based survey to produce a research agenda. They identified research priorities categorized into five major research categories: health care competency, vitality of the profession, health professions education, health care economics, and health information technology. Certain research priorities they identified, such as establishing evidence to support return-to-life/play/work decisions, preventing musculoskeletal injuries, and determining the effectiveness of interprofessional practice, are similar to ones identified in our Delphi study (effects of interventions on athletic outcomes, injury prevention and risk factors, and research about sports healthcare teams). These research areas may represent opportunities for interprofessional collaboration to advance research in sport.

Despite these similarities, differences in priority areas exist between Eberman *et al.*² and this present study. This is likely due to profession-specific factors and the overall purpose of each respective study. Eberman *et al.*² published a research agenda, while the intent of this present study

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is to report on one aspect of research agenda development – the Canadian sports chiropractic perspective. This Delphi study is only one input into developing a research agenda for Canadian sports chiropractors, as there are other considerations when establishing a research agenda for a field of study, such as obtaining input from the discipline's stakeholders and appraising its current research capacity and capability.

Research priority setting frameworks^{21,33,34} recommend the active involvement of stakeholders in the research priority setting process when producing a research agenda. Involving a diverse range of stakeholders in the priority setting process can improve the relevance and legitimacy of research^{21,35}, help to ensure funding decisions and research meet critical evidence gaps to inform decision making³⁵, facilitate shared responsibility and accountability in implementing the research agenda³⁵, and aid in the diffusion of research findings into healthcare settings to achieve better health outcomes³⁶. Stakeholders that can be engaged to set a research agenda for Canadian chiropractors working in sport can include athletes, their sports organizations, funding bodies, chiropractic associations, and academic institutions involved in the research effort.

This present study included input from intra-professional stakeholders in the Delphi panel by including clinical, leadership and research experts; however, it did not include stakeholders external to the profession. We chose not to include external stakeholders in this present study, as our aim was to understand the sports chiropractic perspective on research priorities. Additionally, the Delphi process is a consensus method that utilizes group interaction via questionnaires and not through direct face-to-face interactions.²⁸ It is possible certain external stakeholders with limited knowledge about research or the sports chiropractic field may find it difficult to participate in a consensus process without having the ability to interact in real-time. It may be more relevant to

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engage with stakeholders with consensus methods that utilize direct face-to-face participant interaction (e.g. face-to-face consensus meetings and the nominal group technique) to provide the opportunity for real-time discussions to clarify statements and provide meaningful feedback to the research prioritization process. As part of a qualitative study exploring athletes' expectations and experiences of care received by sports chiropractors, athletes' views on research direction for the sports chiropractic field was explored by asking them what areas of research the sports chiropractic profession should focus on. The athletes interviewed suggested research that focused on understanding the mechanisms behind how an injury occurs, how to prevent injuries, and how care can aid in enhancing their performance.²³ This data provides an initial understanding of the athlete's perspective on research direction for the sports chiropractic field and can be used in combination with this present study's findings to inform decisions to set an eventual research agenda.

Similar to athletes, the perspective of other stakeholders from the sports community, such as sports organizations, may provide valuable input when setting a research agenda. Finch *et al.*³⁷ identified differing research priorities amongst researchers from the International Olympic Committee research centres and international sporting federations. These authors recommend that sports prevention research should involve stakeholders from the sports community at the outset to ensure the incorporation of sport-specific contextual influences into the research, as this will increase the likelihood for more wide-scale adoption of the research by the sports community.^{37,38} The inclusion of representatives from the sports community in setting a research agenda for Canadian sports chiropractors will not only inform the sports chiropractic discipline of its stakeholders' unique perspective, but it can facilitate more participatory research partnerships with the sports community in implementing the research agenda.

