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Investigating the research capacity and productivity of Canadian sports chiropractors

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Objectives: *To investigate the research capacity and productivity of Canadian sports chiropractors.*

Methods: *A cross-sectional survey (phase one) and scoping review (phase two) investigated the research capacity and productivity (from 2015-2020) of the Canadian sports chiropractic field.*

Results: *Most respondents (72%) reported obtaining research training from fellowship and master's programs, with only 2 (1%) PhD qualifications identified. Approximately, 30% reported active involvement in research, with 28% being part-time clinician researchers. Access to human and technological research resources were limited. We identified 67 publications and 16 conference*

Enquête sur la capacité de recherche et la productivité des chiropraticiens du sport canadiens

Objectifs: *Étudier la capacité de recherche et la productivité des chiropraticiens du sport Canadiens.*

Méthodes: *Une enquête transversale (première phase) et un examen de la portée (deuxième phase) ont permis d'étudier la capacité de recherche et la productivité (de 2015 à 2020) du domaine de la chiropratique sportive au Canada.*

Résultats: *La plupart des répondants (72 %) ont déclaré avoir obtenu une formation en recherche dans le cadre de programmes de bourses et de maîtrises, et seulement 2 (1 %) ont indiqué avoir obtenu un doctorat. Environ 30 % des répondants ont déclaré participer activement à la recherche, 28 % d'entre eux étant des cliniciens-chercheurs à temps partiel. L'accès aux ressources humaines et technologiques de la recherche était limité. Nous avons recensé 67 publications et 16 présentations de conférences sur une période de cinq*

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presentations within a five-year period, with clinical, population health, and basic science research as the areas most studied.

Conclusion: *The research effort of Canadian sports chiropractors is primarily conducted by clinicians involved in research on a part-time basis. Its research outputs predominantly reflect the research requirements of the RCCSS(C) Sports Sciences Residency Program, highlighting its contribution in developing capacity and producing research for the Canadian sports chiropractic field.*

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KEY WORDS: Research capacity, research productivity, research output, sports chiropractic, scoping review, survey

ans, les domaines les plus étudiés étant la recherche clinique, la recherche sur la santé des populations et la recherche en sciences fondamentales.

Conclusion: *L'effort de recherche des chiropraticiens du sport canadiens est principalement mené par des cliniciens impliqués dans la recherche à temps partiel. Leurs résultats de recherche reflètent surtout les exigences de recherche du programme de résidence en sciences du sport du Collège royal des sciences chiropratiques du sport du Canada (RCCSS(C)), soulignant leur contribution au développement des capacités et à la production de recherches pour le domaine de la chiropratique du sport au Canada.*

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MOTS CLÉS : Capacité de recherche, productivité de la recherche, résultats de la recherche, chiropratique sportive, examen approfondi, enquête

Introduction

In healthcare professions, research is vital not only to advance knowledge, but also to ensure evidence-informed, up-to-date, and safe patient care.[1,2] As research involving chiropractors has expanded, there have been efforts in North America[1,3,4], Australia[5], and Europe[6] to develop research agendas and evaluate the research capacity of the chiropractic profession.[7–11] Recently, a Delphi study[3] prioritized sports-focused research to inform research agenda development for Canadian sports chiropractors.[3] The top three research priorities were: effects of interventions on athletic outcomes, research about sports healthcare teams, and clinical research related to spinal manipulative and mobilization therapy. The three highest ranked conditions to research were low back pain, neck pain, and concussion. Collaborations with sports physicians, universities/colleges, and sports organizations were identified as important to pursue.[3] While many research priorities identified were specific to the sports chiropractic field, there was commonality among certain topics prioritized from Delphi studies conducted for general chiropractic practice[1,5,6], such as the integration of chiropractic care into multidisciplinary settings[1,3,5], effects of chiropractic care[1,3,5,6], spinal manipulation research[1,3,5,6], and the initiation of collaborative research activities[3,6].

While the development of a research agenda is an important step in advancing research efforts[1–3], its successful implementation is contingent on the available research resources (e.g. human and physical)[10] and the existing research environment (the academic, economic, social, political, technological and legal context in which the research is performed)[12]. Understanding the investigative capacity of the sports chiropractic field is necessary to recognize what research can be feasibly conducted, and what investments must be made to ensure a research agenda's success.[3] Moreover, once an agenda is implemented, methods must be put in place to evaluate the impact of this plan on the field's research capacity, productivity, and dissemination.

Research capacity is defined as "the ability to engage in, perform or carry out quality research."[13], where research productivity relates to the research output of a field of study.[14] Outputs of research are defined as an outcome of research that can take many forms, such as journal articles, conference publications, and patents, as examples.[15,16] Research capacity evaluations of a field of

study are important to conduct. They facilitate the oversight of the research infrastructure (including the human, physical and technological research resources available) and monitors research output.[17] With regular assessment of the research environment, a field of study can more easily conduct a needs analysis to determine what resources are required and how to allocate them responsibly to minimize research waste.[10,18] Regular monitoring can also allow organizations and researchers to navigate more swiftly and proactively when changes occur in the research environment.[10]

Previously, Stuber *et al*.[10] evaluated the research resource environment for the Canadian chiropractic profession by conducting a cross-sectional research capacity survey of members of the Canadian Chiropractic Association. These authors reported 93 full- and part-time chiropractic researchers in Canada who produced 530 authorships within a five-year period. Clinical research was the most common area of research, with systematic reviews representing the study type of the highest-level of evidence conducted. Office and laboratory space were reported as research facilities, and various collaborations were identified. While this information facilitates planning for the advancement of chiropractic research, these findings may not be fully transferrable to the sports chiropractic field, which may have its own unique research resource requirements. To our knowledge, the research capacity and output of the Canadian sports chiropractic field has not been studied.

The aim of this study is to investigate the Canadian sports chiropractic research resource environment by investigating its research capacity and productivity. This evaluation is part of a group of interrelated studies[3,4,19,20] conducted and planned to inform strategies to advance the research impact potential of the Canadian sports chiropractic field. Specifically, this present study will contribute the methods for an on-going research monitoring strategy that can be conducted every five-years to facilitate regular oversight of the Canadian sports chiropractic research effort.

Methods

Two phases were utilized to investigate the research capacity and productivity of the Canadian sports chiropractic field. Phase one involved a cross-sectional research capacity and productivity survey of all active fellows and residents of the Royal College of Chiropractic Sports Sciences (Canada) (RCCSS(C)). Phase two applied scoping review methodology to identify sports-focused chiropractic research outputs from January 17, 2015 to January 17, 2020. Since the intended outcome of this work is to create the methods for an on-going research monitoring strategy, a five-year period was chosen as it aligns with common timeframes for strategic planning cycles for organizations[21,22], such as the RCCSS(C). Additionally, a five-year interval facilitates the identification of research outputs from research occurring in the early to middle stages of an organization's strategic plan as it accounts for time lags from journal submission to publication that can range from a few months to up to two years.[23]

Phase one: *Research capacity and productivity survey*

The Consensus-Based Checklist for Reporting of Survey Studies (CROSS)[24] was used to report the methods of phase one of this study.

Survey content

A cross-sectional survey, the Sports Chiropractic Research Capacity and Productivity Survey (Sports Chiro ReCaP Survey), was developed by modifying an existing research capacity survey that collected data on the Canadian chiropractic research resource environment.[9–11] Modifications were made to adapt the survey to the sports chiropractic research context. Additional questions were added by consulting previous research capacity development studies[17,25] and a framework[26] that identified six principles for research capacity building: skills and confidence development, supporting linkages and partnerships, ensuring research is 'close to practice', facilitating appropriate dissemination, investing in infrastructure, and building sustainability and continuity.

