Current and Prospective Use of Musculoskeletal Diagnostic Ultrasound Imaging at Chiropractic Teaching Institutions: A Worldwide Survey of Diagnostic Imaging Staff

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ABSTRACT

Objective: The purpose of this study was to survey the use of musculoskeletal diagnostic ultrasound imaging (MSK-DUSI) at chiropractic educational programs worldwide and to elicit opinions of academic diagnostic imaging staff of its prospective use at their teaching institutions.

Methods: An electronic questionnaire was delivered in 2014 using SurveyMonkey and notifications were disseminated by e-mail to 127 diagnostic imaging staff at chiropractic programs worldwide. The questionnaire consisted of 27 items using multiple-choice, Likert-type, and open-ended questions. Descriptive statistics were used for basic demographic data and the results of the numerical scales used in each item.

Results: Fifty-nine respondents (46.5%) from 24 (24/41) chiropractic programs returned questionnaires. The reported use of MSK-DUSI at chiropractic programs is low ($n = 5/24$); however, respondents from 9 institutions stated that it is planned to be implemented. Few respondents stated they had formal MSK-DUSI qualifications (4/59); however, 7 respondents stated they were in the process of becoming certified. Most respondents expressed an interest in the prospect of incorporating MSK-DUSI at their chiropractic program. Sixty-five percent stated that chiropractic programs should provide MSK-DUSI training to chiropractic students, and 75% of respondents stated that chiropractic programs should be providing accredited postgraduate MSK-DUSI courses.

Conclusions: The current use of MSK-DUSI among chiropractic programs that responded to this survey is low. The opinions of diagnostic imaging staff who responded suggest a positive attitude to its use and possible growth in its use if foundational work, including gaining funding, accreditation, and acceptance of within the scope of chiropractic practice, is undertaken. (J Chiropr Med 2017;16:54-63)

Key Indexing Terms: *Ultrasonography; Survey; Questionnaire; Musculoskeletal; Chiropractic*

INTRODUCTION

Musculoskeletal ultrasound (MSK-US) is an imaging modality that has the potential to provide accurate and real-time diagnostic applications.¹⁻⁴ Musculoskeletal ultrasound is employed for diagnostic purposes and to monitor progress during rehabilitation programs.⁵⁻⁹ These different uses

are referred to as musculoskeletal diagnostic ultrasound imaging (MSK-DUSI) and rehabilitative ultrasound imaging.¹⁰ In the last 2 decades, interest in MSK-DUSI has increased outside the specialist radiology field, including among chiropractors.^{3,11}

Diagnostic ultrasound has been used in medicine since the early 1950s.^{5,9} The application of diagnostic ultrasound developed rapidly over the following decades to become well established in clinical obstetrics, gynecology, cardiology, and sports medicine.⁵ Diagnostic ultrasound is currently viewed by many of these clinical disciplines, when used appropriately, as an extension of the physical examination.¹² In the 1980s, there was a brief period of interest in MSK-DUSI among chiropractors, when it was hoped that adult spinal canal structures could be imaged, but it was soon discovered that the technology to adequately visualize those structures had not yet been developed.¹³⁻²⁹ Although the current state of MSK-DUSI

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technology has improved, and it can be used in limited circumstances around the spine, technical limitations persist, and MSK-DUSI is still more commonly used to evaluate superficial pathologic conditions of the extremities.