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Lastly, while research priorities were identified and ranked in this present study, these research topics were not evaluated for their feasibility as to whether the Canadian sports chiropractic field has the resources to conduct such investigations. The authors of the European research prioritization Delphi study³ provided commentary on the challenges of conducting research on targeted priorities if a field of study does not have the resources to achieve such research aspirations. This highlights the importance of conducting research capacity evaluations of a field of study when setting research agendas and plans for implementation. Feasibility assessment of the identified research priorities is beyond the scope of this present study, as this project is one of multiple studies being conducted to inform both a research agenda and research plan for the Canadian sports chiropractic field. Presently, both quantitative and qualitative investigations are being conducted to understand the research capacity and capabilities of the Canadian sports chiropractic field. The results of these investigations can help inform what research areas are feasible to prioritize when setting a research agenda. They can also direct the development of an accompanying implementation strategy by providing guidance for areas to pursue for investment, training, and partnership.

As a next step in setting a research agenda, our research group proposes conducting a multi-stakeholder study in partnership with Canadian sports chiropractic experts to co-produce a research agenda for Canadian chiropractors working in sport. Such an investigation can utilize the results from the present Delphi study, the qualitative data obtained from athletes' views on research direction,²³ the data obtained from the research capacity evaluations of the sports chiropractic field, in addition to further stakeholder suggestions for research priorities, as inputs to make decisions on setting a research agenda. Stakeholder engagement in this process can be optimized using consensus methods that involve face-to-face participant interaction, such as the nominal group

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technique, to provide opportunities to deliberate such important decisions. Recently, this approach was used to co-produce a multi-stakeholder research agenda for medicines optimisation.³⁹ The advantage of such a study is the co-production of a research agenda that is relevant to all stakeholders, leading to a greater likelihood that the implementation of the research agenda will have a societal impact to the communities chiropractors working in sport serve.

Strengths and limitations

There are strengths and limitations with this present study. As previously stated, this study only included sports chiropractic experts as part of the Delphi panel and did not include stakeholders external to the discipline. The intent of this study was to determine consensus on research priorities from sports chiropractic experts, and separate investigations will be conducted to obtain stakeholder input to inform the research agenda. One of the strengths of this present study was our multiple approaches to identify experts for the Delphi panel. This process involved obtaining clinician and leadership lists from the RCCSS(C), conducting literature searches to identify researchers, and seeking nominations and rankings of experts from a study advisory committee. Analyzing the demographics of our Delphi panel, we believe our sampling methods achieved our goal of recruiting adequate representation from the Canadian sports chiropractic field. The mean years of practice was 20.5 years, 37% held academic positions, and 37% held leadership positions in the profession. For research representation, 17 advanced research degrees (14 Masters, 3 PhD) and 56 chiropractic fellowships were reported. Only seven participants (13%) reported never being involved in research. One limitation is the small participation of those with PhD qualifications in the present study, which could impact our results as those with PhD training may be better

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positioned to judge the effort required to conduct research in certain priority areas. Preliminary unpublished data from our research capacity evaluations of the Canadian sports chiropractic field informs that there is a limited number of individuals in the field with PhD qualifications, which represents a key area where investment should be made.

While we are confident in our identification of experts to participate in the Delphi panel, we did not conduct maximum variation sampling to ensure equal representation of participants with certain demographic characteristics. Also, we did not collect participant sex or gender in the demographic section of our survey. This could possibly lead to either an over- or under-representation of participants with certain demographic characteristics, such as geographical location, years in practice, or type of expertise. Specifically, our Delphi panel was over-represented from the province of Ontario (74%) with the majority receiving their chiropractic training from CMCC (91%).