The Sports Chiro ReCaP Survey (please contact corresponding author for details) is comprised of 38 questions covering eight themes: demographic characteristics (n=5), professional activities (n=2), research training (n=4), research roles/positions (n=5), research activity (n=4), research resources (n=6), collaborations (n=4), and research output (n=8). For this survey, "sports-focused research" was defined using the RCCSS(C) definition[27] (Appendix 1). Face validity of the survey was established by piloting and revising the survey with five content experts who are active contributors to sports-focused chiropractic

research. Of these experts, two have PhD qualifications, four are fellows of the RCCSS(C), four hold sports chiropractic leadership positions, and one is a coordinator of a sports chiropractic specialty training program. At the time of pilot testing, their mean ± SD clinical practice and research experience was 18 ± 5.9 and 15 ± 6.6 years, respectively.

Recruitment and survey administration

The target population for the cross-sectional survey were all active fellows and residents of the RCCSS(C). In Canada, the RCCSS(C) serves as the national governing organization for sports chiropractic, and RCCSS(C) members are considerable producers of sports-focused chiropractic research in Canada.[28] The majority of RCCSS(C) members have conducted sports-focused chiropractic research at some point in their careers, since a requirement of obtaining fellowship status from the RCCSS(C) involves completing research requirements.[27]

Self-selection sampling[29] was utilized by inviting all active fellows and residents of the RCCSS(C) (197 members) to participate in this online survey by direct recruitment at kiosks stationed at the RCCSS(C) Annual General Meeting (November 8, 2019), Annual Sports Conference (November 9-10, 2019), and by email invitations sent by the RCCSS(C) Office (weekly email invitations sent between November 12, 2019 to December 24, 2019). The Sports Chiro ReCaP Survey was administered electronically utilizing the SurveyMonkey platform (Momentive, San Mateo, California, USA).

To prevent multiple participation of the survey, participant names of those who completed the online survey at a kiosk stationed at the RCCSS(C) Annual General Meeting and Sports Conference were collected by a research assistant and placed in a secure document lockbox. At the completion of each day of kiosk data collection (November 8-10, 2019), the executive assistant of the RCCSS(C) accessed the lockbox to review the list of participants who completed the survey, removed their emails from the study email list for the email recruitment period of the survey, and then destroyed the list of participant names. SurveyMonkey uses cookies to determine if someone has previously taken a survey and provides options to permit single or multiple responses to an online survey.[30] To facilitate survey completion with tablets and laptops at the kiosks, the "multiple responses option" was enabled (November 8-10, 2019). Once kiosk collection was completed, the "multiple responses option" was disabled for the email invitation recruitment period of the survey (November 12, 2019 to December 24, 2019).

Data analysis - research capacity and productivity survey

Only fully completed surveys were included in the analysis. For calculating the survey response rate, fully completed surveys were included in the numerator and both respondents and non-respondents were included in the denominator.[31,32] All survey data were imported into Excel (Microsoft Corporation, USA), and analysed with descriptive statistics (frequencies, percentages and means).

Ethics

Phase one of this study received approval by the Canadian Memorial Chiropractic College (CMCC) Research Ethics Board (#1910B01, approval date 11/1/2019) prior to commencement. The online survey included a project information letter and informed consent form. Participants provided their informed consent to participate in the online survey by selecting the "accept" response at the end of the online informed consent form. No direct identifying information was collected in the survey.

Phase two: *Scoping review of sports-focused chiropractic research outputs (January 17, 2015 to January 17, 2020)*

Phase two applied scoping review methodology, guided by the framework outlined by Levac *et al*[33] and the PRISMA extension for scoping reviews[34]. Protocol registration was conducted at Open Science Framework (https://osf.io/bqahf/).

Identify the research question

We formulated the following research question: 'What is the research output (defined in this study as journal publications and conference presentations) of the Canadian sports chiropractic field from January 17, 2015 to January 17, 2020?' A five-year period was chosen, as this is a common time horizon utilized to set activities for achievement for strategic plans,[21,22] and is a reasonable period to account for the time lag of scholarly activity to lead to a research output (e.g. publication, grant obtainment, patent filing, etc.).[23]

Selection criteria

For inclusion, a research output met the following eligibility criteria: 1) it met the definition of sports-focused research as outlined by the RCCSS(C)[27] (Appendix 1), 2) at least one author was a Canadian chiropractor or a non-chiropractor faculty member of a Canadian chiropractic educational institution, 3) it was published in a peer reviewed journal or was listed as a conference presentation on research output lists obtained from the CMCC or Université du Québec à Trois-Rivières (UQTR) chiropractic training programs, and 4) it was published in either the English or French language. There were no limits on publication type or study design.

Information sources and search strategy

PubMed, MEDLINE (EBSCO), CINAHL, SPORTDiscus and the Index to Chiropractic Literature databases were searched on January 17, 2020. The search strategy was developed in consultation with an academic reference librarian. The search strategy was developed in MEDLINE and adapted to the other bibliographic databases. Search terms included subject headings (e.g., MeSH in MEDLINE) for each database and free text words for the key concepts of sports, chiropractic, and Canada (see Appendix 2 for the MEDLINE search strategy). Additionally, author searches of the studies retrieved from the literature search were cross-referenced using a Google search to confirm if authors were a Canadian chiropractor or a non-chiropractor faculty member of a Canadian chiropractic educational institution. Research output lists were obtained from the chiropractic research departments from CMCC (date range: January 2015 to January 2020) and UQTR (date range: January 2015 to January 2018) by email request. Search results from each database were imported and research output lists were manually entered into Endnote (Endnote X9 Version, Clarivate, Philadelphia, PA, 2013) for reference management. Duplicate citations were identified using the duplicate identifying functions in Endnote and were manually verified before removal.

Study selection

A two-phase (titles and abstracts; full-text articles) screening process was used to select eligible studies. In phase one screening, pairs of independent reviewers screened citation titles and abstracts to determine the eligibility of studies (categorizing studies as possibly relevant or irrelevant). Pairs of independent reviewers screened possibly relevant studies in full text during phase two screening to determine eligibility and documented reasons for exclusion. Reviewers met to discuss disagreements and reach consensus on study eligibility. A third reviewer was consulted in situations where consensus was not reached. Study authors were contacted for additional information as needed when screening and conducting data extraction.

Data extraction and synthesis

Extracted data from eligible studies was used to build key information tables. A second reviewer independently extracted study results and any disagreements were discussed to reach consensus. From each study, extracted data included author, year of publication/presentation, title, journal/conference, publication type, study design, area of research, and sport setting. Data were reported numerically and thematically. Descriptive statistics (frequency counts and percentages) were used to summarize the extracted data.

Results

Phase one: research capacity and productivity survey

Survey response and completion

Of the 197 active fellows and residents of the RCCSS(C), 47 participated in the online survey at a kiosk at the RCCSS(C) Annual General Meeting and Conference and 68 participated in response to email invitations sent by the RCCSS(C) Office. Of the 115 survey responses collected, 109 were fully completed surveys (55% response rate).

Participant demographics (Table 1)

Approximately 50% of respondents were between the ages of 31-50 and 72% of respondents were male. When asked about the number of years in active clinical practice, 36% of respondents practised 0-10 years, and 48% practised 11-30 years. Most respondents were graduates of the CMCC (80%). Approximately, 69% of respondents had obtained a chiropractic fellowship designation, 24% had a master's degree, and only 1.8% had a PhD degree. Additionally, 32% of respondents were currently in the process of completing a graduate training program with chiropractic fellowship being the most common. Nearly 27% of respondents held an academic position at a college or university as permanent or adjunct faculty.