Recent advances in MSK-DUSI technology have allowed for good quality ultrasound images to be obtained from affordable, compact equipment.³⁰⁻³⁴ Resolutions have been compared that of magnetic resonance imaging,³¹ although the best images are still gained through larger, cart-based systems.³⁰⁻³² Musculoskeletal diagnostic ultrasound imaging also allows for the capacity to use power Doppler imaging, which is sensitive in detecting areas of hyperemia.³⁰ This is of interest in the assessment and diagnosis of overuse injuries, rheumatologic conditions, and tumors.³⁵ These advances in technology and affordability have resulted in a resurgence in the interest in MSK-DUSI among nonradiologists.¹¹

There are few studies exploring MSK-DUSI within chiropractic educational programs. A pilot study reported that it is possible to teach relative novices (senior chiropractic students) normal sonographic anatomy.³⁶ Previous studies from other professions found that novice interpreters may be trained in a limited field to the standard of an experienced interpreter.³⁷⁻⁴⁰ As MSK-DUSI becomes more affordable and accessible to chiropractors, increased use and a growing body of literature may emerge. This is evident in that the number of MSK-DUSI training courses tailored for chiropractors has been increasing, as have papers published on the subject.^{14,17,36,41-50}

Musculoskeletal diagnostic ultrasound imaging has been reported as a valid musculoskeletal imaging technique of the extremities^{3,10} and has multiple advantages as a primary diagnostic modality. It is portable, affordable, and highly accessible. In addition, it allows for dynamic, real-time imaging with side-to-side comparisons. The main disadvantages are operator dependence and a steep learning curve. Nevertheless, a high percentage of chiropractic patients report with musculoskeletal complaints of the extremities.^{51,52} It seems appropriate that chiropractic programs could benefit from using MSK-DUSI. Improving patient care is pivotal in all health care professions and developing MSK-DUSI use in chiropractic may allow for earlier, more accurate diagnosis and potentially improved patient management and outcomes. These benefits make MSK-DUSI well suited to chiropractic patient care and research.

To date there have been no studies investigating the current and prospective use of MSK-DUSI at chiropractic teaching programs worldwide. The purpose of this paper was to investigate the current use of MSK-DUSI at chiropractic programs worldwide and to elicit opinions of academic diagnostic imaging staff of its prospective use at their teaching institution.

group consisted of those individuals employed to teach diagnostic imaging at all 41 chiropractic teaching institutions worldwide ($n = 127$). Ethics approval was obtained from Murdoch University Human Research (approval number 2014/110). Before completing the questionnaire, participants were instructed to read an information letter and consent form attached to the preliminary notice e-mail and the survey link e-mail. The information letter and consent form covered 4 items, including voluntary participation and withdrawal from the study; privacy (anonymity), benefits of the study, and possible risks. It was assumed that consent was acknowledged if respondents continued through to the questionnaire ([Appendix A](#)).

A list of the diagnostic imaging staff e-mail addresses was obtained online through publicly available websites of teaching institutions or via a preliminary e-mail to the department head of radiology or head of the chiropractic school requesting contact details for the relevant staff members. A modified Dillman method was used for survey administration.⁵³ In mid-2014, a preliminary notice was disseminated 1 week before the study to herald its arrival and to inform the recipients of the purpose of the study, stimulate their interest, and ask for their cooperation. After the preliminary notice, an online survey link was sent directing recipients to SurveyMonkey to answer and submit their responses to the questionnaire. Three reminders followed at fortnightly intervals. The entire data collection process took 9 weeks.

Questionnaire Design and Content

The questionnaire ([Appendix A](#)) consisted of multiple choice and 7-point Likert-type items (with a free-text answer boxes for some items included). The scale used for the 7-point Likert-type items was as follows: 1 = strongly agree; 2 = moderately agree; 3 = slightly agree; 4 = don't know; 5 = slightly disagree; 6 = moderately disagree; 7 = strongly disagree. The items were designed to elicit responses covering 5 sections: (1) basic demographic data, including age, gender, occupational title, qualifications, experience, and current chiropractic teaching institution of employment; (2) current use of MSK-DUSI; (3) training on the use of MSK-DUSI; (4) desire to use MSK-DUSI; (5) perceived barriers to the use MSK-DUSI. A final open-ended item allowed respondents to record any other thoughts or opinions they may have on the topic.