Another strength of this study was the comprehensive list of research priorities (n=139) that were entered into the Delphi procedure. These research priorities were identified from a separate qualitative study²² and were further refined by the present study's advisory committee and pre-Delphi survey. While we are confident the research priorities list was robust, this led to a large amount of research priorities reaching consensus for being "important" (n=88) at the completion of the Delphi procedure. Previous Delphi research prioritization studies conducted for the chiropractic profession^{1,3} took an opposite approach where lists of individual research priorities were collapsed into larger amalgamated research priorities prior to entering them into the Delphi procedure. In the present study, we entered all identified research priorities into the Delphi procedure, and then amalgamated similar research priorities that reached consensus after the

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Delphi procedure, before ranking them in the final prioritization survey. It is uncertain what the impact either approach would have on the overall results of the final prioritization of research priorities.

End users of Delphi studies should be aware the results obtained from this procedure are influenced by the methodological decisions applied. Presently, there is no consensus on an optimal strategy to use when providing participants with feedback between voting rounds, and it is unclear how this could influence the results of Delphi studies.⁴⁰ In our study, participants were provided with feedback in the form of summary results using descriptive statistics.⁹ One limitation is we did not ask participants to provide their written comments to justify their rankings. If we had captured this data, it may have enhanced the group interaction process and provided participants with more context to judge their decisions in subsequent voting rounds, potentially influencing the results.

Recently, investigations^{41–43} have shown that different rating scales and consensus thresholds can impact the results of the Delphi process. Remus *et al.*⁴¹ investigated the difference between the five- and nine-point Likert scales in a Delphi study to determine a core outcome set for pelvic girdle pain and found the five-point scale resulted in more items that reached consensus. In a similar study, Lange *et al.*⁴² compared three-, five-, and nine-point Likert scales in a Delphi study to determine global treatment goals for total knee arthroplasty. The correlations between the rating scales ranged from 0.65 to 0.74 with more items reaching consensus with the nine-point scale. While the authors state none of the scales showed general superiority according to absolute and relative reliability measures, the nine-point scale reached the highest weighted kappa (0.78) for test-retest reliability. Additionally, De Meyer *et al.*⁴³ compared three- and nine-point Likert scales and different consensus threshold levels in a Delphi study to determine a core outcome set

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for incontinence-associated dermatitis. These authors reported the nine-point scale resulted in almost twice as many outcomes selected compared to the three-point scale. With respect to consensus thresholds, their results suggest a 60% consensus level might not be strict enough, but a 90% consensus level is likely too strict. They suggest thresholds of 70% or slightly higher as a reasonable compromise. As for recommendations for the use of rating scales, both Lange *et al.*⁴² and De Meyer *et al.*⁴³ posit that the choice of the rating scale should reflect the context-based research question being evaluated, and it may be useful to get a first impression of a group opinion with a more wide-ranging rating scale (e.g. nine-point rating scale) to inform a subsequent consensus process, such as a face-to-face consensus meeting where a three-point scale might be preferred when determining a final consensus. Our present study is aligned with these recommendations as it utilized a nine-point rating scale for the Delphi procedure, which informed a subsequent prioritization survey to rank-order the items that reached consensus for being “important”. The consensus level for the current study was set a priori at 75% which is in line with the recommendations by De Meyer *et al.*⁴³ Additionally, Delphi studies involving a prioritization survey of the consensus items produced by the Delphi procedure have used differing methods.^{1,3} The Delphi studies conducted for the chiropractic profession by Rubinstein *et al.*³ used a five-point scale and French *et al.*¹ used a survey that employed conjoint analysis methods to obtain a final prioritized list of research priorities. In the present study, we asked participants to select the “10 most important” research priorities from a list of priorities and calculated the percentage of participants who selected each priority as a “10 most important” to determine the priority ranking for the area of research category. To prioritize the collaboration and specific conditions categories, we used a forced-ranking list and calculated a weighted average ranking score. It is possible that our results could have differed if we used an alternate rating scale, set a different consensus

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threshold, or used different methods for the prioritization survey. Our results should be interpreted within the context of our methodological decisions

Conclusion

This is the first study to involve diverse experts from the Canadian sports chiropractic field to investigate consensus on research priorities. The top three priority-ranked areas of research were “effects of interventions on athletic outcomes (e.g. athletic recovery, return to play/sport and athletic performance)”, “research about sports healthcare teams (e.g. interprofessional dynamics in sports healthcare teams, integration of chiropractic in sports healthcare teams)” and “clinical research: spinal manipulative and mobilization therapy”. Consensus on research collaborations were determined, with 100% of the Delphi panel identifying collaborations with sports physicians and universities/colleges as important research priorities. These results will be used to inform stakeholder consultations to establish a research agenda for Canadian chiropractors working in sport.