Table 1.
Demographic analysis of survey participants (n=109)

Age	**Sample of Respondents, n (%)**
20-30	18 (16.5%)
31-40	27 (24.8%)
41-50	27 (24.8%)
51-60	23 (21.1%)
61+	14 (12.8%)
Gender	
Male	78 (71.6%)
Female	31 (28.4%)
How many years have you been in active clinical practice (active clinical practice is defined as practicing chiropractic either part- or full-time)?	
0-10 years	39 (35.8%)
11-20 years	23 (21.1%)
21-30 years	29 (26.6%)
31 + years	18 (16.5%)
Which chiropractic institution(s) did you graduate from?	
Canadian Memorial Chiropractic College	87 (79.8%)
Université du Québec à Trois-Rivières	5 (4.6%)
Western States Chiropractic College	5 (4.6%)
New York Chiropractic College	3 (2.6%)
Palmer Chiropractic College West	4 (3.7%)
Logan University	2 (1.8%)
Palmer Chiropractic College	1 (0.9%)
Los Angeles College of Chiropractic	1 (0.9%)
National University of Health Sciences	1 (0.9%)
Do you have a graduate degree (completed a university-based program) or a chiropractic specialty fellowship?	**Sample of Respondents, n (%)**
Master's Degree	27 (24.8%)
PhD Degree	2 (1.8%)
Chiropractic Fellowship	78 (69.0%)
No	22 (20.1%)
Are you in the process of completing a graduate degree (university-based) or a chiropractic fellowship?	
Master's Degree	8 (7.1%)
PhD Degree	2 (1.8%)
Chiropractic Fellowship	25 (23.0%)
No	80 (73.5%)
Are you interested in pursuing further graduate studies? Select all that apply.	
Master's Degree	16 (14.2%)
PhD Degree	16 (14.2%)
Chiropractic Fellowship	8 (7.1%)
No	66 (60.6%)
Other	8 (8.0%)
Do you currently hold an academic position at a university or college?	
Yes	30 (26.6%)
No	79 (72.3%)
What is the nature of your academic employment? (n=31)	
Tenured	1 (3.2%)
Tenure Track	0 (0.00%)
Permanent position no tenured track available at institution	13 (41.9%)
Contract	6 (19.4%)
Adjunct Faculty	9 (29.0%)
Other	2 (6.45%)

Professional activities, research training, areas of research, and roles

On average, survey respondents reported clinical practice consumed 66% of their professional workload, followed

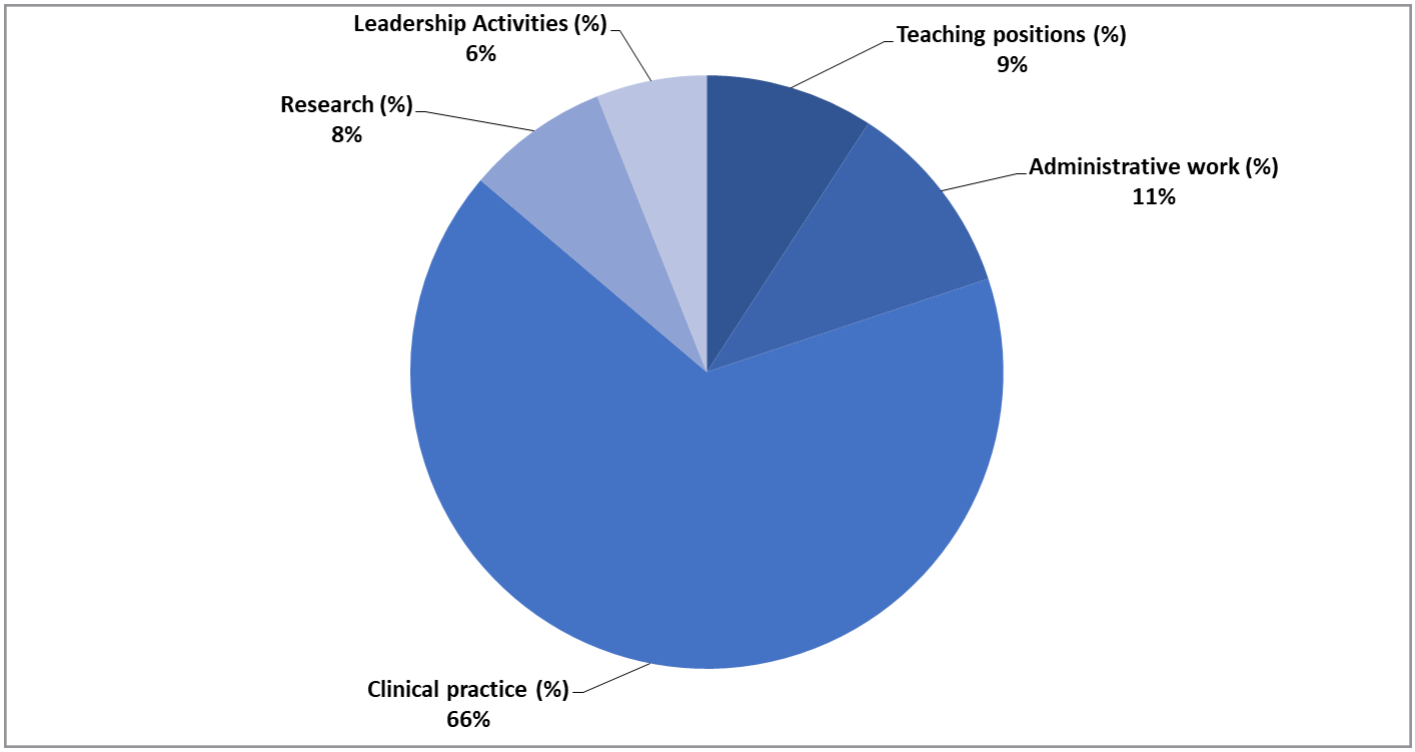

Figure 1.
Breakdown of professional activities

by administrative work (11%), teaching (9%), research (8%) and leadership activities (6%) (Figure 1). Of the 109 respondents, 33 (30%) identified themselves as an active chiropractic researcher. Within this subset, 31 were engaged in research in a part-time capacity, and only 2 respondents reported conducting research full-time. Only 14% of the 109 respondents reported protected time to conduct research. Most participants (72%) reported receiving formal training in research methodology. Of the participants involved in research, the largest categories of research focus (Figure 2) were basic science and mechanism (27%), clinical and epidemiology (25%), and health services and health policy research (21%). Sports-focused research (related to chiropractic practice applied to sport) and general sports-focused research were 10% and 9%, respectively. Sixty-six percent of respondents were involved in other professional activities such as leadership positions (board of directors, committee chair, or committee member). Within the past five years, 15% of respondents reported acting as a research mentor, 18% reported supervising a resident (or graduate student), and 15% reported supervising a chiropractic student research project. With respect to access to research mentorship and/or supervision, 69% reported having the ability to access a PhD supervisor or mentor.

Access to research resources

Survey respondents reported on their access to research-related resources in three domains with variable results (Table 2). Overall, respondents reported the highest access to reference librarians for human resources (46%), chiropractic table for physical resources (83%), and research databases for technological resources (65%). There were 45 (41%), 13 (12%), and 32 (29%) respondents who reported no access to human, physical, and technological research resources, respectively.