There was no previously validated questionnaire on which to base this survey instrument. Instead, we used direct questions and Likert scales.⁵⁴ The questionnaire was designed by the lead author and then reviewed by the other authors as well as another colleague, a diplomate of the American Chiropractic Board of Radiology (DACBR), for logic, consistency, and readability. However, it was not pretested or validated. The credentials of those who contributed to the development of the survey included doctors of chiropractic (4), DACBRs (2), masters of applied

METHODS

Study Design

This study used an Internet-based survey through SurveyMonkey (www.surveymonkey.com). The study

science in medical imaging (1), masters of public health (1), and a doctor of public health (1).

Sample Size

The aim was to recruit as many participants from as many chiropractic programs as possible. According to the World Federation of Chiropractic there are 41 chiropractic programs worldwide.⁵⁵ A Google search (April 2014) by the authors also confirmed these 41 chiropractic programs. The e-mail contact of diagnostic imaging staff at each were obtained via sending a preliminary e-mail to the Department Head of Radiology or Head of the Chiropractic School of each institution requesting the details. No response was received from 7 institutions initially, so the websites of those institutions were searched for relevant staff. The total number of individuals teaching diagnostic imaging was 127 (July 2014). Because of the small number of potential respondents, a response rate of about 50% was deemed adequate to be largely representative. This was determined using the computer program EpiInfo (CDC, Atlanta, Georgia) and is also comparable to online survey response rates from previously published physician specialist survey-based studies.⁵⁶ This equated to 21 chiropractic programs and 64 staff members.

Analysis

The data collected from the multiple choice and 7-point Likert-type items were entered into a statistics program (SPSS Version 21, IBM, Armonk, NY) and cleaned by looking for outliers and nonplausibilities. No outliers or nonplausibilities were found. Descriptive statistics were used to describe basic demographic data and the results of the numerical scales used in each item.

RESULTS

Response

Questionnaires were returned by 59 of 127 of those surveyed (response rate: 46.5%) representing 24 of 41 chiropractic programs (58.5%). Five questionnaires were partially incomplete, which accounts for the differing number of reported responses. It is not known why the respondents did not complete all items. However, it is possible that these respondents did not wish to provide their demographic data because of the risk of being identified from the limited sample population. Other reasons may include technical difficulties and eventual boredom or disinterest in the questionnaire.

Demographic Characteristics

Table 1 displays the demographic details of participating diagnostic imaging staff at chiropractic teaching institutions worldwide. The “other” qualifications not detailed in Table 1 included 4 master of science degrees and 1 registered nurse.

Table 1. Demographic Characteristics of Participating Diagnostic Imaging Staff at Chiropractic Teaching Institutions Worldwide

Demographic Characteristic	n (N = 54) ^a
Sex	
Females	19
Males	35
Age	
21-30	10
31-40	8
41-50	14
51-60	18
61 and older	4
Location/Region	
North America	43 (18 programs)
South America	0
Australia	5 (3 programs)
Asia	3 (1 program)
Europe	3 (2 programs)
South Africa	0
Occupational Title	
Professor	20
Assistant/associate professor	14
Diagnostic imaging/radiology resident	8
Senior lecturer	5
Chiropractic radiologist	3
Chiropractor	3
Radiographer	1
Relevant Qualifications	
Chiropractor, DACBR	30
Chiropractor	10
Chiropractor, DACBR, other	3
Chiropractor, other	2
Chiropractor, radiographer	2
Radiographer	2
Chiropractor, PhD	1
Chiropractor, DACBR, PhD	1
Chiropractor, DACBR, sonographer, radiographer	1
Sonographer	1
Chiropractor, DACBR, radiographer, sonographer	1
Years registered as chiropractor	
0-10	19
11-20	11
>21	21
Not Applicable	3
Years registered as DACBR	
0-10	13
11-20	12
>21	11
Not Applicable	18

DACBR, diplomate of the American Chiropractic Board of Radiology; MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

^a Five respondents did not complete the demographic items, which accounts for the differing number of reported responses.