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References

1. French SD, Beliveau PJH, Bruno P, Passmore SR, Hayden JA, Srbely J, et al. Research priorities of the Canadian chiropractic profession: a consensus study using a modified Delphi technique. *Chiropr Man Therap*. 2017;25(38): 1–8.
2. Eberman LE, Walker SE, Floyd RT, Covassin T, Nolton E, Snyder Valier AR, et al. The prioritized research agenda for the athletic training profession: a report from the strategic alliance research agenda task force. *J Athl Train*. 2019;54(3): 237–244.
3. Rubinstein SM, Bolton J, Webb AL, Hartvigsen J. The first research agenda for the chiropractic profession in Europe. *Chiropr Man Therap*. 2014;22(1): 1-9.
4. Canadian Fitness and Lifestyle Research Institute. Bulletin 1: sport participation in Canada. Ottawa; 2018. Available from: <https://cflri.ca/bulletin-1-sport-participation-canada>
5. Statistics Canada. Table 13-10-0096-13: Physical activity, self reported, adult, by age group. Ottawa: Government of Canada. 2018. Available from: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310009613>
6. Canadian Fitness and Lifestyle Research Institute. Bulletin 1: Participation in sport among children and youth. Ottawa; 2013. Available from: <https://cflri.ca/bulletin-1-participation-sport-among-children-and-youth>
7. Hsu C, Sandford B. The Delphi technique: making sense of consensus. *Pract Assess Res Eval*. 2007;12(10): 1–8.

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IT WILL APPEAR IN THE DECEMBER 2022 EDITION OF THE
JOURNAL OF THE CANADIAN CHIROPRACTIC ASSOCIATION**

8. Powell C. The Delphi Technique: myths and realities. *Methodol Issues Nurs Res.* 2003;41(4): 376–382.
9. Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs.* 2000;32(4): 1008–1015.
10. van de Glind I, Berben S, Zeegers F, Poppen H, Hoogeveen M, Bolt I, et al. A national research agenda for pre-hospital emergency medical services in the Netherlands: a Delphi-study. *Scand J Trauma Resusc Emerg Med.* 2016;24(1): 1-9.
11. Mooijaart SP, Nickel CH, Conroy SP, Lucke JA, van Tol LS, Olthof M, et al. A European research agenda for geriatric emergency medicine: a modified Delphi study. *Eur Geriatr Med.* 2021;12(2): 413–422.
12. Araújo V, Teixeira PM, Yaphe J, Correia De Sousa J. The respiratory research agenda in primary care in Portugal: A Delphi study. *BMC Fam Pract.* 2016;17: 124.1-8.
13. Dainty KN, Jensen JL, Bigham BL, Blanchard IE, Brown LH, Carter AJE, et al. Developing a Canadian emergency medical services research agenda: a baseline study of stakeholder opinions. *CJEM.* 2013;15(2): 83–89.
14. Bolling C, Delfino Barboza S, van Mechelen W, Pasman HR. How elite athletes, coaches, and physiotherapists perceive a sports injury. *Transl Sports Med.* 2019;2(1): 17–23.