Collaboration

At the time of the survey, 18% were currently involved in a research collaboration outside of their academic institutions. When asked about professionals they collaborate with in research, respondents were most likely to collabor-

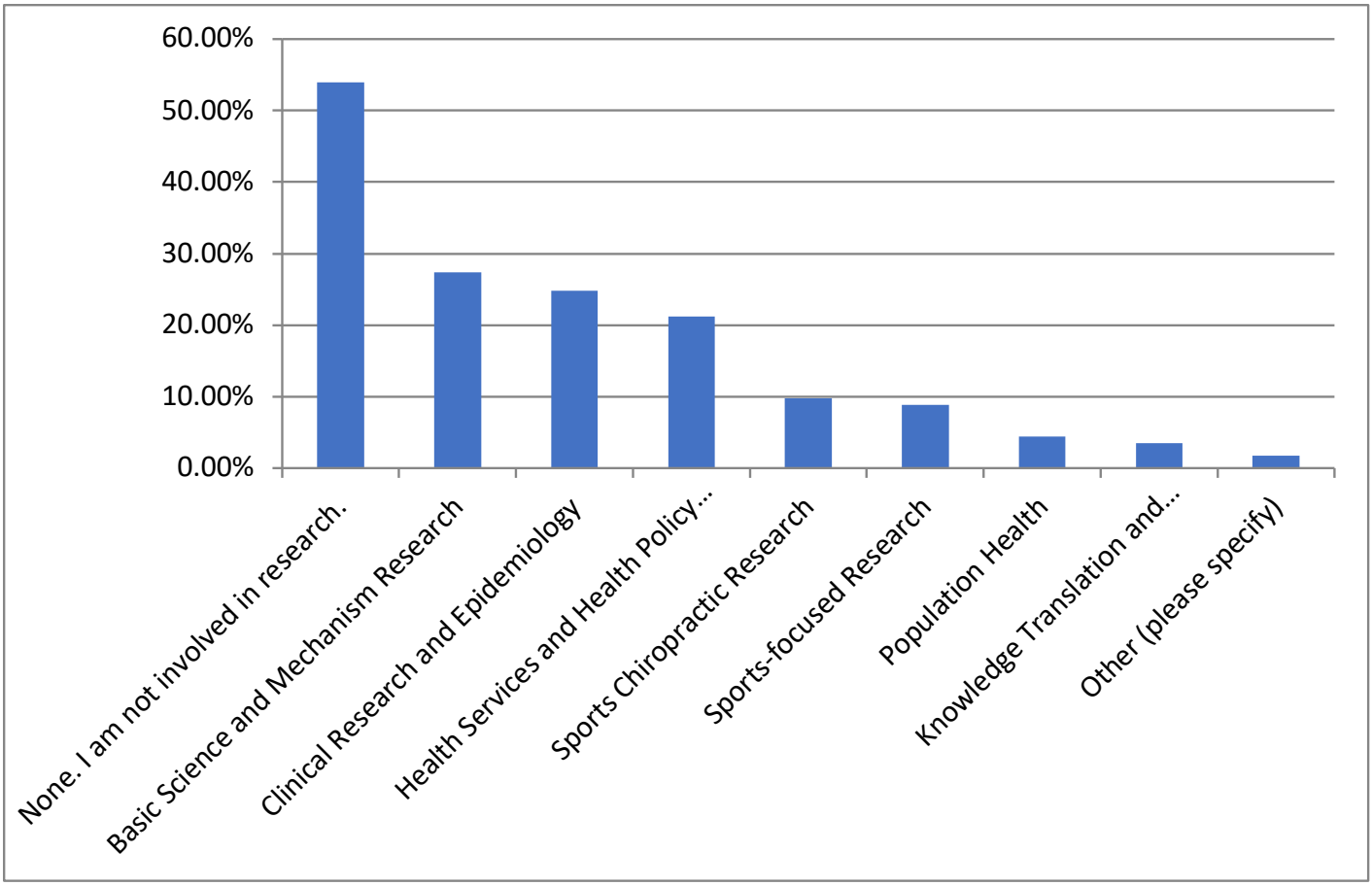

Figure 2.
Areas of research focus reported by Canadian sport chiropractors

ate intra-professionally (67%), with sport residents, sports chiropractic organisations, and the Canadian Chiropractic Research Foundation, provided as examples. Inter-professional collaboration was reported by 62% of respondents, and other areas of collaboration reported were with leading experts in the field (36%), funding agencies (7%), and industry (3%).

Research productivity

In the last 5 years, 29 (27%) respondents reported publishing a scientific paper as a primary author, with most of these respondents (76%) involved in publishing 1-2 articles. Similarly, 30 (28%) respondents reported publishing a scientific article as a secondary or co-author, with most of these respondents (77%) involved in 1-2 publications (Table 3). The top five study types that respondents participated in within the past 5 years were case reports (36%), systematic reviews/meta-analyses (28%), observational studies (20%), questionnaire/survey studies (14%), and narrative reviews/commentaries (12%). In total, 20 (18%) and 16 (15%) respondents reported conducting a scientific poster and platform presentation within the last 5 years, respectively. Forty-seven respondents (43%) reported current involvement in a sports-focused research project, with 17% as a primary investigator, 21% as a co-author, 3% as a research assistant, and 2% as a consultant. Within the past five years, 21 (19%) respondents reported receiving research grant funding, with one participant obtaining over 9 grants. As for participation in other scholarly activities within a five-year period, 27 (25%), 9 (8%), and 5 (5%) respondents reported serving as a peer reviewer for a journal, scientific conference, and granting agency,

respectively. A total of 6 respondents reported serving as a member of an editorial board of a journal, and 18 reported serving on a research committee.

Table 2.
Number of respondents with access to specific research resources (n=109)

Human Resources	**Respondents with Access**
Reference librarian	51 (46.4%)
Statistician	43 (39.1%)
Research Ethics Board	42 (38.2%)
Research methodologist	30 (27.3%)
Research assistants	27 (24.6%)
Laboratory technicians	25 (22.7%)
None of the above	45 (41.0%)
Other (please specify)	0
Physical Research Resources	**Respondents with Access**
Chiropractic table	91 (82.7%)
Office space	63 (57.3%)
Academic library	54 (49.1%)
Force plate	33 (30.0%)
Motion capture system	33 (30.0%)
Laboratory space/equipment	31 (28.2%)
Simulation lab	23 (20.9%)
Cadaver lab	22 (20.0%)
Electromyography system	21 (19.1%)
Biochemical resources	19 (17.3%)
None of the above	13 (11.8%)
Other (please specify)	3 (2.73%)
Technological Research Resources	**Respondents with Access**
Research databases (Eg. Medline, CINAHL, etc.)	72 (64.9%)
Bibliographic referencing software, such as Endnote, Mendeley, etc.	45 (40.5%)
Electronic journal holdings	44 (39.6%)
None of the above	32 (28.8%)
Statistical software	28 (25.2%)
Other (please specify)	1 (0.9%)

Table 3.
Research productivity of RCCSS(C) members over previous five years

Number of publications	0	1-2	3-4	5-6	7-8	9+
Sports-focused research paper in peer-reviewed journal as primary author (n=109)	80 (73.4%)	22 (20.2%)	5 (4.6%)	2 (1.8%)	0 (0.0%)	0 (0.0%)
Sports-focused research paper in peer-reviewed journal as co-author/ non-primary investigator (n=109)	79 (72.5%)	23 (21.1%)	3 (2.8%)	3 (2.8%)	0 (0.0%)	1 (0.9%)
Number of conference presentations	0	1-2	3-4	5-6	7-8	9+
Sports-focused research poster presentations (n=29)	9 (31.0%)	14 (48.3%)	5 (17.2%)	1 (3.5%)	0 (0.0%)	0 (0.0%)
Sports-focused research platform presentations (n=29)	13 (44.8%)	10 (34.5%)	4 (13.8%)	2 (6.9%)	0 (0.0%)	0 (0.0%)

Phase two: sports-focused chiropractic research outputs (January 17, 2015 to January 17, 2020)

Search results and study selection (Figure 3)
A total of 762 and 775 citations were identified through database searching and retrieval of research output lists (CMCC and UQTR), respectively. After removal of duplicates, 1105 citations were screened by reviewing titles and abstracts, of which 956 were excluded for not meeting the inclusion criteria. Of the 149 journal articles and conference presentations assessed for eligibility, 21 did not meet the sports-focused research definition, 35 did not include a Canadian chiropractor and/or Canadian chiropractic academic faculty, and 10 additional duplicates were identified. A total of 83 scientific works (67 journal publications[19,35–100] and 16 conference presentations[101–116]) were included in the qualitative synthesis (contact primary author for details).