Current Use

Table 2 displays the responses to items inquiring about current use of MSK-DUSI at chiropractic teaching institutions worldwide.

Table 2. Current Use of MSK-DUSI at Chiropractic Teaching Institutions

Current Use of MSK-DUSI	Number of Programs (N = 24)
Yes	5 (North America = 3; Europe = 2)
No, but it is planned to be implemented	9 (North America = 8; Australia = 1)
No, and there is no plan to implement	10 (North America = 7; Australia = 2; Asia = 1)

MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

Table 3 displays the responses of items relating to the 5 chiropractic programs that answered “yes” to using MSK-DUSI. Most chiropractic teaching institutions had employed MSK-DUSI for 1 to 2 years and use it routinely several times per week in a clinic or teaching setting. All 5 chiropractic programs used MSK-DUSI in teaching clinics, and it was typically operated and interpreted by a chiropractic radiologist (DACBR). One chiropractic teaching institution stated, “We run a post-graduate training centre in ultrasound studies for chiropractors, doctors, physiotherapists, osteopaths and sonographers.” Of these 5 chiropractic programs, 4 taught the interpretation and operation of MSK-DUSI to its chiropractic students, and 3 taught the interpretation and operation of MSK-DUSI to their chiropractic radiology residents (candidates for the DACBR). Table 4 lists the level of competency of each program.

Table 3. Time, Use, and Purpose of MSK-DUSI Employed at Chiropractic Teaching Institutions

Characteristic	n (N = 5)
Time	
<6 mo	0
6 mo–1 y	0
>1–2 y	4
>2–5 y	0
>5–10 y	1
>10 y	0
Times per week	
Once per wk	0
Several times per wk	3
Every day	1
Multiple times per day	1
Who Uses MSK-DUSI? ^a	
Chiropractic students	2
Chiropractic radiology residents	2
Chiropractic radiologists	4
Nonradiologist chiropractors	3
Medical radiologists	3
Radiographers/sonographers	2
Other	1
Purpose ^a	
Diagnosis	5
Tracking response to treatment	4
Patient education	4
Rehabilitation/biofeedback	2
Teaching	4
Research	4
Other	0

MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

^a Multiple choices were allowed for this item.

Formal MSK-DUSI Qualifications and Experience

There were 26 responses to the item inquiring about formal MSK-DUSI qualifications held by the diagnostic imaging staff. Of these, 14 responses were staff from 1 of the 5 teaching institutions that currently used MSK-DUSI. All 14 respondents were chiropractors and 10 also held current DACBR status. The formal MSK-DUSI qualifications held by the respondents included formal training during chiropractic radiology residency and continued training as DACBR (7), American Institute of Ultrasound in Medicine accreditation (1), and master of science (MSK-US) (1). The other 5 respondents were in the process of completing formal MSK-DUSI qualifications, including registration in musculoskeletal sonography credentials (4) and a master of science (MSK-US) program (1). The remaining 12 responses were from staff not employed at an institution that currently used MSK-DUSI. Only 2 respondents held a formal MSK-DUSI qualification: musculoskeletal sonographer. Two respondents were in the process of completing formal MSK-DUSI qualifications, including a registered in musculoskeletal sonography credential (1) and a master of science (MSK-US) program (1). The remaining 8 respondents had received no formal qualifications or formal training and stated that they had less than 1 year of experience in MSK-DUSI operation and interpretation.

Table 5 shows the years of experience in operating and interpreting MSK-DUSI held by diagnostic imaging staff at chiropractic teaching institutions (n = 26, follow-up item to formal MSK-DUSI qualifications). Most respondents had 1 to 5 years’ experience in the operation and interpretation of MSK-DUSI.

Table 4. Level of Competency Taught in Chiropractic (n = 4) and Radiology (n = 3) Programs

Level of Competency Taught	Very Basic ^a	Basic	Somewhat Competent	Very Competent	Very Competent ^a
Chiropractic students (n = 4)	2	1	1	—	—
Chiropractic radiology residents (n = 3)	—	1	—	—	2

MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

^a Very basic = can identify basic anatomy in one body area but cannot identify pathologic conditions. Very competent = able to diagnose all applicable conditions in all body areas.