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IT WILL APPEAR IN THE DECEMBER 2022 EDITION OF THE
JOURNAL OF THE CANADIAN CHIROPRACTIC ASSOCIATION**

15. Burns L, Weissensteiner JR, Cohen M. Lifestyles and mindsets of Olympic, Paralympic and world champions: is an integrated approach the key to elite performance? *Br J Sports Med.* 2019;53(13): 818–824.
16. Hostrup J, Koza A, Myburgh C. The professional contribution of chiropractors to Danish elite football clubs: a qualitative exploration of role and perceived value in an interprofessional service provision context. *Chiropr Man Therap.* 2020;28(1): 1–9.
17. Myburgh C, Andersen J, Bakkely N, Hermannsen J, Zuschlag M, Damgaard P. The Danish sports chiropractic landscape: an exploration of practice characteristics and salient developmental issues. *Chiropr Man Therap.* 2021;4: 1–11.
18. Theberge N. The integration of chiropractors into healthcare teams: a case study from sport medicine. *Social Health Illn.* 2008;30(1): 19–34.
19. Fletcher S, Breitbach AP, Reeves S. Interprofessional collaboration in sports medicine: findings from a scoping review. *Health Interprof Pract.* 2017;3(2): 1-16.
20. Lee AD, Szabo K, Mcdowell K, Granger S. Opinions of sports clinical practice chiropractors, with sports specialty training and those without, about chiropractic research priorities in sports health care: a centering resonance analysis. *J Can Chiropr Assoc.* 2016;60(4): 342–369.
21. Tan A, Nagraj SK, Nasser M, Sharma T, Kuchenmüller T. What do we know about evidence-informed priority setting processes to set population-level health-research agendas: an overview of reviews. *Bull Natl Res Cent.* 2022;46(6): 1-20.

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IT WILL APPEAR IN THE DECEMBER 2022 EDITION OF THE
JOURNAL OF THE CANADIAN CHIROPRACTIC ASSOCIATION**

22. Lee A, deGraauw L, Muir B, Belchos M, Szabo K, deGraauw C, et al. A qualitative study investigating research priorities and investigative capacity in sports-focused chiropractic research, part 1 - identifying research priorities to inform a Delphi study. *J Can Chiropr Assoc.* 2021;65(3): 292–317.
23. Eindhoven E, Lee A, Stilwell P, Mior S. I expected to be pain free: a qualitative study exploring athletes' expectations and experiences of care received by sports chiropractors. *Chiropr Man Therap.* 2022;30(21): 1-12.
24. Coyne IT. Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *J Adv Nurs.* 1997;26(3): 623–630.
25. Campbell S, Greenwood M, Prior S, Shearer T, Walkem K, Young S, et al. Purposive sampling: complex or simple? Research case examples. *J Res Nurs.* 2020;25(8): 652–661.
26. Royal College of Chiropractic Sports Sciences Canada (RCCSS(C)). Sports Sciences Residency Program Supervisor Handbook. Calgary, AB: RCCSS(C); 2018.
27. Hancock MS, Gile KJ. Comment: on the concept of snowball sampling. *Sociol Methodol.* 2011;41(1): 367–371.
28. Mcmillan SS, King M, Tully MP, Tully MP. How to use the nominal group and Delphi techniques. *Int J Clin Pharm.* 2016;38(3):655–662.
29. Akins RB, Tolson H, Cole BR. Stability of response characteristics of a Delphi panel: application of bootstrap data expansion. *BMC Med Res Methodol.* 2005;5(37): 1–12.

**THIS IS AN ACCEPTED, PRE-PRINT VERSION OF THIS MANUSCRIPT.
IT WILL APPEAR IN THE DECEMBER 2022 EDITION OF THE
JOURNAL OF THE CANADIAN CHIROPRACTIC ASSOCIATION**

30. Campbell SM, Cantrill JA. Consensus methods in prescribing research. *J Clin Pharm Ther.* 2001;26(1): 5–14.
31. Schunemann H, Brozek J, Guyatt G, Oman A. eds. *GRADE Handbook for grading quality of evidence and strength of recommendations.* The GRADE Working Group. 2013.