Study design (Table 4)
Among the 67 journal publications, 34 (51%) were case reports/case series and 16 (24%) were original research studies. The most common original research study type was questionnaire/survey studies (10%). Of the higher level of evidence study types, only one systematic/scoping review and one randomized clinical trial were identified. Of the conference presentations, 12 (75%) were original research, two (13%) were systematic/scoping reviews, and none were case reports/case series.

Table 4.
Study design

Study Design	Journal publications[a], n (%)	Conference presentations[a], n (%)
Case reports/case series	34 (51%)	0
Original research (published)	16 (24%)	12 (75%)
Questionnaire/survey	7 (10%)	5 (31%)
Retrospective chart review	2 (3%)	0
Prospective cohort	2 (3%)	0
Quantitative text analysis	1 (1%)	1 (6%)
Computer simulation	1 (1%)	0
Randomized clinical trial	1 (1%)	0
Retrospective cohort	1 (1%)	1 (6%)
Laboratory study	1 (1%)	3 (19%)
Controlled trial	0	1 (6%)
Qualitative	0	1 (6%)
Editorials/commentaries	8 (12%)	1 (6%)
Book reviews	5 (7%)	0
Narrative reviews	2 (3%)	0
Systematic/scoping reviews	1 (1%)	2 (13%)
Historical paper	1 (1)%	0
Conference workshop presentation	0	1 (6%)
Total publications	67	16

a Due to rounding, may not add to 100%

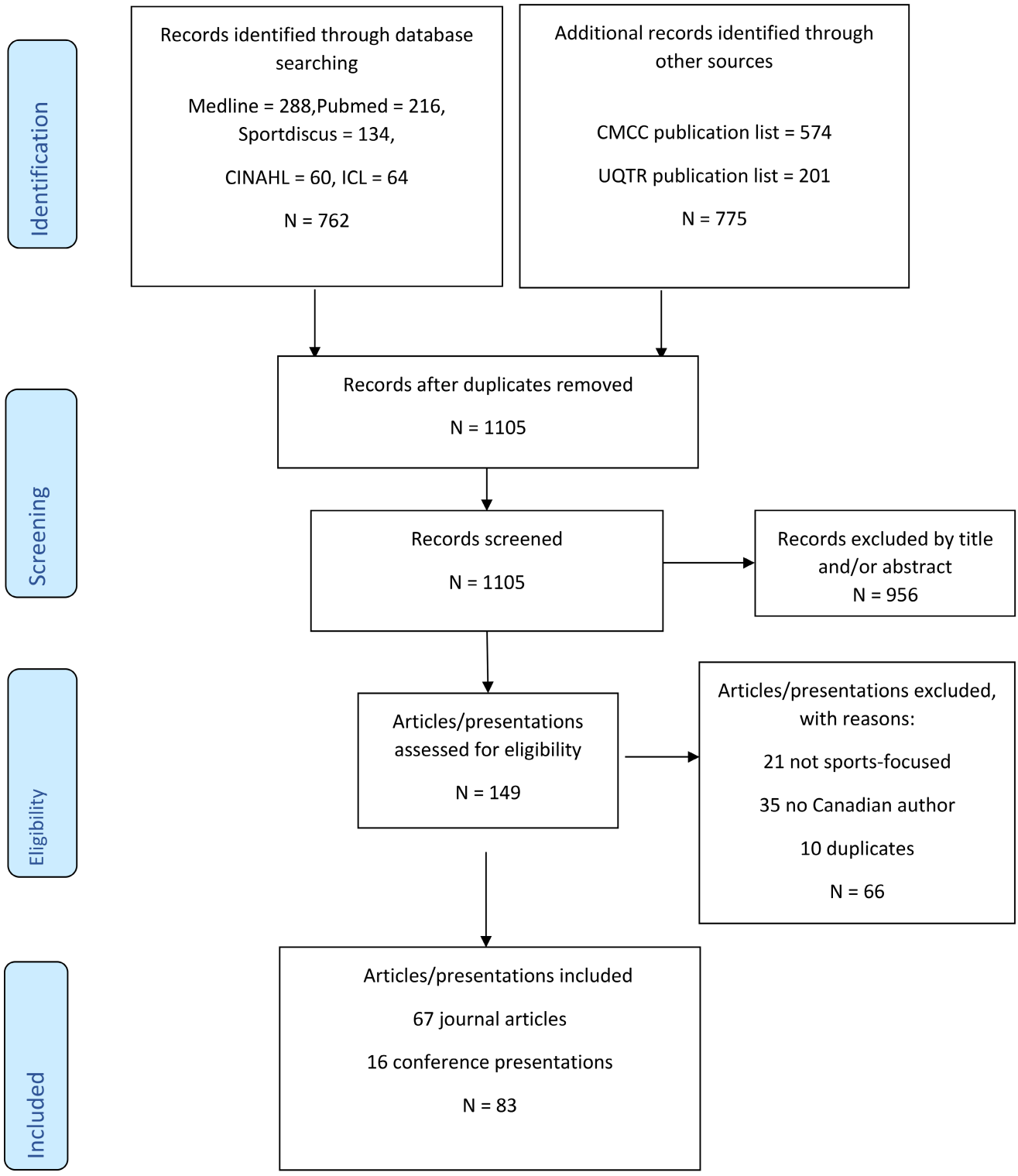

Figure 3.
Preferred Reporting Items for Systematic Reviews and MetaAnalyses Extension for Scoping Reviews flow diagram

Area of research (Table 5)

Clinical research was the most common area of research with 48 (91%) and 12 (75%) of journal publications and conference presentations contributing to this topic area, respectively. Population health and special populations was the second highest area of research for journal publications (25%) and third highest for conference presentations (13%). Basic science and mechanism research was third highest for journal publications (6%) and second highest for conference presentations (31%).

Table 5.
Area of research

Area of Research	Journal publications[b], n (%)	Conference presentations[b], n (%)
Clinical	48 (91%)	12 (75%)
Population health and special populations	13 (25%)	2 (13%)
Basic science and mechanism	3 (6%)	5 (31%)
Health services	1 (2%)	2 (13%)
Total publications/presentations contributing to the Area of Research Count[a]	53	16

[a] Certain publications & presentations contributed to more than one area of research. Editorials/commentaries, historical papers, and book reviews did not contribute to the area of research count

[b] Due to rounding, may not add to 100%

Journals, conferences, and specific sports

For journal publications, the majority (56 publications, 84%) were published in the Journal of the Canadian Chiropractic Association (JCCA), two (3%) were published in the Clinical Journal of Sport Medicine, and one each were published in Sports Health: A Multidisciplinary Approach, Journal of Orthopaedic & Sports Physical Therapy, The Physician and Sports Medicine, Journal of Martial Arts Anthropology, Journal of Back and Musculoskeletal Rehabilitation, Journal of Chiropractic Medicine, Chiropractic & Manual Therapies, Journal of Contemporary Chiropractic, and Journal of Bodywork and Movement Therapies. Most conference presentations were made at the World Federation of Chiropractic Biennial Conference (8 presentations, 50%), followed by the Association of Chiropractic Colleges Research Agenda Conference (2 presentations, 12.5%), and the International Symposium for Taekwondo Studies (2 presentations, 12.5%). Additionally, 45 scientific works (publications and/or conference presentations) conducted research on a specific sport, with the top five sports being hockey (10), soccer (7), taekwondo (5), baseball (4), and mixed-martial arts (3).