Table 5. *Years of Experience in Operating and Interpreting MSK-DUSI Held by Diagnostic Imaging Staff Who Responded to Formal Qualifications*

Years of Experience	Number of Respondents (N = 26)
<1	9
1-5	10
6-10	5
11-20	2

MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

Table 6. *Barriers to the Use of MSK-DUSI in Chiropractic Teaching Institutions*

Barrier Cited	n (N = 55)
Cost of purchasing the equipment	42
Time availability of staff to undertake training	37
Limited accessibility to training	33
Cost of training	31
Operator and reader variability	23
Other	9
Doubt of its utility and impact on patient care	5
None	2
Doubt of its utility and impact on research	1

MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

Four respondents did not complete the demographic items, which accounts for the differing number of reported responses.

Barriers to Use

Initial cost of purchasing the equipment, cost of training, time availability for staff to undertake training, and limited access to training were the most consistent barriers reported by the respondents (Table 6). Nine respondents used the “other” section, in which several common ideas were found. They included the perception that MSK-US was not within

a chiropractor’s scope of practice, an already overloaded curriculum, and government controls or regulations.

Desire to Use MSK-DUSI

Table 7 lists the responses to items relating to potential future use and scope of practice.

“Additional Comments”

Responses from the “additional comments” section of the survey can be viewed in Appendix B.

DISCUSSION

This survey explored the current use of MSK-DUSI at chiropractic programs worldwide and elicited opinions of academic diagnostic imaging staff of its prospective use at their teaching institution. To the authors’ knowledge, this is the first survey of its type. The results highlight a number of points that improve understanding of the perception of the utility of the modality for the profession. Reported use among the schools was low; however, respondents from 9 schools reported plans to implement MSK-DUSI in their programs. Most respondents expressed an interest in the prospect of incorporating MSK-DUSI at their teaching institution, even if plans were not imminent. This finding was consistent with results of studies involving sports medicine physicians, rheumatologists, and physiotherapists.⁵⁷⁻⁶⁰ No studies investigating the current use of MSK-DUSI among other health professions schools were found, and future research in this area is recommended.

More than half of North American chiropractic schools may be using MSK-DUSI in the future, which suggests that North American policymakers and imaging experts in

Table 7. *Opinions of Diagnostic Imaging Staff at Chiropractic Teaching Institutions on Desire to Employ MSK-DUSI Within Chiropractic Programs and Its Scope of Practice Within the Profession (N = 55)*

Opinion	Agree (%)	Don’t Know (%)	Disagree (%)
MSK-DUSI is within a chiropractors’ scope of practice.	76.4	1.8	21.9
MSK-DUSI is an important imaging modality in the future of the chiropractic profession.	89.0	5.5	5.4
Chiropractic radiologists and residents should be proficient in MSK-DUSI.	85.5	3.6	10.9
MSK-DUSI training should be made more accessible to chiropractors.	76.4	5.5	18.3
MSK-DUSI should be implemented in to chiropractic teaching institutes for the purpose of:			
Providing MSK-DUSI training to chiropractic students.	65.4	3.6	30.9
Providing accredited postgraduate MSK-DUSI courses.	74.6	5.1	13.6
Research.	90.9	3.6	5.4
Diagnosis (teaching clinic).	90.9	1.8	7.2
Tracking treatment response (teaching clinic).	80.1	10.9	9.1
Patient education (teaching clinic).	50.9	20.0	29.1
Rehabilitation/biofeedback/RUSI (teaching clinic).	65.5	21.8	12.7

MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

Four respondents did not complete the demographic items, which accounts for the differing number of reported responses.