Available from: <https://gdt.gradepro.org/app/handbook/handbook.htmlgroup.org>
32. SurveyMonkey.com. Article: ranking question [Internet]. 2021 [cited 2021 May 27].

Available from: <http://help.surveymonkey.com/en/create/ranking-question/>.
33. James Lind Alliance. *The James Lind Alliance Guidebook; version 10.* Southampton (UK): National Institute for Health and Care Research. 2021. Available from: www.jla.nihr.ac.uk
34. Terry R, Ali M, Althabe F, Azim T, Chadwick C, Chib M, et al. *A systematic approach for undertaking a research priority-setting exercise - guidance for WHO staff.* Geneva: World Health Organization; 2020. Available from: <http://www.who.int/about/licensing>.
35. Tong A, Synnot A, Crowe S, Hill S, Matus A, Scholes-Robertson N, et al. Reporting guideline for priority setting of health research (REPRISE). *BMC Med Res Methodol.* 2019;19(243): 1-11.
36. Haynes SC, Rudov L, Nauman E, Hendryx L, Angove RSM, Carton T. Engaging stakeholders to develop a patient-centered research agenda lessons learned from the

**THIS IS AN ACCEPTED, PRE-PRINT VERSION OF THIS MANUSCRIPT.
IT WILL APPEAR IN THE DECEMBER 2022 EDITION OF THE
JOURNAL OF THE CANADIAN CHIROPRACTIC ASSOCIATION**

- research action for health network (REACHnet). *Med Care*. 2018;56(10 Suppl 1): S27-S32.
37. Finch CF, Talpey S, Bradshaw A, Soligard T, Engebretsen L. Research priorities of international sporting federations and the IOC research centres. *BMJ Open Sport Exerc Med*. 2016;2: 1–8.
38. Finch CF. Whose research agenda is it? Reconciling the views of researchers and sports stakeholders. *Br J Sports Med*. 2017;51(1): 3-4.
39. Fellenor J, Britten N, Courtenay M, Payne RA, Valderas J, Denholm R, et al. A multi-stakeholder approach to the co-production of the research agenda for medicines optimisation. *BMC Health Serv Res*. 2021;21(64): 1-9.
40. MacLennan S, Kirkham J, Lam TBL, Williamson PR. A randomized trial comparing three Delphi feedback strategies found no evidence of a difference in a setting with high initial agreement. *J Clin Epidemiol*. 2018;93: 1–8.
41. Remus A, Smith V, Wuytack F. Methodology in core outcome set (COS) development: the impact of patient interviews and using a 5-point versus a 9-point Delphi rating scale on core outcome selection in a COS development study. *BMC Med Res Methodol*. 2021;21(10): 1-15.
42. Lange T, Kopkow C, Lützner J, Günther KP, Gravius S, Scharf HP, et al. Comparison of different rating scales for the use in Delphi studies: different scales lead to different consensus and show different test-retest reliability. *BMC Med Res Methodol*. 2020;20(28): 1-11.

**THIS IS AN ACCEPTED, PRE-PRINT VERSION OF THIS MANUSCRIPT.
IT WILL APPEAR IN THE DECEMBER 2022 EDITION OF THE
JOURNAL OF THE CANADIAN CHIROPRACTIC ASSOCIATION**

43. de Meyer D, Kottner J, Beele H, Schmitt J, Lange T, van Hecke A, et al. Delphi procedure in core outcome set development: rating scale and consensus criteria determined outcome selection. *J Clin Epidemiol.* 2019;111: 23–31.

Appendix 1. RCCSS(C) sports-focused research definition

Sports-focused research is a field of research directly related or relevant to anyone involved in the sport, athletic, or exercise community. These topics may include but are not limited to the following: injuries, injury prevention, treatment, rehabilitation, biomechanics, performance, assessment metrics, nutrition, epidemiology, diagnostic imaging, emergency care, athletic event coverage, team travel, education, exercise physiology, and sport psychology.