Discussion

To our knowledge, this is the first study to investigate the research capacity and productivity of the Canadian sports chiropractic field. Our findings revealed most RCCSS(C) survey respondents had formal research training, with the majority achieved through chiropractic fellowship programs, with a proportion attained from high degree research (HDR) training programs (28 master's and 2 PhD degrees). Approximately, 29% of survey respondents reported being active in chiropractic research, which represents 17% of RCCSS(C) members. The majority conduct research part-time with clinical duties making up the highest proportion of their professional workload. Access to research resources was varied across respondents. Human and technological research resources were areas where many reported not having access. Only 18% reported being actively involved in a research collaboration outside of their academic institution. We identified 67 publications and 16 conference presentations within a five-year period. Of the publications, the majority were case reports (34) with 16 being original research. The publications were in the areas of clinical, population health, basic science, and health services research.

Interpreting our results within the context of the most recent evaluation of the Canadian chiropractic research resource environment, Stuber *et al*.[10] identified 26 full-time and 67 part-time researchers, with 84 master's and 18 PhD qualifications. These researchers combined for a total of 530 authorships within a five-year period. The main areas of research reported were clinical, epidemiology, basic sciences, and health services research. Considering sports chiropractic is a small specialty within the Canadian chiropractic profession, the absolute number of researchers and research output identified from our study is smaller compared to that of Stuber *et al*.[10] due to its smaller relative size. However, at the time of our survey, 17% (33/197) of RCCSS(C) members reported being actively involved in research, which is larger than the 1.3% of Canadian chiropractors engaged in research as previously reported.[10]

At present, the Canadian Chiropractic Association report there are greater than 9,000 chiropractors licensed in Canada.[117] Applying our survey results to this national data, active researchers of the RCCSS(C) comprise approximately 0.37% (33/9000) of Canadian chiropractors engaged in research. The level of research engagement by RCCSS(C) members may be the result of its fellowship training program, where residents are required to conduct research as a part of their training, and fellows often mentor residents in this process.[27] With 18% of respondents in the present survey reporting involvement with research mentorship of a resident, mandatory research built into fellowship training programs is a mechanism that can stimulate research engagement.[118] To our knowledge, research capacity and productivity evaluations have not been published by other chiropractic fellowship programs, so it is not known if the level of research engagement within the RCCSS(C) is similar to other chiropractic specialties. With a "duty of care" of Canadian chiropractic specialty colleges to train its members and establish research as an important professional goal,[119] conducting such evaluations enables specialty colleges to monitor and evaluate their research activities to facilitate strategic planning to attain their research goals.

Investigating fellowship training programs in medicine, Cvetanovich *et al*.[120] evaluated the academic productivity of the orthopaedic sports medicine fellowship of the American Orthopaedic Society for Sports Medicine (AOSSM) and identified 610 faculty members representing 90 fellowship programs. Using the commercially available Scopus database, these authors identified 57 cumulative publications and 16 occurring within a three-year period. A similar study[118] of the American Orthopaedic Foot and Ankle Society (AOFAS) fellowship programs identified 187 faculty members from 48 fellowships programs and found the reported mean total number of publications per faculty member was 44.9 (SD=53.0; range 0-323; median=30). Interestingly, only 12 (2%) and 2 (1.1%) PhD qualifications were identified within the AOSSM and AOFAS samples, respectively.[118,120] A more recent study[121] that analyzed the American Medical Association's residency database and publicly available orthopaedic surgery residency programs identified 911 orthopaedic sports medicine faculty members and reported 38% master's and 23% PhD degrees. In comparison to these orthopedic fellowships, the research qualifications within our sample were lower at 24.8% and 1.8% for master's and PhD degrees, respectively. The lack of PhD qualifications within the RCCSS(C) represents a critical research capacity gap, since evidence indicates that researchers with advanced academic degrees contribute to greater engagement in research.[121]

At present, the Canadian sports chiropractic field does not have a financial support program for its clinicians to undertake HDR training (master's and PhD). Pursuing HDR studies requires significant investment and sacrifice for clinicians in practice (e.g., time away from practice, financial limitations, etc). These barriers may make such pursuits unfeasible for clinicians without formal support programs. An additional research capacity concern was the scarcity of full-time researchers. With only two survey respondents who reported conducting research full-time, the ability of the Canadian sports chiropractic field to increase its research output, maintain stakeholder collaborations, and sustain research leadership will be limited unless strategies are developed to fund full-time research opportunities. Additionally, many respondents to our survey reported limited access to research resources. With 80 (73.5%) respondents not presently enrolled in formal research training programs and 79 (72.3%) without an academic position, it is not surprising RCCSS(C) members without academic affiliation have difficulty accessing research resources. Strategies identified to build research capacity in allied health professions include creating pathways for HDR training, offering funding for research career opportunities, providing access to research resources, and establishing collaborations/partnerships with experienced research teams.[13] The Canadian sports chiropractic field should pursue and invest in these strategies.

When reviewing the study designs of the research outputs identified from our scoping review, the majority were case reports/case series (51%), which is reflective of the written requirements of the sports sciences residency training program of the RCCSS(C) (written requirements option 1: 4 case reports/case series, 1 literature review, 4 book reviews, and 1 original research study or option 2: 2 case reports/case series, 1 systematic review, and 1 original research study).[27] There was a paucity of research outputs from study designs of higher levels of evidence (e.g., randomized clinical trials, systematic reviews, large cohort studies). This is not surprising given only two full-time researchers and two PhD qualifications were identi-

fied. Complex study designs require advanced research expertise, supportive infrastructure, and adequate funding for successful execution. From our scoping review, the study designs with the highest frequency were those that are typically less resource intensive to conduct (e.g. questionnaires, retrospective chart reviews, case series, case reports). This finding likely reflects the current resource capability of the field. Should the Canadian sports chiropractic field aim to conduct more complex investigations, investments must be made to develop the human resources, infrastructure, and funding to support this work. An additional explanation for the limited RCTs and systematic reviews identified from our scoping review includes our selection criteria of only including research that met the definition of "sports-focused research"[27]. It is likely many researchers from the Canadian sports chiropractic field were involved in additional research that was not sports-focused. Our Sports Chiro ResCaP survey results support this supposition as 30 (28%) respondents reported being involved in conducting a systematic review within the investigated timeframe, which contrasts with our scoping review where one and two systematic/scoping reviews were identified as a publication and conference presentation, respectively.

With respect to the venue of publication, the JCCA published 84% of the sports-focused chiropractic research identified within the five-year review period of this study. Since 2009, the JCCA has published a special annual sports chiropractic issue, providing a publication setting to facilitate the dissemination of sports-focused chiropractic research.[122] This special sports edition along with offering open-access publication without a publication fee is likely a reason for the publication preference of Canadian sports chiropractic researchers. While the JCCA's special sports edition is an important publication venue for Canadian sports chiropractors, the high concentration of the field's research appearing in a single journal can potentially promote bias by engaging a smaller pool of peer reviewers in providing scholarly feedback. By concentrating publications within a single chiropractic journal, the dissemination of the work may be limited to a readership confined to the chiropractic profession. Submitting research for publication to various journals has benefits, especially if interdisciplinary journals are targeted. It can lead to broader diversity in the peer review process, providing researchers with valuable interdisciplinary insight to help shape their work. It can also increase the dissemination of research, permitting a broader reach to increase the diffusion of the field's research beyond the chiropractic profession.