Anglo-European College of Chiropractic

- The evaluation of cervical and lumbar erector spinae (multifidus) activation with MSK-DUSI.
- Project using diagnostic ultrasound to investigate the accuracy of acupuncture/dry needling placement.
- Sonoelastography assessment of various muscles and tendons.
- The reliability of sonoelastography in assessing patella tendon softening.

National University of Health Sciences

- The evaluation of the lower lumbar facet joints to determine mobility of facet joints pre-and postmanipulation with diagnostic ultrasound.
- The evaluation of the lower lumbar facet joints to determine CSF flow pre-and postmanipulation with diagnostic ultrasound.

Logan University

- The ultrasound assessment of compression of the brachial plexus in various arm positions in patients with clinically suspected thoracic outlet syndrome.
- The ultrasound assessment of sciatic nerve compression at the piriformis muscle.
- MSK-DUSI in the assessment of adhesive capsulitis.
- MSK-DUSI in the assessment of subgluteal etiology of sciatica.
- MSK-DUSI in the assessment of the interscalene interval.
- Diagnostic ultrasound in the assessment of vascular risk factors (cervical).
- Various projects acquiring sonographic measurements of various structures (nerves, tendons, anatomic spaces) for normative data.

University of Western States

- The level of knowledge by doctors of chiropractic for the clinical application MSK-DUSI: survey.

Fig 1. Active research studies at chiropractic programs (mid-2014). CSF, cerebrospinal fluid. MSK-DUSI, musculoskeletal diagnostic ultrasound imaging.

chiropractic education may wish to consider developing relevant and standardized MSK-DUSI regulations. The regulations should meet the accredited standards as outlined by the appropriate regulatory body (eg, for the United States, the American Institute of Ultrasound in Medicine⁶¹). According to our respondents, only 1 of 3 accredited Australian University chiropractic courses is planning to implement MSK-DUSI. However, this curricular shift indicates that policymakers should consider developing relevant training programs that meet the standards of the regulating body, the Australian School of Ultrasound in Medicine.⁶²

This leads to the question of whether training should be provided at an undergraduate or postgraduate level or both. Most respondents expressed a greater favor toward

providing postgraduate training rather than undergraduate training. Proficiency in MSK-DUSI requires a thorough knowledge of sectional anatomy, ultrasound physics and technology, joint ultrasound scanning methods, the sonographic pattern of normal and pathologic musculoskeletal tissues, artifacts, diagnostic criteria, and Doppler technique.⁶³ Minimum training requirements for MSK-DUSI have been proposed by professional bodies in Australia, America, and Europe for nonradiologists, and they are extensive.^{61,62,64} The requirements described are not possible to teach at an undergraduate level without sacrificing another component of the curriculum. At an undergraduate level it may be feasible to teach an introduction to MSK-DUSI and 1 anatomic region of normal sonographic anatomy, as reported by Hung et al,³⁶

or to provide MSK-DUSI as an elective for those students with a keen interest. The potential for MSK-DUSI training at a postgraduate level seems more feasible.

The respondents viewed the initial cost of purchasing the equipment, closely followed by time availability of staff to undertake training as the principal barriers to the use of MSK-DUSI in teaching institutions. Respondents stated operator and reader variability as the fifth most significant barrier, which is usually reported higher in the literature.^{31,65,66} This finding may be explained by the fact chiropractic schools have much smaller budgets than medical, physiotherapy, and podiatry programs; therefore, the cost may be more significant to a chiropractic school. Another possible explanation may be the fact that many respondents were speculating, having had no actual experience using the modality. Operator and reader variability may only be fully understood as a barrier after training. No studies investigating the barriers to the use of MSK-DUSI in other health care teaching institutions were found. However, barriers to the use of MSK-DUSI in clinical practice from other health care settings, including rheumatology, sport medicine, and physiotherapy, have been reported.^{57-59,67,68} These barriers are comparable to those in this study: cost, time, accessibility to training, operator and reader variability, and impact on patient care. There is no simple answer to overcoming these barriers. The implementation of MSK-DUSI within chiropractic programs would require time and commitment from policymakers and academic staff to ensure successful execution. If training programs are implemented in the future, students and practitioners willing to undertake the necessary commitment to develop adequate skills in MSK-DUSI should be able to use this skill in clinical practice with the suitable remuneration. As such, courses should be accredited or at a minimum provide advanced standing for becoming certified by the appropriate regulatory body. Investigating the eligibility for national health care rebates, private health rebates, and other third party rebates for chiropractors who are certified and perform MSK-DUSI should be considered a high priority.