The findings of this research capacity and productivity evaluation provide the data necessary to inform research strategy development for the Canadian sports chiropractic field. For the Canadian sports chiropractic field to conduct impactful research, investments in research capacity building interventions are required. The field of research capacity development (RCD) for health professions is an important area of study. A recent systematic review by Matus *et al*.[13] investigated research capacity building frameworks for allied health professions and identified three interconnected and interdependent themes essential for research capacity building that include 'supporting clinicians in research', 'working together' and 'valuing research for excellence'. These authors integrated these themes along with specific strategies to create a consolidated framework for RCD that can be applied at the individual, team, organization, and policy levels. In particular, the 'supporting clinicians in research' theme of this framework includes strategies of direct relevance to address areas of concern identified from our present research capacity and productivity evaluation. These strategies include education and training, opportunities to get involved, research friendly workplace, mentoring/coaching, access to resources, protected time and funding, reward and recognition, support to undertake post-graduate study including HDR, and skill mix of teams. Additionally, Cooke *et al*.[123] published a framework for research capacity development for impact that includes seven principles: skills and confidence building, co-production, actionable dissemination, infrastructure, linkages and collaborations, sustainability and leadership, and ownership and responsibilities. Similar to Matus *et al*.[13], this framework outlines the importance of RCD interventions working at and across individual, team, organization, and whole systems levels to foster RCD. In addition to this quantitative research capacity and productivity evaluation, our research group also conducted a qualitative study that interviewed sports chiropractic researchers and leaders to identify the challenges and opportunities for building research capacity in sports-focused research in the chiropractic profession. A manuscript reporting these results is forthcoming. It is our intention that the results of our qualitative and quantitative research capacity evaluations will

provide the data to apply RCD frameworks[13,123] to develop a RCD strategy for the Canadian sports chiropractic field. This RCD strategy will aim to develop the research resources and environment for the Canadian sports chiropractic field to conduct quality research that can make a positive impact to the health and well-being of Canadian society.

Strengths, limitations and future research

A strength of our study was our 55% survey response rate, which is larger than the 7.5% obtained from the research resource environment survey conducted for the Canadian chiropractic profession.[10] Previous research capacity survey studies utilizing email invitation for survey recruitment report response rates ranging from 7.5% to 48%.[10,124–126] A possible reason for our favourable response rate is likely the result of our recruitment approach that involved email invitation combined with in-person recruitment at a kiosk at the RCCSS(C) AGM and annual conference. However, it is possible our recruitment at these events may have introduced a biased sample as RCCSS(C) members who attended the AGM and annual conference may represent a more engaged sample compared to RCCSS(C) members who do not attend such events. Our results should be interpreted within this limitation.

Previous research capacity and productivity investigations have relied on self-report surveys[10,126] and conducting author searches of the Scopus database[118,120]. Self-report surveys are prone to recall bias and low response rates, influencing the accuracy of surveys to capture research output data. The Scopus database is a commercial database,[127] and not all journals are indexed in Scopus, potentially providing a limited view of research published. Since not all sports-focused chiropractic research in Canada is conducted by RCCSS(C) members, it was important to conduct a scoping review to supplement our survey results to capture research output data of sports-focused research conducted by Canadian chiropractors who are not RCCSS(C) members. We believe obtaining research output data from these two approaches has the benefit of providing a broader view of the research output of the Canadian sports chiropractic field by triangulating the results from both methods. The true research productivity likely falls between the results of both approaches. An advantage of our survey collection includes the capability to capture ongoing and unpublished research, which can be difficult for scoping reviews to identify.

A limitation of our scoping review approach was our inclusion of only publications or presentations that met the RCCSS(C) definition of being "sports-focused research"[27]. This likely underestimated the overall research output of the Canadian sports chiropractic field, as some of these researchers may be involved in research in other areas of study. However, the aim of the scoping review component of this study was to identify only "sports-focused" research outputs over a five-year period (January 17, 2015 to January 17, 2020), and we did not attempt to determine the field's cumulative publication output. Additionally, we only included journal publications and conference presentations, and other research outputs, such as policy documents or patent applications, were not included. It is possible our search strategy could have missed possible publications as our literature search was not peer reviewed by a second librarian utilizing the Peer Review of Electronic Search Strategies statement[128], and while we reviewed publication lists from CMCC and UQTR, we did not search other grey literature sources (e.g. thesis dissertations, unpublished repositories).

An additional limitation is the validity of the Sports Chiro ReCaP Survey. While the survey was developed by modifying an existing one that collected data on the Canadian chiropractic research resource environment,[9–11] the original survey was not evaluated for validity or reliability. Face validity of our survey was determined by five content experts, but a full validation study has not been conducted. Our survey findings should be interpreted within this limitation. Future research can conduct validity assessments of the Sports Chiro ReCaP Survey and investigate its test-retest reliability should the survey be used as an outcome measure to determine the effectiveness of RCD interventions. Additionally, the Sports Chiro ReCaP Survey did not capture data on research culture, which relates to how organisations value research.[17,129] To investigate research culture at the individual, team, and organizational levels, Holden *et al*.[130] developed and validated the Research Capacity and Culture (RCC) Tool. Future research can apply the RCC Tool to investigate the research culture of the Canadian sports chiropractic field. Readers should also be aware that our survey sample was members of the RCCSS(C), the official governing organization of sports chiropractic in Canada.[28] It is possible there are chiropractors in Canada who are members of sports chiropractic organizations from other countries or

internationally, such as the Diplomate American Chiropractic Board of Sports Physicians from the United States of America or the International Federation of Sports Chiropractic (FICS). RCCSS(C) members have affiliate membership with FICS and some may have dual membership with sports chiropractic organizations from other countries. Due to logistical challenges we chose to limit our survey sample to members of the RCCSS(C) but accounted for this limitation by adding a scoping review component to this study designed to identify sports-focused research outputs of Canadian chiropractors, irrespective of their memberships in various sports chiropractic organizations.

An intended application of our work is to implement these methods as an on-going research monitoring initiative. Repeating this evaluation in five-year intervals will provide serial data about the influence of the field's research strategy, investment, and capacity-building initiatives. Regular assessment will allow the field to adapt to changes in the research resource environment and adjust its research strategy accordingly.[10] While these methods provide useful quantitative research monitoring data, it does not provide evidence about the impact of the Canadian sports chiropractic research effort on Canadian society. To provide such investigations, research impact assessments (RIA) are required. RIA is a relatively new field of practice where a research enterprise is assessed using multiple methodologies to determine the value of research conducted in terms of its influence on stakeholders, government, and society.[18] Measuring and monitoring the impact of healthcare research is becoming increasingly common in government funding agencies and higher education institutions as part of a research quality assurance program to demonstrate accountability for research investment.[12,18] While conducting RIAs can be time consuming and resource heavy, a benefit to such an assessment is the ability to assign better judgement to the value of research conducted based on factors such as research quality and its impact on society. For example, our current evaluation identified that there were minimal RCTs conducted in the Canadian sports chiropractic field. While the field's current research resources do not permit these investigations, other study designs, such as descriptive healthcare utilization studies co-produced with stakeholders, may lead to a pathway for impact by stimulating stakeholder-led strategies to increase access to care to improve the health of Canadians. While RCTs have a high potential to influence healthcare decisions if conducted properly, other studies that require less monetary investment, may have reasonable impact potential if they are prospectively designed with the goal of attaining research impact. This can be enabled by applying research impact frameworks[18,131,132], such as the Canadian Academy of Health Sciences Impact Framework[15], in the planning process of a research endeavor to optimize a pathway to impact, such as co-producing research with key stakeholders to optimize research adoption. RIA will allow the Canadian sports chiropractic field to be better informed when pursuing research opportunities and prioritizing investment. To advance the research impact potential of the Canadian sports chiropractic field, we recommend future approaches to monitor its research resource environment to include an element of RIA.

Conclusion

This research capacity and productivity evaluation revealed that the current research effort of the Canadian sports chiropractic field is primarily conducted by part-time clinician researchers with limited protected time to conduct research. Many members of the RCCSS(C) report formal research training with the majority obtained through fellowship and master's training programs. There is a paucity of researchers with PhD qualifications, potentially limiting the field's ability to conduct investigations utilizing certain research designs. Despite its relative size, the Canadian sports chiropractic field has a reasonable level of engagement in research with many RCCSS(C) members involved in mentoring sports residents in research. The current research resource environment has produced research outputs that are consistent with the research requirements of the Sports Sciences Residency Program of the RCCSS(C), providing evidence of the importance of the RCCSS(C) fellowship training program in developing research capacity and producing research for the Canadian sports chiropractic field. Our results can be used to inform RCD strategies to advance the research impact potential of the Canadian sports chiropractic field.