In addition to teaching diagnostic ultrasonography, nearly all respondents stated that MSK-DUSI should be used as a diagnostic tool in teaching clinics and research. Respondents reported more than 14 individual studies suggesting a growing body of literature within the profession is likely to emerge. A brief description of each study is provided in Figure 1. Musculoskeletal ultrasound has also been proposed as an adjunct resource to teaching anatomy.⁶⁹⁻⁷¹ Musculoskeletal ultrasound can provide students an understanding of the dynamic living anatomy of the musculoskeletal system. Two pilot studies in medical education have reported that MSK-US enhances knowledge and understanding of the musculoskeletal system when used in conjunction with standard anatomy resources (eg, cadavers, models, plain films, etc).^{70,71} Further studies are

required to understand the best context for MSK-US as an anatomy teaching resource.

Strengths

To the authors' knowledge, this is the first study to investigate the current and prospective use of MSK-DUSI among chiropractic programs worldwide. The target sample was seen as a strength, because the diagnostic imaging experts at teaching institutions were more likely to be aware of the existence of the emerging technology, familiar with at least some literature on the subject, and have some level of interest than other chiropractic educators.

Limitations

There are several limitations inherent in this study. First, sampling biases and coverage errors are the primary limitations. The target population may have led to overly optimistic responses regarding the likelihood of adopting ultrasound at their institutions, because those who responded may have had a greater interest in ultrasound technology. The response rate was 46.5%, and therefore the results have an increased potential for selection bias and may not be representative of the view of all chiropractic diagnostic imaging staff. However, our response rate is comparable to online survey response rates from previously published physician specialist survey-based studies.⁵⁶ It has also been reported that response rates of health professionals are decreasing over time.⁷² Second, the survey instrument was used de novo and was not pretested; thus it was not validated. This may have affected the reliability of the items in the questionnaire and may affect the comparability of the results to different studies. However, most items were direct questions and no combined summative scores were used from them, thus reducing this possibility. Third, we cannot be 100% confident that our list of 127 diagnostic imaging staff was accurate. There was the potential to receive inaccurate information because of human error or an out-of-data website, thus our responder estimates may actually be lower or higher. Other limitations include the possibility that an e-mail was identified as spam mail when using e-mail as a contact method, possibly reducing the response rate.

CONCLUSIONS

The results of this study indicate that the current use of MSK-DUSI among chiropractic programs is low. Most diagnostic imaging staff who responded to the survey expressed an interest in the prospect of incorporating MSK-DUSI at their institution. Such information provides an insight into the imaging trends within the profession and could inform policymakers and imaging experts in chiropractic education.

Practical Applications

- Findings indicate the growth of MSK-DUSI among chiropractic programs to be a probable trend.
- Our findings add to the current literature that MSK-DUSI is growing outside the radiology specialty. Although the current use is small and in a limited capacity within chiropractic settings, it is important for policymakers to be aware of this information when developing imaging standards, scope of practice guidelines, training programs, and so on.
- Our findings may also prompt further research in this area, which may result in increased MSK-DUSI training made available to students and chiropractors in the future.
- Finally, the results describe the opinions of diagnostic imaging staff regarding whom and what MSK-DUSI should be used for in chiropractic settings.

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No funding sources or conflicts of interest were reported for this study.

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APPENDIX A. SUPPLEMENTARY DATA

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.jcm.2016.10.001>.

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