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Appendix 1.
RCCSS(C) Sports-focused Research Definition[21]

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.

Appendix 2.
MEDLINE (EBSCO) Search Strategy

1. 1. NSO (1-63) AND Chiropract* AND (PL) Canada	Literature search using PubMed, MEDLINE (EBSCO), CINAHL, ICL, SportDiscus using (a) NSOs, (b) chiropractic, (c) location: Canada
2. (Sports Words) AND Chiropract* AND (PL) Canada	Literature search using PubMed, MEDLINE, CINAHL, ICL, SportDiscus using (a) sport terms, (b) chiropractic, (c) location: Canada. The sport terms identified include: athlete, performance, nutrition, athletic event coverage, team travel exercise physiology, sport psychology, sport, games, elite, Olympic, national, varsity
3. Author search	Authors identified from searches (1) and (2) will be cross-referenced using Google search to confirm they are a Canadian chiropractor involved in sport-focused research
Limiters: 1. (LA) - English and French language 2. (PT) - Peer reviewed publications including conference abstracts published in peer reviewed publications 3. (DP) - Publications with the last 5 years	

1. MH Sports+
2. MH Athletes
3. MH Athletic Performance
4. MH Games, Recreational
5. MH Psychology, Sports
6. MH Return to Sport
7. MH Sports Medicine
8. MH Sports Nutritional Physiological Phenomena
9. MH Sports Nutritional Sciences
10. TI athlet* or AB athlet*
11. TI competition or AB competition
12. TI competitive* or AB competitive*
13. TI elite* or AB elite*
14. TI game* or AB game*
15. TI olympi* or AB olympi*
16. TI recreational* or AB recreational*
17. TI return to play* or AB return to play*
18. TI sport* or AB sport*
19. TI varsity* or AB varsity*
20. 1-19/0R [***sports terms]
21. TI archery* or AB archery*
22. TI badminton* or AB badminton* or MH badminton
23. TI baseball* or AB baseball* or MH baseball*
24. TI basketball* or AB basketball* or MH basketball
25. TI biath* or AB biath*
26. TI bmx* or AB bmx*
27. TI bobsle* or AB bobsle*
28. TI boccia* or AB boccia*
29. TI boxing* or AB boxing* or TI boxer* or AB boxer*
30. TI bowling* or AB bowling* or TI bowler* or AB bowler*
31. TI broomball* or AB broomball*
32. TI canoe* or AB canoe* or MH water sports
33. TI cricket* or AB cricket*
34. TI curling* or AB curling*
35. TI cross country* or AB cross country* or TI cross-country or AB cross-country*
36. TI cycling* or AB cycling* or TI cyclist* or AB cyclist*

37. TI diving* or AB diving* or TI diver* or AB diver* or MH diving
38. TI equest* or AB equest*
39. TI fencing* or AB fencing* or TI fencer* or AB fencer*
40. TI field hockey* or AB field hockey* or MH hockey
41. TI figure skat* or AB figure skat*
42. TI football* or AB football* or MH football
43. TI golf* or AB golf* or MH golf
44. TI goalball* or AB goalball*
45. TI gymnast* or AB gymnast* or MH gymnastics
46. TI hockey* or AB hockey* or MH hockey*
47. TI judo* or AB judo* or MH martial arts
48. TI karate* or AB karate* or MH martial arts
49. TI kayak* or AB kayak* or MH water sports
50. TI lacrosse* or AB lacrosse* or MH racquet sports
51. TI lawn bowl* or AB lawn bowl
52. TI luge* or AB luge*
53. TI racquet* or AB racquet* or MH racquet sports
54. TI ringette* or AB ringette*
55. TI rower* or AB rower* or TI rowing* or AB rowing* or MH water sports
56. TI rugby* or AB rugby* or MH football
57. TI runner* or AB runner*
58. TI running* or AB running* or MH running
59. TI sailing* or AB sailing* or TI sailor* or AB sailor* or MH ships
60. TI soccer* or AB soccer* or MH soccer
61. TI skiing* or AB skiing* or TI skier* or AB skier* or MH skiiing
62. TI skating* or AB skating* or TI skater* or AB skater*
63. TI sledding* or AB sledding* or MH snow sports
64. TI snowboard* or AB snowboard* or MH skiing
65. TI softball* or AB softball* or MH baseball
66. TI speed-skat* or AB speed-skat* or MH skating
67. TI squash* or AB squash*
68. TI swim* or AB swim* or MH swimming
69. TI taekwondo* or AB taekwondo*
70. TI tennis* or AB tennis* or MH tennis
71. TI (track n2 field) or AB (track n2 field) or MH track and field
72. TI triath* or AB triath*
73. TI volleyball* or AB volleyball* or MH volleyball
74. TI wakeboard* or AB wakeboard*
75. TI water polo* or AB water polo* or water sports
76. TI wrestling* or AB wrestling* or TI wrestler* or AB wrestler* or MH wrestling
77. weightlift* or AB weightlift* or TI weight lift* or AB weight lift* or MH weight lifting
78. TI jiu jitsu* or AB jiu jitsu* or TI jiu-jitsu* or AB jiu-jitsu* or TI ju-jitsu* or AB ju-jitsu*
79. TI jogging* or AB jogging* or TI jogger* or AB jogger*
80. TI kendo* or AB kendo*
81. TI kung fu* or AB kung fu* OR TI kung-fu* or AB kung-fu*
82. TI mountaineer* or AB mountaineer*
83. TI qigong* or AB qigong*
84. TI tai ji or AB tai ji or TI tai chi* or AB tai chi* or TI taiji* or AB taiji* or TI taichi* or AB taichi*
85. TI walking* or AB walking*
86. 21-85/ OR [***National Sports Organizations]
87. MH Chiropractic
88. MH Manipulation, Chiropractic
89. MH Manipulation, Spinal
90. MH Musculoskeletal Manipulations

91. chiropra*
92. (spinal* or spine) n2 manip*
93. active* n2 releas*
94. Graston
95. instrument* n2 assist*
96. manip* n2 (cervical* or lumbar* or musculoskeletal* or thorac* or msk)
97. manip* n2 (therap* or treat* or manag* or intervention* or care)
98. mobilization* OR mobilisation*
99. musculoskeletal* n2 (therap* or treat* or manag* or intervention* or manip* or care*)
100. myofascial* n2 releas*
101. taping or kinesiotap*
102. 87-101/ OR [***chiropractic]
103. MH Canada +
104. Canad*
105. CMCC* or UQTR*
106. Alberta* or British Columbia* or Manitoba* or New Brunswick* or Newfoundland* or Nova Scotia* or Ontari* or Prince Edward Island* or Quebec* or Saskatchewan* or Nunavut* or Northwest Territor* or Yukon* or
107. Toronto* or Montreal* or Vancouver* or Edmonton* or Calgary* or Ottawa* or Waterloo* or Guelph* or Kingston* or Halifax* or Fredericton* or Hamilton* or Winnipeg* or Saskatoon* or St. John's or Thunder Bay or Regina* or Lethbridge* or Windsor*
108. Dalhousie* or UBC or mcgill* n2 universit* or mcmaster* n2 universit*
109. AF (ab or alta or qc or ont or bc or mb or sk or ns or nb or nf or nfld or pei
110. 103-109/ OR [***Canada]
111. 20 OR 88
112. 111 AND 102 AND 110
113. LIMIT 112 English OR French
114. LIMIT 113 2015- current